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Computers as Theatre

Second Edition

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Computers as Theatre

Second Edition

BRENDA LAUREL

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For my grandson,
Jem Wade

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Contents

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Foreword

WHAT DOES A GESTURE-OPERATED SMART device have in common with a Shakespearian play?

No, this isn't a pun, and it isn't a trick question. The answer gets to the heart of this book. Theatre is about interaction, about themes and conflicts, goals and approaches to those goals, frustration, success, tension, and then the resolution of that tension. Theatre is dynamic, changing, always in motion. Our modern technologies with their powerful computers, multiple sensors, communication links, and displays are also about interaction, and treating that interaction as theatre proves to be rich, enlightening, and powerful.

Until recently, computers interacted with people in a stilted, pedestrian manner. Each screen was a static display. Designers and those in the field of human-computer interaction tended to think of each screen as a fixed entity, making sure it was well designed, understandable, and attractive. This is obviously good, but it isn't enough. Real interaction does not take place in the moment, on a fixed, static screen. Real interaction is ongoing over a protracted period. It ebbs and flows, transitions from one state to another. Transitions are as important as states. Until recently, the only computer systems that acted this way were games. But as students of the theatre have long known, we get the greatest pleasure from our ability to overcome early failures and adversaries. If everything runs perfectly and smoothly with no opportunity to deploy our powers and skills, pleasure is diminished. Human emotion is sensitive to change; starting low and ending high is a far better experience than one that is always high. Is this a cry for deliberate placement of obstacles and confusions? Obviously not, but it is a cry for a look at the temporal dimensions, at engagement, agency, and the rise and fall of dramatic tension.

Many years ago I wrote the foreword to the original edition of this book. Years later, I reread it, this time with a broader, richer perspective. The next time I met Brenda, I told her that I finally understood the book. “What?” she exclaimed in horror. “You wrote the Foreword and didn’t understand it?” “No, no,” I hastened to reassure her. “I understood it then, but now I understand it quite differently. Your book,” I told her, “was ahead of its time. I thought I understood it when it was written, but I missed some of the most important points, most especially the role of time, change, and a continuing encounter. The book was ahead of its time when it was initially published; please bring it out again, now that the time is ready for you.”

Here it is. I’m delighted to see it reborn—now, when the time is ripe. The first edition was ahead of its time. This new edition comes at just the right time. Now the world is ready.

What makes the difference?

Both Brenda and I started in the early days of computers, long before computers routinely displayed images on the screen. It was remarkable that computers could do anything at all. As the years passed, the machines got more powerful. We started by controlling them with typed commands, moved from typing to selection through mouse and menus, and finally graduated to the potential for interaction with the entire body, starting with simple gestures, speech, and eye gaze, but for some systems proximity, location, movement, angle of regard, and whole body motion are also relevant. Today, social interactions are the norm, as is the networked interaction of multiple people and systems distributed across the globe. None of this was true in 1991 when the first edition was published.

When I first encountered Brenda’s ideas, I envisioned them being applied to the formal elements of display screens and the early devices used for interaction. This is a very limited viewpoint. It is better to think of these systems and their programmed applications as a platform, the stage upon which the dramas are enacted. To quote from Chapter 1:

> Thinking about interfaces is thinking too small. Designing human-computer experience isn’t about building a better desktop. It’s about creating imaginary worlds that have a special relationship to reality—worlds in which we can extend, amplify, and enrich our own capacities to think, feel, and act.

The Computer's a Stage

"All the world's a stage," said Jaques in William Shakespeare's *As You Like It*, "and all the men and women merely players." For us, the computer and its various programs and applications are the stage, providing the platform on which we enact our own scenes and activities. Much as plays are divided into acts, sometimes with intermissions, our computer-based activities are divided into sessions, sometimes separated by short periods and other times by long breaks.

Although Brenda Laurel focuses on the theatre, she extends her metaphor by looking at plot structures in television (Chapter 3). Contrasting forms of dramatic media have unique rules of engagement; they are different for a play than for a movie, different again for a television drama, and different yet again for the activities performed with the aid of a computer.

Games are the easiest of computer activities to translate into the language of theatre, although they are more like television episodes than theatrical performances or movies being viewed in a large auditorium. In a theatre or movie, once the drama has begun, it is difficult to leave, whereas in television, the viewer can leave at any moment, so it is important to keep people continually engaged; long explanations, background, or backstory information that might be necessary for the story must be disguised to maintain the audience's interest. In similar fashion, a computer game must continually engage interests, for the disinterested player can easily quit. Attention must be continually maintained. This can be done even in quiet periods through anticipation, as long as the player always has an expectation of future interesting engagement. Anticipation is the soul of emotion.

What about more mundane examples of computer usage? Laurel shows how even the activity of writing or composing a budget on a spreadsheet has a dynamic that permits interest to be sustained for long periods. Here, the actor is also the playwright and the spectator, so the expectations are self-generated, enabling interest to be sustained for what otherwise might be considered long, dull periods. After all, the actor/playwright/spectator is always watching to see how their self-generated drama unfolds, whether it meets expectations, and whether the characters (the numerical characters in the spreadsheet) behave as expected.

Television and movie series provide yet another lesson. Some episodes might follow previous ones in periods measured in years; think of the *Star Wars*, *Star Trek*, or *James Bond* films. These gaps require reminders to carry the viewers over the gaps. Sometimes these reminders are given through flashbacks or asides, or sometimes by introducing new characters who then have to be brought up to date, with the audience as eavesdropper. Similar needs for reminders exist for email interactions, checking up on friends via social networks, or even writing a homework assignment, an essay, or a book. These activities are spread out over time, with variable gaps between segments. How do we maintain continuity? One mechanism is through repeated snippets of previous conversations in social networks or email, another through ready access to previous work, and yet another though mechanisms somewhat akin to the way movies and television episodes must brief newly introduced characters. With computer systems, this can be done through active reminding and prompting.

This component of drama is usually overlooked by computer system designers. When a break in activities is caused by interruptions from competing activities, when we resume the initial task, if the playwright (that is, the programmer or system designer) does not provide reminders of the previous states and activities, the result can be errors in the conduct of critical tasks. Witness errors in the use of medical systems, in aviation, and in complex activities that range from cooking a meal to controlling a complex chemical plant. Just as playwrights must help the audience bridge time gaps, the designers of systems must help computer users bridge their gaps.

Simple Rules, Emergent Outcomes

Many interface designers tend to optimize every element of an experience, but as Brenda points out, maximum enjoyment and emotional peak can only come about as a contrast to lows, disappointments, and tension. A positive experience is much enhanced by contrast to just previously experienced negative ones (and in turn, negative engagement is enhanced when it follows positive experiences). The shaping of the emotional experience is critical to the development of dramatic experience, whether in a theatre or through a computer-mediated interaction.

Although the basis of dramatic theory can be traced to Aristotle, over the centuries of thought and experimentation much more has been learned. We don’t have to consider drama as a self-contained play on a single stage, because even in Elizabethan times it was sometimes played out on several simultaneous stages. Modern experiments allow such things as the sprinkling of actors throughout a house, all engaged in various patterned activities. Engagement and emotion can occur in a wide variety of settings, and we can imagine multiple future possibilities as well as the existence of ones that we cannot yet imagine, but which are sure to appear. These themes are explored in the provocative ending chapter.

What will the future bring? That will be determined by you, the readers of this book, aided by the speculations and discussions of the concluding chapters. But one thing is certain: The future of our interactions with technology will build upon the foundations provided by Brenda Laurel in this deep, thought-provoking, and critically important book.

—Don Norman
Silicon Valley, 2013
www.jnd.org

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Preface

In the early 1980s while I was still at Atari Research, I began talking with Alan Kay and Don Norman about a particular *idée fixe*: the notion that when people were using computers they were interacting in *representational worlds*, much more like plays in which they were characters than computers on which they ran programs. What a funny idea—at once both obvious and strange. The idea got its hooks into me. At first, I wanted to develop an approach to creating games that might imbue "the system" with enough intelligence about dramatic theory and structure to generate dramatically interesting "next actions." That was what I was trying to think about in my PhD dissertation.

Through a painful process of learning what I could about artificial intelligence, I arrived at an expert system as the correct approach. It took me a couple of years (and the experience of working with Joe Bates' Oz project at Carnegie Mellon) to disabuse myself of that notion. At issue, I decided, was not only programming method, but also a perspective about how interaction is framed, and it relied on a solid understanding of dramatic structure and theory in the process of interaction design.

I wrote *Computers as Theatre* in 1989–1990 to put my hypotheses to the tests of persuasion, articulation, and application to the then-contemporary landscape of interactive media. My examples were drawn primarily from single-player games, "productivity" software like word processors and spreadsheets, and the operating environment of the shiny new Macintosh computer. My sources were in many cases bright young scholars and designers who are elders in the field today.

Looking back at the original text, I've been embarrassed by how outdated many of my assumptions and examples seem today. But I was also surprised by those things that remain relevant—the notion of dramatic interaction and the interplay between structure and experience. Many of my original sources are still vibrant, amazing scholars and designers. Even some of the examples are still germane; there are still word processors (or "document creation programs") and spreadsheets. There are still single-player games. And traces of the Desktop still bleed through many contemporary operating environments; even smartphones show vestiges of the ancient desktop metaphor.

But how much has changed! Then, I was a young PhD with a need to prove myself. Now, I can see retirement just around the corner. Then, I had two very young daughters. Now, I am a grandmother. Then, I was an entry-level producer and researcher; now, I've started three companies, spent the better part of a decade at Interval Research, and founded two graduate programs in design. Then, there were damned few women kicking butt in the field; now, there are young superstars like danah boyd,[1] Mary Flanagan, Amy Bruckman, Justine Cassell, Celia Pearce, Emma Westecott, and many, many more. Then, there was no World Wide Web, no Internet access for the common folk, no recognizable social networks, no "consumer-grade" mobile phones, no embedded sensors. Now, there are massively multiplayer online games, sophisticated collaborative work environments, subversive games, and distributed sensing. New science generates fundamentally new understandings about how brain, mind, and biology can inform our work. When I revise this book again . . . well—let me not get ahead of myself.

If you have read the first edition of this book, thank you. Be patient. The emphasis on dramatic fundamentals in the early chapters will look familiar. I promise we will take that understanding in some new directions. You will see some of the old examples, but now they are set alongside new ones and contextualized as part of a broader historical traverse. You will see lots of sidebars with lots of stories in them, old and new. And you will see some new ideas from the present that may change the future. Please enjoy.

1. No, she doesn't capitalize her name.

Acknowledgments

I THANK PROFESSOR DONALD R. GLANCY, my mentor, PhD advisor, and friend. He encouraged me to explore strange new worlds and defended my work to the graduate theatre faculty at Ohio State University. Before he passed away, I was able to put the very first copy of *Computers as Theatre* in his hands, and that made both of us happy.

I'm very grateful to my editor, Peter Gordon, for his support in revising this book. Peter's encouragement was just as important this time as the first time. As always, my work has been inspired and informed by Don Norman and Henry Jenkins, two of the smartest people I've had the pleasure to know. Barry Lopez holds a singular position in my life as a writer, friend, and the one who helped me find and hold the connection between nature and story. Documentary filmmaker Rachel Strickland has been my partner in most of the formative adventures of my professional life.

Thanks to Martin Venezky for the truly awesome cover design. Martin is in a class by himself. I'm honored that he would do this work. I also thank my dear former-student-now-colleague Verna Bhargava for the illustrations in this new edition. Verna went way above and beyond what I asked of her.

I want to give special thanks for the intellect, vision, and creativity of Douglas Englebart, who passed away while this book was in production. The story you will read about him in the book is now better known after his passing. I know that he suffered from the shifting of his particular passion for inventing for the Good to a more commercial ethos in the early days of personal computers. But all of us who worked in the big labs that existed "back in the day"—PARC, Atari, Interval, Sun, AT&T—were motivated by the same magnificent what-ifs of the new technologies we were investigating and inventing. I'm certain that Engelbart came to know that he was profoundly appreciated—the National Medal of Technology surely demonstrated that to him. I hope he knew how many of us continue to be inspired by his spirit.

I thank Christopher Ireland, David Liddle, Nancy Deyo, and all the other Purple Moonies for making and supporting excellent research and doing the hard work of founding a company. I thank Interval Research and the Banff Centre for supporting the *Placeholder* collaboration with Rachel Strickland, Rob Tow, John Harrison, and Michael Naimark. I have difficulty describing how much I learned from both *Placeholder* and Purple Moon. Some of it is expressed in this book. I also thank Eric Hulteen for his thoughtful support in developing the first edition.

I am grateful to many folks for freely sharing their wisdom and knowledge with me in this work. Sean and Jen White were extremely helpful in the domains of augmented reality and narrative design. My colleagues Noah Wardrip-Fruin and Michael Mateas at University of California, Santa Cruz, also made invaluable contributions in both theory and design. Kimberly Lau generously shared segments from her tantalizing research on *World of Warcraft*. My interviews with Noah Wardrip-Fruin, Pavel Curtis, Lisa McDonald, and Eric Zimmerman played an active role in the work, and conversations with my long-time colleagues Nathan Shedroff and Abbe Don helped in more ways than I can describe here. Emily Short's work in narrative storytelling has been inspirational. My colleagues in feminist and critical game design, especially Emma Westecott and Mary Flanagan, are, as always, profoundly inspirational. I also want to thank those who freely shared images for the book, including Michelle Amsbury, Eric Zimmerman, Sean White, Quinn Dombrowski, Scott Nazarian, Laura Crawford, and Matthew McBride.

Over the years, I have had the good fortune to work with remarkable people as students, who are even more remarkable as graduates. Scott Nazarian, Matthew McBride, and Laura Crawford from Art Center as well as Will Newton and Kathleen Moynahan from California College of the Arts are among the finest students I've had the privilege to work with. I've learned a great deal from all of them. Thank you, people!

I am grateful to my family from the center of my heart. To my three daughters—Hilary, Suzanne, and Brooke—thank you. You have grown up strong and beautiful, each in your own way; I'm grateful both for who you were (the inspiration for Purple Moon and the best junior booth babes E3 ever saw) and who you are now. Thanks also to Suzanne for writing a sidebar for this book.

And then there's Rob. In the old days at Interval (where I first met him), Rob was well known for pronouncing some things to be "deeply wrong." He was almost never wrong in that. Over the 22 years that we have known each other, we've had professional and personal adventures; Rob wrote most of the code for *Placeholder*, and I consulted on Rob's robot project. We hike and snorkel and hunt abalone together, we play and record Tibetan bowls in diverse natural environments, and we kayak like Klingons. We've talked theory, practice, or politics just about every day. Rob's insights and editing have made this book so much better than it might have been. I think you will enjoy his sidebars as well. Rob says he liked the first edition of this book so much he married the author. That's pretty sweet, and sometimes I choose to believe it. I thank you, Rob, for all we've done and all we will do.

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About the Author

Photo by Hilary Laurel Hulteen

Brenda Laurel has worked in interactive media since 1976 as a designer, researcher, writer, and teacher. She currently serves as an Adjunct Professor of Computer Science and Affiliated Faculty for Games and Playable Media at University of California, Santa Cruz. She served as Professor and Founding Chair of the graduate program in design at California College of the Arts from 2006 to 2012. She designed and chaired the graduate Media Design Program at Art Center College of Design in Pasadena (2001–2006) and was a distinguished engineer at Sun Microsystems Labs (2005–2006). Based on her research in gender and technology at Interval Research (1992–1996), she cofounded Purple Moon in 1996 to create interactive media for girls. In 1990 she cofounded Telepresence Research, focusing on virtual reality and remote presence. Other employers include Atari, Activision, and Apple. Her books include *The Art of Human-Computer Interface Design* (1990), *Computers as Theatre* (1991), *Utopian Entrepreneur* (2001), and *Design Research: Methods and Perspectives* (2004). She earned her BA (1972) from Depauw University and her MFA (1975) and PhD in theatre (1986) from Ohio State University.

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1

The Nature of the Beast

In 1962, THE FIRST MODERN VIDEO game was invented by some hackers at MIT. It was called *Spacewar!*, and it ran on a DEC PDP-1, the world's first mini-computer, connected to a CRT display. One of the game's designers explained that the game was born as a group sat around trying to figure out what sort of "interesting displays" they could create for the CRT with some pattern-generating software they had developed. "We decided that probably, you could make a two-dimensional maneuvering sort of thing, and decided that naturally the obvious thing to do was spaceships." The MIT hackers weren't the only ones to invent *Spacewar!*. As Alan Kay noted, "the game of *Spacewar!* blossoms spontaneously wherever there is a graphics display connected to a computer" (Brand 1974).

Why was *Spacewar!* the "natural" thing to build with this new technology? Why not build a pie chart, an automated kaleidoscope, or a desktop? Its designers identified *action* as the

In 1962, I was given my first computer. It was a prize for a Halloween costume contest run by the local hardware store. The manager handed me what looked like a grey plastic box, with the word "Eniac" embossed on it. "It's a computer," he explained. He demonstrated its operation. First he showed me a card with this question printed on it: "What is the distance of the earth from the sun?" He inserted the card into the plastic box and turned a crank. A card was ejected from the other side of the device that showed the number 92,876,479.56. I was amazed. "You see?" he said excitedly. "It can answer questions. All kinds of questions. Here are the questions, right here." He brandished a packet that presumably contained all of the important questions one might ever want to ask. "All you have to do is feed them into the computer." I took the card from him and turned it over to discover that the question was printed on the back. The plastic Eniac had simply flipped the card over.

key ingredient, and conceived *Spacewar!* as a game that could provide a good balance between thinking and doing for its players. They regarded the computer as a machine naturally suited for representing things that you could see, control, and play with. Its interesting potential lay not simply in its ability to perform calculations, but in its capacity to co-create and represent actions with human participants.

The Interface

Why don't we look at everything computers do in the way that the *Spacewar!* hackers did? Consider the following question: What is being represented by a human-computer interface?

1. A way for a person to communicate with a computer.
2. A way for a computer to communicate with a person.
3. A surface through which humans and computers can communicate.
4. A way for humans and computers to construct actions together.

Number three comes close, but it implies a membrane or separation between the human and the computer. But the object is not the membrane; rather it is the action co-created by the human and technical forces at play. The difference in emphasis may be the impetus of the trend toward replacing the term "human-computer interface" with "human-computer interaction" in recent years.

There are two major reasons for belaboring such a seemingly obvious point. First, it wasn't always true—and the design disciplines for applications and interfaces still bear the marks of that former time. Second, reconceptualizing what computers do as enabling and representing actions that involve both human and technological participants suggests a design philosophy that diverges significantly from much of the received wisdom about interface design.

Provenance of the Interface

The notion of the "human-computer interface" was presaged by the field of human factors engineering, or human factors design. This discipline was born with the design of airplanes during WWII and the famous Link Trainer simulations that helped pilots safely learn how to fly by instruments. The field was informed by earlier work, including the famed "time motion studies" conducted by Frank and Lilian Gabreth in the 1920s. In fact, there is evidence that the closely related field of ergonomics was a design concern even in ancient Greece (see Marmaras et al. 1999). Human factors and ergonomics are concerned with taking the human's physical and cognitive abilities into account in the design of things humans use, as the sidebar illustrates with the evolution of the automobile "interface." An important characteristic of the human factors world before computerization was that the elements of the "interface"—the chair or airplane—were fixed in space and existed with fixed operational characteristics. The plasticity of the human-computer interface created huge new problems and opportunities for the human factors field. The "interface" was a powerful bridge, and design began to rely more upon cognitive aids such as metaphors rather than upon the characteristics of the body *per se*.

"Interface" became a trendy (and lucrative) concept in the 1980s and 1990s—a phenomenon that is largely attributable to the introduction of the Apple Macintosh. Interface design was concerned with making computer systems and applications easy to use (or at least usable) by humans. When we thought of human-computer interfaces in those days, we were likely to visualize icons and menu bars or perhaps command lines and blinking cursors. But, of course, many conceptions came before as well as after.

John Walker (founder and president of Autodesk, Inc.) provides an illuminating account of the "generations" of user interface design (Walker 1990). In the beginning, says Walker, there was a one-on-one relationship between a person and a computer through the knobs and dials on the front of massive early machines like the ENIAC. The advent of punched cards and batch processing replaced this direct human-computer interaction with a transaction mediated by a computer operator. Time-sharing and the use of "glass teletypes" reintroduced direct human-computer interaction and led to the command-line and menu-oriented interfaces with which the senior citizens of computing (people over forty) are probably familiar. Walker attributes the notion of "conversationality" in human-computer interfaces to this kind of interaction, in which a person does something and a computer responds—a tit-for-tat interaction.

This simplistic notion of conversation led many early interface specialists to develop a model of interaction that treats human and computer as two distinct parties whose "conversation" is mediated by the screen. But as advances in linguistics demonstrated, there is more to conversation than tit for tat. Dialogue is not just linearized turn-taking in which I say something, you go think about it, then you say something, I go think about it, and so

Automobile Interfaces

Interface for the Pontiac Firebird III.
Source: www.oldcarmanualproject.com

Interface design often is initially fluidly variant and later rather sticky, or conservative, as is seen in the history of automobiles. Automotive control interfaces initially resembled small boats in that they were steered with tillers (often with the driver in the rear) and featured hand controls for power and braking. A profusion of such designs existed in the 19th century. These evolved at the turn of the 20th century into a canonical set of controls that we would easily recognize today, with the steering wheel placed in front of an off-side driver in the front. The first car with a steering wheel was the single seat 4hp Panard racer in 1894, and the first production automobile with the driver and steering wheel on the left was Thomas B. Jeffery's 1904 Rambler (the 1903 Rambler was steered with a tiller).

The General Motors turbine-powered Firebird III concept car of 1957 was a notable exception inspired by the jet fighters of the time; the driver "piloted" it with a control stick placed between the car's two seats. This uni-control moved forward for acceleration, backwards for braking, side-to-side for steering, and twisted for shifting gears. It was located on the center arm rest between the two seats (each with an individual bubble canopy). This did not catch on as a control design. The seven tail fins, pop-out air-drag brakes, and titanium body were kinda cool, though.

It is likely that self-driving cars will continue to have vestigial steering wheels and brake/accelerator pedals well after the Robot Revolution, for reasons having to do with the stories we tell ourselves about power and control. These will be on the left side, except in Britain and Australia. But our robot masters will seldom let us drive unconstrained.

—Rob Tow, Ex-Xerox PARC Scientist and Part-time Abalone Diver

on. An alternative model of conversation employs the notion of common ground, as described by Herbert H. Clark and Susan E. Brennan (1990):

> It takes two people working together to play a duet, shake hands, play chess, waltz, teach, or make love. To succeed, the two of them have to coordinate both the content and process of what they are doing. Alan and Barbara, on the piano, must come to play the same Mozart duet. This is

> coordination of content. They must also synchronize their entrances and exits, coordinate how loud to play forte and pianissimo, and otherwise adjust to each other's tempo and dynamics. This is coordination of process. They cannot even begin to coordinate on content without assuming a vast amount of shared information or common ground—that is, mutual knowledge, mutual beliefs, and mutual assumptions (see Clark and Carlson 1982, Clark and Marshall 1981, Lewis 1969, Schelling 1960). And to coordinate on process, they need to update, or revise, their common ground moment by moment. All collective actions are built on common ground and its accumulation.

In her work in applying the notion of common ground to human-computer interfaces, Brennan (1990a) suggests that common ground is a jointly inhabited "space" in which meaning takes shape through the collaboration and successive approximations of the participants. Brennan's work was aimed at designing human-computer interfaces so that they offer means for establishing common ground ("grounding") that are similar to those that people use in human-to-human conversation, such as interruptions, questions, and utterances and gestures that indicate whether something is being understood (Brennan 1990b).

Successful graphical interfaces, exemplified early on by the Macintosh, explicitly represented part of what Clark called the "perceptual common ground" of interaction through the appearance and behavior of objects on the screen (Clark 1996). Some of what goes on in the representation is exclusively attributable to either the person or the computer, and some of what happens is a virtuous artifact of a collaboration in which the traits, goals, and behaviors of both are inseparably intertwined.

The concept of common ground not only provides a superior model of the conversational process, but it also supports the idea that an interface is not simply the means whereby a person and a computer represent themselves to one another; rather, it forms a shared context for action in which both are agents.[1] When the old tit-for-tat paradigm intrudes, the "conversation" is likely to break down, once again relegating person and computer to opposite sides of a "mystic gulf"[2] filled with hidden processes, arbitrary

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1. This book employs the noun "agent" to mean *one who initiates action*. This definition is consistent with Aristotle's use of the concept in the *Poetics*.

2. The term "mystic gulf" is attributed to composer Richard Wagner to refer to the gap between audience and actors created by the orchestra pit.

understandings and misunderstandings, and power relationships that are competitive rather than cooperative. Mistakes, unanticipated outcomes, and error messages are typical evidence of such a breakdown in communication, in which the common ground becomes a sea of misunderstanding.

Interface Metaphors

The notion of interface metaphors was introduced to provide a conceptual scheme for people that would guard against such misunderstandings by deploying familiar objects and environments as stakes in the common ground: the anchoring expectations. The most famous of these is the desktop metaphor, first developed by Alan Kay at Xerox PARC in 1970, borrowing from some of the work of Douglas Engelbart at the Stanford Research Institute (SRI) in the 1960s. The Xerox Alto (1973) was the first computer that used the desktop metaphor and a graphical user interface (GUI), followed in 1981 by the Xerox Star workstation and the Apple Lisa in 1983. The first broad exposure of the desktop metaphor was in 1984 with the introduction of the Apple Macintosh, intended as a computer for the general public rather than for business use. It employed graphical icons to represent individual files as "documents" and hierarchical organizational units as "folders." Rumors of the death of the desktop have been highly exaggerated. Although it has sprouted many non-desktop affordances over the years (e.g., scroll bars and docks), we can still see its fundamental outlines in contemporary personal computers as well as in the arrangement of icons and what they mean on smartphones.

But even "good" metaphors don't always work as intended. Several years after the introduction of the Mac, in an informal survey of Macintosh-literate university students, for instance, many people failed to employ the word "desktop" anywhere in their description of the Finder.[3] Where an interface metaphor diverges significantly from its real-world referent, people proceed by accounting for the behaviors of particular "objects" on the screen with *ad hoc* explanations of system operation that are often incorrect: a "naïve physics" of computing (see Owen 1986). In such cases, metaphors do not serve as "stakes in the common ground," but rather as cognitive

3. The Macintosh Finder is an application for managing people's file systems and for launching other applications. It comes with the system and is automatically launched when the machine is turned on.

mediators whose labels may be somewhat less arcane (but possibly more ambiguous) than a computer scientist's jargon.

Since the introduction of the Mac, we have seen a variety of interface metaphors, both local and global. With the advent of the World Wide Web, we began to speak of a Web page as if it were a page in an enormous book. When things turned out to be a little more complicated, with hyperlinks both within and without, the terrain of the Web was re-visualized in terms of geography with Web sites. The notion of the Web portal was based on the idea that a wise provider would open a view of the Web that would protect us from chaos and provide uniform representations of information, but which might well lob us into sites and pages with diverse characteristics and an unexpected entrance into the Wild Wild Web, or else, if we wanted to stay safe, we could choose to remain penned up in walled gardens.

Names also change as technology and design advance. In the 1940s, for instance, some people had "car phones" that worked with radio technology. With the development of a reliable cellular system, we had handheld mobile devices that we called "cell phones." When mobile phones began to have something like a browser, some "apps," and messaging capabilities, we began to call them "smart phones." These phone names are not so much driven by metaphor as by somewhat naïve understandings of technology. But metaphors are still with us; for example, we see terms like "notebook" and "tablet" used to describe computers with certain dimensions and capabilities, even though one cannot typically sketch on, scribble on, or tear out and wad up a page.

A behavioral metaphor that has been rather more successful and pervasive is the notion of direct manipulation (discussed in more depth ahead), in which users can move objects about the screen in much the same way as they might in the physical world. Although the operations and conventions implicit in direct manipulation interfaces require more procedural learning than actually picking something up, the value of the metaphor is strong enough to boost most people up the learning curve.

Although interface metaphors can fail in many ways (as discussed later in this book), their prevalence has expanded the domain of interface design to admit contributions from specialists in graphic and industrial design, linguistics, psychology, education, and other disciplines. The metaphorical approach contributed to making interface design an interdisciplinary concern. They became lightning rods for people from many disciplines, either in service of or in reaction against them.

What is a User?

I resist using the word "user" in most contexts because it implies things we may not intend (drug users come to mind). In the context of human-computer interactions, "user" implies a power relationship and a kind of experience that tends to mischaracterize both technology and people. When we began to define human-computer interaction back in the 1970s and 1980s, the term "user" became quickly over-generalized. A person isn't typically defined as a "user" of the *New York Times* (unless you are house-breaking the dog) or of an automobile or a doctor. Over the years, I have exhorted my students not to use "user" unless it's really the correct word. For example, the "user" of a computer game is better characterized as a "player"; the "user" of an e-book is a "reader." Char Davies has called participants in VR experiences "immersants." Because this book covers a wide variety of human-computer interactions, I have used the word "interactor" as a general term, although I use "user" when I really mean it!

Interface Interdisciplines

While often driven by hardware innovation, the growing interdisciplinarity of interface design is also a product of heightened sensitivity to the experience of human-computer interaction. Change has been sparked by technology, scholarship, and imagination. The sections ahead are not complete histories; they contain brief sketches of exemplars and some comparisons to theatrical design.

IN THE BEGINNING, THERE WERE ENGINEERS Engineers were the first human-computer interface designers. Along that road, Douglas Engelbart and his team at Stanford Research International (SRI) were at the confluence of engineering, ease of use (human factors), and psychology and values, led by Engelbart's unwavering commitment to making the world a better place. Influenced early on by Vannevar Bush's canonical paper "As We May Think" (Bush 1945), Engelbart created a program at SRI called The Augmentation Research Institute (see Engelbart 1962). Its most famous invention was the computer mouse, but history often forgets that the group also invented hypertext, networked computers, and some of the foundations for graphical user interfaces, among other achievements.

What is a Computer?

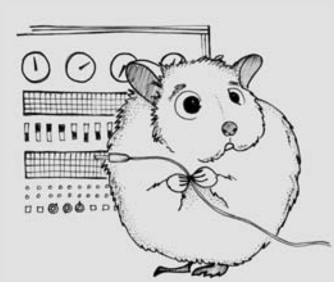
Computers were originally people. "Computer" was a title that described those people—mostly women—whose job it was to "perform the repetitive calculations required to compute such things as navigational tables, tide charts, and planetary positions for astronomical almanacs" (Kopplin 2010).

When I first wrote this book, the Macintosh computer was entering its fifth year in the marketplace. The personal computer was still a revolutionary device. Laptops, first envisioned by Alan Kay as what he called the "Dynabook" (Kay 1972), were developed. The Osborne Computer was designed in 1979 by Lee Felsenstein for Adam Osborne's company. Lee's primary design criterion was that the Osborne 1 had to fit under an airplane seat, and it did. The Grid Compass—the first successful "clamshell" portable—was released in 1981.*

Since those days, we have all seen an explosion of personal computing devices, from laptops to tablets to smartphones and smart wrist-watches, and change will keep coming. When I use the word "computer," I am speaking of it in the way it is defined by the *Oxford English Dictionary* (2013):

> *noun*
>
> *an electronic device which is capable of receiving information (data) in a particular form and of performing a sequence of operations in accordance with a predetermined but variable set of procedural instructions (program) to produce a result in the form of information or signals.*

I am using the term specifically in the domain of personal computing. The OED defines a personal computer as one that is designed for use by one person at a time. But if you consider a networked application such as a massively multiplayer online game, that definition may be misleading, since much of the processing is done on mainframe computers that are handling interactions from many people simultaneously, all in relation to one another. Where the code lives and which device is doing the bulk of the processing is not particularly relevant in my use of the term "computer." Most relevant to my argument are the representation produced and the interface affordances that shape and constrain human interaction with personal computers. We will ignore the tiny hamsters that run them.



* A somewhat less successful clamshell was introduced in Australia only about four months before the Grid Compass launched.

Engelbart believed that there were fantastic new horizons for human potential with computers. The notion of augmentation, while not a metaphor, was a vision that drove all of his work and solidified his team. It was only much later that the world rewarded him for it. He was ahead of his time, and the fledgling industry predictably pulled away key members of his team for shorter-term profit-making ventures.

Engelbart's legendary demo in 1968 was an incredible theatrical triumph as well as a technological one. Later nicknamed "the Mother of All Demos," Englebart sat on stage in San Francisco while his team was in Menlo Park. Engelbart recalls:

> Our computer was down at SRI in Menlo Park. In order to demo it, we beamed two channels of video along two microwave links up to San Francisco, bouncing them off dishes above the airport. There was only one video projector on the West Coast powerful enough for the conference hall, a Swedish Eidophor that I had to borrow from NASA. It was huge, maybe 6 feet tall. Then we rigged up a homemade modem—2,400 baud—to get signals from my console in San Francisco back to SRI over a leased line.
>
> On stage right was a big screen, 22 feet high. At the side of my display monitor, a camera pointed right at my face. Another camera was pointing down to capture my hands at the keyboard. It was pretty elaborate. My face would be on one side of the screen, with text on the other—or on a split screen with people in Menlo Park showing something as I talked about it. I'm told that this is the original videoconferencing demo (Jordan and Englebart 2004).

The theatre of the live performance and the skin-of-your-teeth presentation technology may sound familiar to theatre folk, but they were so far away from the culture of computing at the time that they made an indelible impact on the audience. Engelbart's demo lived on in the culture of SRI as well as the culture of PARC. The MIT Architecture Machine Group (later to become the MIT Media Lab) was still relying on demos that were often mock-ups, deconstructed as soon as they had been shown. At the same time, the content of the demo marked a major turning point in the practice, technology, and purpose of interface design.

ENTER THE PSYCHOLOGISTS Psychologists have been involved in the quest to understand human-computer interaction since the beginning of computing, through such disciplines as human factors design.[4] In the decade of the 1970s and on through the 1980s, cognitive psychologists developed critical and theoretical perspectives on human-computer interaction that were more focused on interface design than those of their colleagues in other branches of psychology. The work of Donald A. Norman, founder of the Institute for Cognitive Psychology at the University of California at San Diego, is especially illuminating. In the 1980s, Norman built a lab at UCSD that fostered some of the most innovative and germane thinking about human-computer interaction to that date (see Norman and Draper 1986 for a collection of essays by members and associates of this group). Norman's perspective is highly task-oriented. In his book *The Psychology of Everyday Things* (1988), Norman drives home the point that the design of an effective interface—whether for a computer or a doorknob—must begin with an analysis of what a person is trying to *do*, rather than with a metaphor or a notion of what the screen should display.

Norman's emphasis on action as the stuff that interfaces both enable and represent bores a tunnel out of the labyrinth of metaphor and brings us back out into the light, where what is going on is larger, more complex, and more fundamental than the way that the human and the computer "talk" to each other about it.

Norman's insights dovetail nicely with those of the "common ground" linguists, suggesting a notion of the interface that's more than screen-deep. The interface becomes the arena for the performance of some intentional activity in which both human and computer have a role. What is represented in the interface is not only the task's environment and tools, but also the process of interaction—the contributions made by both parties and the evidence of the task's evolution. I believe that Norman's analysis supports the view that interface design should concern itself with representing whole actions with multiple agents. This is, by the way, precisely the definition of theatre.

Norman was also a key figure in the development of another pivotal interface concept, the idea of direct manipulation. Direct manipulation

4. The literature in human factors and other psychological perspectives on human-computer interaction is huge. It is beyond the scope and purpose of this book to provide even a cursory survey of the entire domain. The work mentioned in this chapter is selected in terms of its relevance to the thesis of this particular book. Interested readers may wish to review *The Human Factor* by Richard Rubinstein and Harry Hersh, which includes an excellent bibliography; *Readings in Human-Computer Interaction*, by Ronald M. Baecker and Willam A.S. Buxton; or the various proceedings of ACM SIGCHI and the Human Factors Society.

interfaces employ a psychologist's knowledge of how people relate to objects in the real world in the belief that people can carry that knowledge across to the manipulation of virtual[5] objects that represent computational entities and processes. The term "direct manipulation" was coined by Ben Shneiderman of the University of Maryland, who listed these key criteria:

1. Continuous representation of the object of interest.
2. Physical actions or labeled button presses instead of complex syntax.
3. Rapid incremental reversible operations whose impact on the object of interest is immediately visible (Shneiderman 1982).

Shneiderman (1982) reported that direct-manipulation interfaces can "generate a glowing enthusiasm among users that is in marked contrast with the more common reaction of grudging acceptance or outright hostility." In a cognitive analysis of how direct manipulation works, Edwin Hutchins, James Hollan, and Don Norman suggest that direct manipulation as defined may provide only a partial explanation of such positive feelings. They posit a companion effect, labeled direct engagement: A feeling that occurs "when a user experiences direct interaction with the objects in a domain" (Hutchins et al. 1986). They add the requirements that input expressions must be able to make use of previous output expressions, that the system must create the illusion of instantaneous response (except where inappropriate to the domain), and that the interface must be unobtrusive.

It seems likely that direct manipulation and direct engagement are head and tail of the same coin (or two handfuls of the same elephant): one focusing on the qualities of action and the other focusing on subjective response. The basic issue is what is required to produce the feeling of taking action within a representational world, stripped of the "meta-context" of the interface as a discrete concern. Hutchins et al. sum it up this way: "Although we believe this feeling of direct engagement to be of critical importance, in fact, we know little about the actual requirements for producing it" (Hutchins et al. 1986).

5. The adjective "virtual" describes things—worlds, phenomena, etc.—that look and feel like reality, but which lack the traditional physical substance. A virtual object, for instance, may be one that has no real-world equivalent, but the persuasiveness of its representation allows us to respond to it as if it were real.

Nearly 20 years later, in his book *Emotional Design*, Norman (2004) says:

> We cognitive scientists now understand that emotion is a necessary part of life, affecting how you feel, how you behave, and how you think. Indeed, emotion makes you smart.

In more recent years, Norman might say that direct engagement arises from the emotional pleasure of a well-designed affordance; the characteristics of immediacy and lack of fussy procedural steps simply make direct manipulation feel good to us.

Here, I think, is an important articulation between psychology, interface design, and theatre. Direct engagement in the theatre arises first of all from real-time enactment and the enhanced attention it evokes. Audiences (and actors) have immediate emotional responses to the action on stage. Over the course of a play, emotions take on greater resonance, ideally producing empathy (literally, "feeling with" the characters). The interface (the venue, stage machinery, etc.) is not a matter of direct concern; when an audience is directly engaged with the action of the play, these elements literally disappear from conscious awareness. Further, theatrical audiences have an expectation of emotional pleasure. We will examine the nature of that pleasure in the next chapter.

Psychology is a familiar domain to dramatists, actors, and other theatre artists because of its focus on the human mind, behavior, and emotions. Understanding how psychology and theatre are alike and different may illuminate the distinct contributions that each can make in the field of human-computer interaction. The two domains have several elements in common. Both concern themselves with how agents relate to one another in the process of communicating, fighting, solving problems, building things, having fun—the whole range of human activity. Both interpret human behavior in terms of emotions, goals, conflicts, discoveries, changes of mind, successes, and failures. Both observe and analyze human behavior, but each employs those means to different ends: In general, psychology attempts to understand what goes on with humans in the real world with all their fuzziness and loose ends, while theatre means to represent a kind of thing that might go on, simplified for the purposes of logical and affective clarity. Psychology explicates human behavior, while theatre represents it in a form that provides intellectual and emotional closure. Theatre is informed by psychology, but it turns a trick that is outside of psychology's province through the direct representation of action.

GRAPHIC DESIGN, ANIMATION, AND SOUND In the analyses of both Shneiderman (1987) and Hutchins et al. (1986), continuous representation and physical action depend heavily upon graphical representation. Hutchins identifies the granddaddy of direct manipulation as Ivan Sutherland's graphical design program *Sketchpad* (Sutherland 1963). Graphical (and, by extension, multisensory) representations are fundamental to both the physical and emotional aspects of directness in interaction.

In many ways, the role of the graphic designer in interface design is parallel to the role of a theatrical scene designer. Both create representations of objects and environments that provide a context for action. In the theatre, the scene designer provides objects like teacups and chairs (props), canvas-covered wooden frames that are painted to look like walls (flats), and decorative things like draperies and rugs (set dressing). The behaviors of these elements are also designed: doors open, make-believe bombs explode, trick chairs break in barroom brawls. The lighting designer uses elements of color, intensity, and direction to illuminate the action and its environment and to focus our attention on key areas and events. In interface design, animation has been used increasingly as processing power has grown.

Scene and light designers use such elements as line, shadow, color, texture, and style to suggest such contextual information as place, historical period, time of day, season, mood, and atmosphere. Theatrical designers also employ metaphor (and amplify the metaphors provided by the playwright) in the design of both realistic and non-realistic pieces: The looming cityscape around Willy Loman's house in *Death of a Salesman* metaphorically represents his isolation and the death of his dreams; abstract webs of gauzy fabric suggest the multiple layers of illusion in the personality of *Peer Gynt*. At Ohio State University, the Advanced Computing Center for the Arts and Design (ACCAD) has collaborated with the Departments of Theatre and Dance to produce real-time visual effects, including characters projected from the motion-capture studio onto the stage where they interact with "live" actors.

In interface design, graphic designers and animators make the same sorts of contributions. They render the objects and environments in which the action of the application or system will occur, imparting behaviors to some objects and representing both concrete and ephemeral aspects of context through the use of such elements as line, shadow, color, intensity, texture, and style. Such familiar metaphors as desktops and windows provide behavioral and contextual cues about the nature of the activity that they support.

Sounds Good to Me

The music in some of the early arcade and box games was truly horrible. Tim Vasikalis, an extremely successful composer and producer of sound for games, explains that "early video game music was exclusively developed by the engineers themselves. . . . Back in the day, the only way to embed sound into a game was by directly programming it into the computer chips" (Vasikalis 2012). Oh, that explains it.

Despite *Pac Man*, it became clear to me in the early 1980s that audio had tremendous potential in computer games. This belief began with the simple observation that when the radio is on, my brain visualizes the action and characters, but if the TV is on without sound, my brain does not create a soundtrack. Audio-only videogames generally met with curiosity, but not great success in the general marketplace (e.g., *Real Sound* by Kenji Eno, 1997) until spatialized audio showed up. Binaural recording has enabled spatialized sound for VR as well as for absorbing audio games (e.g., the mobile game *The Nightjar*).

I first used binaural field recording to create spatialized sound in the production of *Placeholder*, a virtual reality project at the Banff Centre for the Arts in 1993. One of the soundscapes we needed was the sound of a waterfall, including walking through it. I asked my partner Rob to do the recording, which involved wearing special microphones on either side of his head. As it was a waterfall, we had to do something to protect the microphones. A search party was sent to town to get some condoms, which were then placed over the mics. So here was this guy, struggling through a rushing creek with strange affordances on his head, then standing (briefly) under falling water that was hitting his head at about 300 psi. At that moment I wondered what a random hiker would have thought.

Two big things came out of the *Placeholder* recordings. One was that, although the piece represented three scenes using very different videographic methods, the audio held the world together. The other was that Rob and I have continued to make environmental binaural recordings since then, and it's been a blast.

Sound and music design in interactive media—especially games—has become increasingly important and sophisticated. The introduction of spatialized sound into computer games in the late 1990s accelerated the development of sound-design tools, technology, expertise, and curricula. Simpler sounds give us cues as well as a sense that something "real" is going on, from the minimalist "whoosh" when you send a message to the "crackle" of "paper" when you drag something to the "trash" on the Mac.

Both theatrical design and interface design are aimed at creating representations of worlds that are like reality, only different. But a scene design is not a whole play; for that we also need representations of character and action. Likewise, the elements of interface design are only part of the whole representation that we call human-computer interaction.

How should an interface come to be? In effective interaction design, the interface does not come last; it develops throughout with the entire design process. It is deeply entwined with functionality. It shows sensitivity to the interactor and sometimes even constrains functionality that cannot or need not be touched effectively by the interactor. If we think of an application as an organic whole, the process by which it is created should be organic as well.

Throw the Baggage Out

The previous section picks up some of the stronger threads in the evolution of interface design, but these elements alone are not sufficient in defining the nature of human-computer interaction or in realizing it effectively. It recommended theatre as an additional perspective, but it may not be productive for theatre people simply to join all the other cooks in the kitchen. I want to take the argument a step further and suggest that the concept of the interface itself is a half-baked idea, and we might do better to throw it out and begin afresh.

A Definitional Digression

My frustration with the notion of the interface is as old as my involvement with computers. Perhaps the best way to explain it is to take a short excursion through the history of my personal view. I became involved with computers as a way to support myself while I was a graduate student in theatre. I thought that my career was going to take me to the stage, either as an actor or as a director. But a life in the theatre promised little in terms of income, and when a friend of mine started a little company to create computer software in 1976, I jumped at the chance to bolster my survival potential with some technical skills.

I became a software designer and programmer, working primarily on interactive fairy tales and educational programs for kids. The company was called CyberVision, and the machine was a lowly 1802 processor with a four-color, low-resolution display and an alphanumeric keypad.

Can You Put an Interface on This?

Back in the day, as they say, it was not uncommon for engineering to develop an application and then ask a designer to slap an interface on it. Of course, the "interface" should organically emerge from the purpose, functionality, etc. of a piece of software, but there was a time that this was not understood. The interface was seen as a "face" that you draw on top of a program. That kind of thinking still exists in some corners.

After Purple Moon was sold to Barbie, I did some "interface consulting" to make ends meet. One of my first clients was a company that helped people to build their own websites. They asked me to look at their website and help them with the interface.

I prepared for our first meeting by running the website through its paces. Something was deeply wrong. I could enter text and specify a position for it, but I couldn't see it in the window at the center of the screen. Nothing. I clicked around everywhere, trying to figure out what to do. Eventually I clicked outside the border of the window, and the site crashed. Just crashed.

The day of the meeting, after polite personal greetings, I announced that I could take down their site with one click. The clients expressed disbelief. I said, OK, if I can demonstrate this to you, will you double my fee? "Of course," they said, laughing. So I clicked in that funny place and the site went down. The project leader cried, "but nobody would DO that!" I replied, "Well, I did," and proceeded to explain the problem I was having. It turned out that their program was placing black text on a black background. And they doubled my fee.

Fifteen years later, I told that story to a friend who is the CEO of a major Silicon Valley corporation. He laughed politely, then said, "You know, we acquired them." My jaw dropped. "They're doing quite well now," he added.

The CyberVision computer was cassette-loaded with 2K of RAM, and it had the capacity to synchronize taped audio with animation on the screen. My first "feature" was an interactive, animated version of "Goldilocks." Later, I created the first lip-synching on a microcomputer for a game of "Hangman" in which the evil executioner delivered menacing lines in a Transylvanian accent (all this with only sixteen lip positions). I immediately became immersed in mapping my knowledge of drama and theatre to the task at hand because the two media were so obviously alike. There were characters, emotions, and actions. I could imagine other worlds through the looking glass, and I could imagine reaching into them.

Working at CyberVision was a time of wonder. It was also a time of wrestling with unfamiliar technologies with for novel purposes, hamstrung by the tiny RAM, the slow BAUD rate, fat pixels and "cyberwind" that smeared colors across the screen, and an alphanumeric keypad as an input device. The ability to synchronize audio with video was a great aspect of cassette tape; oxide dropouts were emphatically not. Most troubling was the need to create converging nodes in our branching tree architectures because consequential choices could not be held in tiny memory past the boundary of a 2K data load. A vision of possibility was emerging for me—meaningful interactions, responsive worlds—but I didn't know how to pursue it.

When CyberVision folded to its competition (an upstart company called Atari), I asked my boss to help me think about what kind of job to look for next. He said, "Why don't you go work for a bank? They need people to help design automated teller machines." "I don't know anything about that," I cried. "Of course you do," he replied. "That's human factors." In response to my blank look, he elaborated, "That's making computer things easy for people to use."

What a concept!

I ended up going to work for Atari, not a bank, but the notion of ease of use as a design criterion fit neatly and permanently into my developing intuitions about how theatrical expertise could inform the art of designing software. There's nothing between the audience and the stage but some good illusion. Clearly, I was on the right track. But I hadn't run into the other "i" word yet.

I got off to a rocky start in the software branch of the newly-minted Atari Home Computer Division, first as a software specialist for educational applications, then as a producer, and finally as director of software product management. That job included thinking up what would make good applications, getting buy-ins from marketing and engineering, and doing much of the basic design work. Various producers managed budding application areas as we struggled to understand what would differentiate the Atari 400/800 from the Atari Video Computer System (VCS, later 2600) as well as from competitors like the Apple 2.

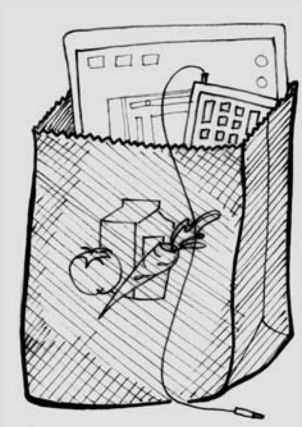
Product differentiation (or imaginings of what personal computers could do) was the sticking point between me and the president of the company. He wanted me to devote 80% of our budget to porting VCS games to the

What Do Women Want?

In 1981, my boss at Atari asked me to draw up a list of products for the personal computer that might be interesting to women. What began as a request that seemed sane to the polyester-suited dude who made it became a howling joke for several of my team of Atari 400/800 personal computer software ideators and producers. We began thinking about the problem after a few drinks.

Appliances are certainly a problem, we thought. So why not repurpose *Missile Command* into *Appliance Command*? Sure, it wouldn't really run your appliances, but women enjoy running large appliances as they dance around in shirtwaist dresses (given the demographic, we suspected that my boss's mother was perhaps a victim of the post-WW II propaganda romancing gleaming household appliances, aimed at getting the women the hell out of the workforce to make room for returning veterans). Sure, we thought, that should fly with the boys.

To be personal for a moment, we ladies know that every woman dreads the annual pelvic exam. Our proposed product, the *Atari Home Pelvic Exam*, featured a chilled cartridge, cozy footholders that could be attached to the screen, and other affordances that might have inspired excellent research. Another distinctly female concern is personal appearance. Unwittingly foreseeing *Photoshop*, we proposed the *Atari Stretch Mark Editor*, my personal favorite.



Yes, I got in trouble for that smart-assed list. My boss, bless him, tried hard to persuade me that recipes and grocery lists were the way to go. Before *Hypercard* (this is a test of your age, young reader), there wasn't an obviously easy way to fool around with recipes and grocery lists. But his argument was so touching, so sincere, that not a year has gone by since that I have not had a computer in my kitchen, fooling around with new ways to organize recipes, menus, and my grocery list.

Golly, *Barbie Fashion Designer* was so liberating after all those years in my apron.

400/800 computers. I consistently resisted. Finally, I went to the head of the Home Computer Division and drew him a map of all the areas in which we could be creating applications that had no equivalents in game systems—personal finance, education, personal development, and useful tools like word processing and spreadsheets. He gave me a raise and a promotion.

Warner, the new corporate owner of Atari, did not share my views on diversifying the product offering. The Warner folks believed that, while videogames may be permanent fixtures of our culture, personal computers were likely a fad (in fact, I participated in a research gathering where some significant luminaries agreed, including Stewart Brand, who compared personal computers to jogging—no offense to Stewart; these were jogging's early days, and it was hard to tell whether it was a fad). Further, Warner's idea of great videogames went no further than great movie or comic licenses. The great game designers recruited by Atari founder Nolan Bushnell got little support for developing high-quality games from the new regime, including a lack of personal credit, but those who remained after the Warner acquisition continued to do mostly great work, at least until the *E.T.* disaster. Most important, perhaps, was the fact that the Atari VCS actually provided both a better processor and a better interface for most Atari games.

As the corporate axe began to swing my way, I literally ran over to the Atari System Research Lab to ask Alan Kay to let me work there. I wanted to devote time to thinking through what I had come to believe about computers and theatre (I also needed to begin my dissertation, which I had

Phone Home!

In 1983, the story goes, a bunch of kids were riding their bikes around Alamagordo, New Mexico. Alamagordo is a sea of gorgeous white sand dunes. The town itself used to have establishments such as the Blast Heat Motel, if memory serves. Or perhaps it was a bar. In any case, that's because the area was home to the Trinity nuclear weapons testing in 1945. The kids found interesting stuff in the white sands. They found *E.T.* cartridges. According to the *New York Times*, the landfill included Atari computers, assorted parts, and approximately 3.5 million unsold *E.T.* cartridges encased in concrete. According to the *Alamagordo Daily News* in a column written by M. E. McQuiddy on September 27, 1983, the dumping caused the Alamagordo city commission to take a "strong stand against 'extratorrial' garbage. . . . El Paso Atari officials apparently refused to confirm or deny the dumping, and referred any queries to California." The site was filled with concrete. But urban legend has it that the kids on bikes found *E.T.* cartridges, and it seems like a little more than urban legend to me, and I think it probably had something to do with Atari's rapid downturn and crash (and subsequent sale to Jack Trameil).

CEO Ray Kassar was indicted by the SEC for insider trading, but settled out of court.

decided would be on that subject). Alan gave me the opportunity. "Interface" was every other word in the conversations of the bright young MIT wizards that populated the lab. I dimly perceived that there must be more to it than ease of use, and so I signed up for a weekly interface seminar that one of the psychologists on staff was conducting.

Models of the Interface

The interface seminar group began by looking at how the concept was typically understood by people in the computer field. Figure 1.1 shows a schematic model of the interface. The shaded rectangle in the middle represents the interface, and it was seen to include what appears on the screen, hardware input/output devices, and their drivers.

Compelling as its simplicity might make it, this model was immediately dismissed by everyone in the group. In order for an interface to work, the person has to have some idea about what the computer expects and can handle, and the computer has to incorporate some information about what the person's goals and behaviors are likely to be. These two phenomena—a person's mental model of the computer and the computer's "understanding" of the person—are just as much a part of the interface as its physical and sensory manifestations (see Figure 1.2).

But in order to use an interface correctly, a person must also have an idea of what the computer is "expecting" her to do. If you are going to admit that what the two parties "think" about each other is part of what's going on, you will have to agree that what the two parties think about what the other is thinking about them must perforce be included in the model (see Figure 1.3). This elaboration has dizzying ramifications.

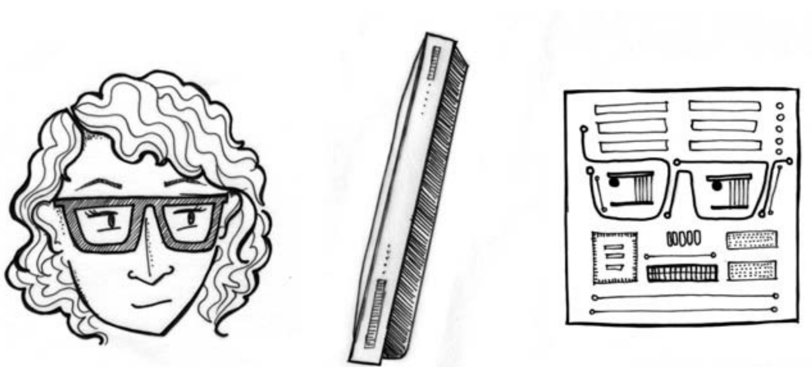


Figure 1.1. *The pre-cognitive-science view of the interface*

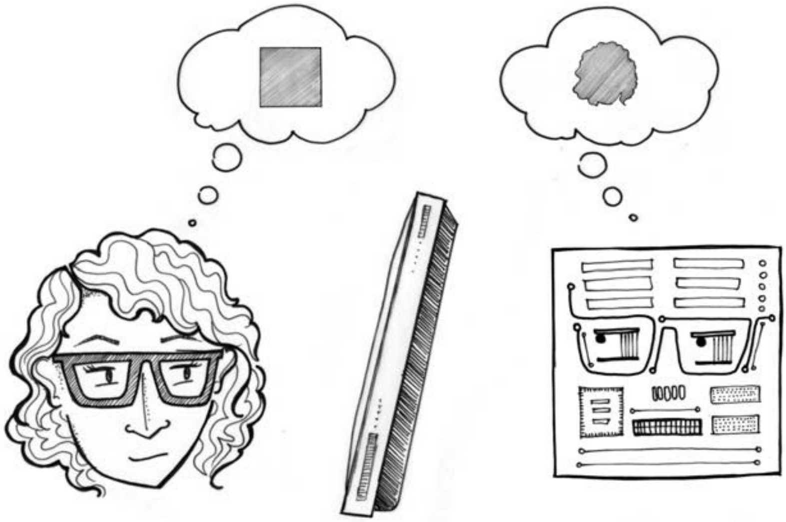


Figure 1.2. *The "mental models" view. The thought bubbles and their contents are considered part of the interface.*

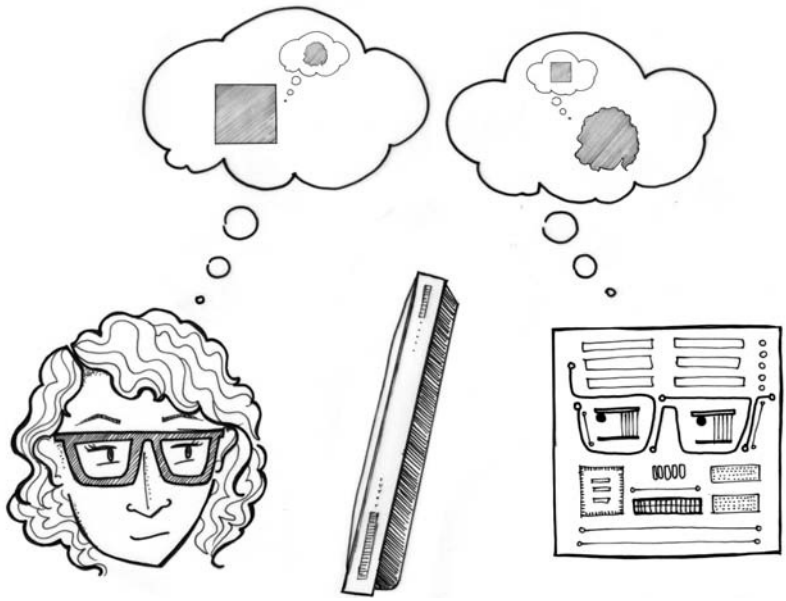


Figure 1.3. *The "horrible recursion" version of the mental-models model of the interface. More bubbles could be added ad infinitum.*

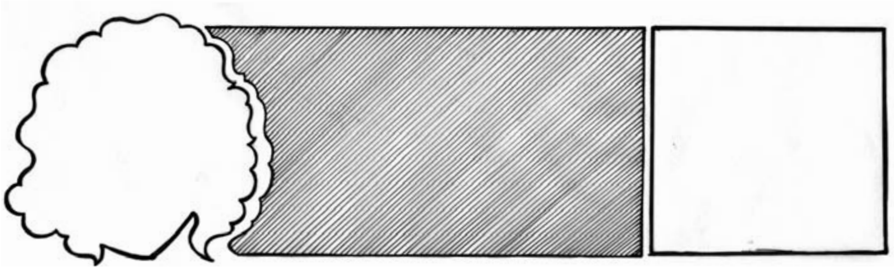


Figure 1.4. *A simple model of the interface, circa 1989. In this view, the interface is that which joins human and computer, conforming to the needs of each.*

Faced with this nightmare, the group at the Atari Lab abandoned the topic and turned their attention to more manageable concepts, such as the value of multisensory representations.

Over the years, I have frequently observed interface workers backing away from such gnarly theoretical discussions in favor of the investigation of more tractable issues of technique and technology—such subjects as direct manipulation, "user" testing, online help functions, animation, and sound and speech, gesture, body tracking, and facial recognition. These areas contain hard problems and add greatly to the potential for interface design, but they do not necessarily advance the theoretical conversation. The working definition of the interface has settled down to a relatively simple one—how humans and computers interact (see Figure 1.4)—but it avoids the central issue of what this all means in terms of reality and representation.

It occurs to me that when we have such trouble defining a concept, it usually means that we are barking up the wrong tree.

The World's a Stage

For purposes of comparison, let's take a look at the theatre. We have observed that the theatre bears some similarities to interface design in that both deal with the representation of action. Theatre, unlike novels or other forms of literature, incorporates the notion of performance; that is, plays are meant to be enacted.[6] Enactment typically occurs in a performance area called a stage. The stage is populated by one or more actors who portray characters. They perform actions in the physical context provided by the

6. In his book *The Elements of Friendly Software Design* (1982), Paul Heckel remarks, "When I design a product, I think of my program as giving a performance for its user."

scene and light designers. The performance is typically viewed by a group of observers called an audience (see Figure 1.5).

Part of the technical magic that supports the performance is embodied in the scenery and objects on the stage (windows that open and close, teacups that break); the rest happens in the backstage and wing areas (where scenery is supported, curtains are opened and closed, and sound effects are produced), the loft area above the stage, which accommodates lighting instruments and backdrops or set pieces that can be raised and lowered, and the lighting booth, which is usually above the audience at the back of the auditorium. The magic is created both by people and machines, but who, what, and where they are do not matter to the audience.

It's not just that the technical underpinnings of theatrical performance are unimportant to audience members; when a play is working, audience members are simply not aware of the technical aspects at all. For the audience member who is engaged by and involved in the play, the action on the stage is all there is. In this sense, plays are like movies: When you are engrossed in one, you forget about the projector, and you may even lose awareness of your own body. For the actor on stage, the experience is

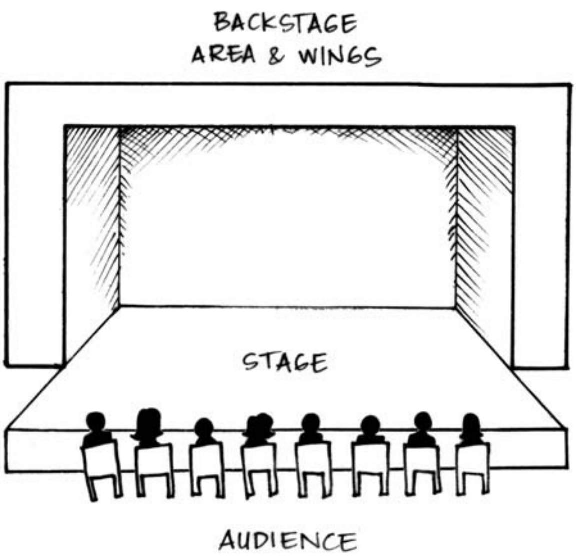


Figure 1.5. *A typical proscenium theatre*

similar in that everything extraneous to the ongoing action is tuned out, with the exception of the audience's audible and visible responses, which are often used by the actors to tweak their performance in real time (this, by the way, reminds us that theatrical audiences are not strictly passive and may be said to influence the action). For actor and audience alike, the ultimate reality is what is happening in the imaginary world on the stage—the representation.

When the Lights Went Out

It's 1973 and I'm doing my MFA in Theatre at Ohio State. We are in Act I Scene 3 of Shakespeare's Richard III on the main stage. I am playing nasty Queen Margaret, who curses tremendously well.

In this scene she goes after several characters, ultimately King Richard. At this point in the scene she is warning Gloucester that he is in danger from Richard's aspirations and bemoans her own fate (the loss of her son and husband):

As time goes by, I see that I accurately predicted where my wrinkles would be.

Duke of Gloucester … *but I was born so high,*
Our aery buildeth in the cedar's top,
And dallies with the wind and scorns the sun.

Queen Margaret. *And turns the sun to shade; alas! alas!*

At this moment, the lights go out on the stage. The actors pause briefly, then continue with the scene in the dark, as emergency lights come on in the audience. I think it is strange to be in the dark on the stage, seeing the audience eerily lit, but only for a moment. The heat of the argument burns through the strange sensory experience for the actors and we continue the scene to its conclusion.

At the end of the scene, the actors go down to the green room to see what's happening (normally we would have a bridge game going). We learn that there has been a blackout over about half of Columbus. The rest of the performance is cancelled. The next morning, the *Columbus Dispatch* reports: "Queen Margaret Curses Play into Darkness." This is my first inkling that I may have supernatural powers.

As people grapple with the notion of interaction in the world of computing, they sometimes compare computer users to theatrical audiences (see Figure 1.6). "Users," the argument goes, are like audience members who are able to have a greater influence on the unfolding action than simply the fine-tuning provided by conventional audience response. In fact, I used this analogy in my dissertation in an attempt to create a model for interactive fantasy. The user of such a system, I argued, is like an audience member who can march up onto the stage and become a character, shoving the action around by what he says and does in that role.

But let's reconsider for a minute. What would it be like if the audience marched up on the stage? (See Figure 1.7.) They wouldn't know the script, for starters, and there would be a lot of awkward fumbling for context. Their clothes and skin would look funny under the lights. A state of panic would seize the actors as they attempted to improvise action that could incorporate the interlopers and still yield something that had any dramatic integrity. Or perhaps it would degenerate into a free-for-all, as performances of avant-garde interactive plays in the 1960s often did.

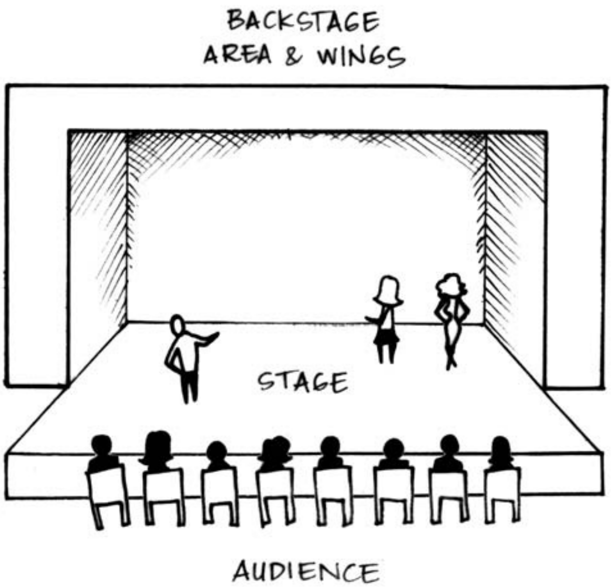


Figure 1.6. *For the audience, what's happening on the stage is all there is.*

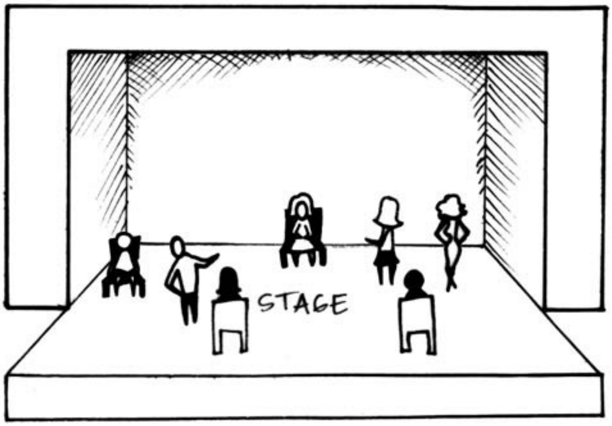


Figure 1.7. *Putting the audience on the stage can create confusion.*

The problem with the audience-as-active-participant idea is that it adds to the clutter, both psychological and physical. The transformation needs to be subtractive rather than additive. People who are participating in the representation aren't audience members any more. It's not that the audience joins the actors on the stage; it's that they become actors—the notion of observers goes away.

In this view, the "stage" is a virtual world. It is populated by agents, both human and computer-generated, and other elements of the representational context (windows, teacups, desktops, or what-have-you). The technical magic that supports the representation, as in the theatre, is behind the scenes. Whether the magic is created by hardware, software, or wetware is of no consequence; its only value is in what it produces on the "stage." In other words, *the representation is all there is* (see Figure 1.8). Think of it as existential WYSIWYG.[7]

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7. WYSIWYG stands for the rubric "what you see is what you get," coined by Warren Teitelman at Xerox PARC. It has been held up as a paradigm for direct-manipulation interfaces, but some theorists have contested its value (see, for instance, Ted Nelson's (1990) article "The Right Way to Think about Software Design" in *The Art of Human-Computer Interface Design*).

Figure 1.8. *An alternate view of human-computer interaction, in which the representation is all there is. The shape of the "stage" is oval, like the beam of a spotlight, to suggest that all that matters is that which is "illuminated."*

Theatre: More than an Interface Metaphor

The idea of enabling humans to take action in representational worlds is missing in most attempts to use theatre simply as an interface metaphor. A central goal of this book is to suggest ways in which we can use a notion of theatre not simply as a metaphor, but as a way to conceptualize human-computer interaction itself.

Focusing on human agency allows us to simplify another perpetually problematic concept, the notion of interactivity. People in the computer game business have been arguing about it for decades. In 1988, the first conference aimed at bringing together people from all sectors of the interactive entertainment business took place in New York.[8] People came from such diverse industries as personal computers, videogames, broadcast and cable television, optical media, museums, and amusement parks. Over the course of the two days, a debate about the meaning of the word "interactive" raged through every session, disrupting carefully planned panels and presentations. People seemed to regard "interactivity" as the unique cultural discovery of the electronic age, and they demanded a coherent definition. Several speakers tried to oblige, but no one succeeded in presenting a definition that achieved general acceptance. Many participants departed

8. INtertainment was an annual conference sponsored by Alexander Associates.

angry and dissatisfied. Such conversations persist today, at ACM SIGCHI, South by Southwest Interactive, the Game Developers' Conference, and many others. It has also become the topic of dozens—if not hundreds—of books. The conversation has become much more diversified and nuanced, but the nature of interactivity continues to generate new theories and controversies (see, for example, Dubberly et al. 2009).

In the past, I posited that interactivity exists on a continuum that could be characterized by three variables: frequency (how often one could interact), range (how many choices were available), and significance (how much the choices really affected matters) (Laurel 1986a and b). In his book *Expressive Processing* (2009), Noah Wardrip-Fruin gives us a good test for significance: "What changes to the state of the system and influence on future operations can be produced by this interaction" (p. 75). A not-so-interactive computer game judged by these standards would only let you do something once in a while, only give you a few things to choose from, and the things you could choose wouldn't make much difference to the whole action (or produce significant changes to the state of the underlying system). A very interactive computer game (or desktop or flight simulator) would let you do something that really mattered at any time, and it could be anything you could think of.

But these variables provide only part of the picture. There is another, more rudimentary measure of interactivity: You either feel yourself to be participating in the ongoing action of the representation or you don't. Successful orchestration of the variables of frequency, range, and significance can help to create this feeling, but it can also arise from other sources—for instance, sensory immersion and the tight coupling of kinsethetic input and visual response. If a representation of the surface of the moon lets you walk around and look at things, then it probably feels pretty damned interactive, whether your virtual excursion has any consequences or not. It's enabling a person to act within a representation that's important. Optimizing frequency, range, and significance in human choice-making will remain inadequate as long as we conceive of the human as sitting on the other side of some barrier, poking at the representation with a joystick or a mouse or a virtual hand. You can demonstrate Zeno's paradox[9] on the "user" side of

9. Zeno's paradox (called the theory of limits in mathematics) says that you can never get from here to there because you can only get halfway, then halfway of halfway, etc. Mathematics offers a solution; so does common sense. But the paradox is compelling enough to have interested logicians and mathematicians for centuries.

the barrier until you're blue in the face, but it's only when you traverse it that things get "real."

Wardrip-Fruin (2009) suggests an alternative to sensory immersion as a way to intensify the experience of interactivity. He argues for "systems that more clearly communicate their structures to audiences." In what he calls "the *SimCity* effect," the experience of interaction is enhanced, paradoxically, when players incrementally build "a model of the system's internal processes based on experimentation." This model brings players' initial expectations into line with the capabilities of the game, dissolving an important barrier to successful (pleasurable) interaction.

The experience of interactivity is a "thresholdly" phenomenon, and it is also highly context-dependent. The search for a definition of interactivity diverts our attention from the real issue: How can humans participate as agents within representational contexts? Actors know a lot about that, and so do children playing make-believe. Buried within us in our deepest playful instincts, and surrounding us in the cultural conventions of theatre, film, and narrative, are the most profound and intimate sources of knowledge about interactive representations. A central task is to bring those resources to the fore and to use them in the design of interactive systems.

So now we have at least two reasons to consider theatre as a promising foundation for thinking about and designing human-computer experiences. First, there is significant overlap in the fundamental objective of the two domains—that is, representing action with multiple agents. Second, theatre suggests the basis for a model of human-computer activity that is familiar, comprehensible, and evocative. The rest of this book will explore some of the theoretical and practical aspects of theatre that can be directly applied to the task of designing human-computer experiences. But there are a few more stones to be turned in arranging the groundwork for this discussion.

Is Drama Serious Enough?

Because theatre is a form of entertainment, many people see it as fundamentally "non-serious." I have found in conversations with computer-science-oriented developers that there is high resistance to a theatrical approach to designing human-computer activity on the grounds that it would somehow trivialize "serious" applications. Graphic designers undoubtedly have had to wrestle with the same sort of criticism, where design is seen, not as a task of representation, but merely one of decoration. Decoration is suspect because it may get in the way of the serious work to be done.[10] But the fact of the matter is that graphic design is an indispensable part of the representation itself, as amply demonstrated by the Macintosh and other contemporary computing environments.

Seriously Minimalist

Although rounded rectangles are older than the iPad, we look to Sir Johnathan Ive as the master minimalist industrial designer who has given Apple its shape, so to speak. The sleek beauty of the curves, textures, and colors of Apple devices are minimalism at its best. They are neither serious nor playful in their naked state; they whisper of magic and futurism.

And yet, what do people do with them? They cover their MacBooks with decals—a sedate dancing bear or a full-sized Virgin of Guadalupe. They dress their iPhones in little outfits, from Hard Candy to Hello Kitty to industrial strength protectors that look like recycled automobile tires. What does this mean about seriousness in relation to computational devices?

Frankly, those serious dudes who want to send the "no fun EVER" message are probably toting VAIOs and running Windows. Really, have you ever seen a VAIO with a Ché Guevara decal? Bob Marley? Hello Kitty? No, you have not.

Apple people, on the other hand, smother Ive's minimalism in personalization and uniqueness. Let's face it—they are playful and artsy. Or at least that's the persona they and their computers and phones are wearing. But Apple people still do serious stuff with their dressed-up hardware—3D modeling, for example, and sophisticated audio and video editing software. And just about everybody, regardless of the box, uses things like spreadsheets and tax calculators.

Oh, Sir Ive, it appears that minimalism in industrial design does not necessarily imply either seriousness or playfulness. You knew that. But were you expecting everybody to ruin your design with personalization? I have one iPad with a cushy cover and one Mac Book with a tasteful Hawaii decal.

Two Mao jackets—one to wear and one to send to the laundry.

10. The same argument was used a few decades ago to ban bright colors, potted plants, and chatchkas from the workplace; but that's another story.

The no-frills view that permeates thinking about interfaces of "serious" applications is the result of a fundamental misunderstanding of the nature of seriousness in representations. The idea that theatre is "really not real" and is therefore unsuited as an approach to serious human-computer activities is misguided, because those activities are "really not real" in precisely the same ways. Without the representation, there is nothing at all—and theatre gives good representation.

Human-computer interaction may be divided into two large categories: productive and experiential (Laurel 1986b). Experiential activities, such as computer games, are undertaken purely for the experience afforded by the activity as one engages in it, while productive activities such as word processing have outcomes in the real world that are somehow beyond the experience of the activity itself. They are often mistakenly defined in terms of their artifacts—a printed document or a spreadsheet filled with numbers. But seriousness is not equivalent to concreteness. A printed paper (such as this manuscript, for example) has "real" implications (e.g., transmitting knowledge, changing how something is done, receiving a grade, or getting paid) even though it is itself a representation. "Productivity" as a class of applications is better characterized, not by the concreteness of outcomes, but by their seriousness vis-à-vis the real world.

There is a parallel here with seriousness as an aspect of drama. In formal terms, "serious" treatments of subjects are reserved for tragedy (and in some senses, melodrama), and "non-serious" treatments are found in melodrama, comedy, farce, and satire. Here again, although the plays themselves are representations, seriousness depends largely on the consequences of the actions represented in them. In a serious work like *Hamlet*, for instance, falling down (as does Ophelia after her father's death) has serious consequences both physically and symbolically, while in a farce, falling down (tripping over a piece of furniture or slipping on a banana peel, for instance) causes no permanent injury or pain to the agent.

To trace these effects through to the real world, we need to look at their impact on audiences. Ophelia's fall and its symbolic meaning impart information about suffering, revenge, and the consequences of evil that can be contemplated, absorbed, and acted upon by an audience. The fall of a clown, on the other hand, may arouse laughter and ephemeral pleasure; it may also, as in more thoughtful flavors of comedy, communicate a philosophical view (e.g., a lighthearted attitude toward random accidents). Seriousness in both theatre and human-computer activities is a function of the subject and its treatment in both formal and stylistic terms. Drama provides means for representing the whole spectrum of activity, from the ridiculous to the sublime.

Another objection to a theatrical approach is that theatre by its very nature is "fuzzy," while serious applications of computers require crystal clarity. The connotation of fuzziness probably derives from drama's emphasis on emotion—subjective experience—while serious productivity is seen to require undiluted objectivity. Yet such "serious" tasks as formatting a paper for publication or designing a business plan for a new product can involve a far greater degree of subjectivity (in terms of creativity and evaluation, for instance) than "objective" skill and action (cutting and pasting, typing, and mousing around). At the farthest extreme, the notion that serious applications require objectivity, clarity, and precision is used as a rationale for rejecting natural-language interaction because the success of machine understanding, at least in leading contemporary approaches, is probabilistic, whereas the understanding of symbolic logic (in mathematical or numerical representations) is seen to be unambiguous.

Yet people often drown in precision because of the complexity and artificiality of its expression (both lexical and syntactic). From the gamer grappling with a parser to the inexperienced Linux user trying to "alias" a complicated e-mail address, people experience the requirement for precision as troublesome. This is no secret; the problem is commonly acknowledged and wrestled with by most interface designers (see, for example, Rubinstein and Hersh 1984, Chapter 6). What may stop them from making a foray into the world of dramatic representation is the view that drama is fundamentally imprecise and therefore prone to error (both in terms of interpretation and subsequent action), while people require 100% success in all of their communications with computers. My experience suggests that, in the vast majority of contexts, this simply isn't true.

The imprecision of dramatic representation is the price people pay—often quite enthusiastically—in order to gain a kind of lifelikeness, including the possibility of surprise and delight. When "imprecision" works, it delivers a degree of success that is, in balance against the effort required to achieve it, an order of magnitude more rewarding than the precision of programming, at least for the non-programmer. When it doesn't work (as in the case of a parser error), how it is experienced depends heavily upon how the system handles the failure. "I DON'T UNDERSTAND THAT WORD" disrupts flow and frustrates people; an in-context response based on the most probable interpretation imitates a normal conversational failure and opens the way to methods of repair that are quite natural to use (see Brennan 1990b).

Seriousness in human-computer activities is a thresholdy thing. "Serious" and "non-serious" or "playful" activities can occur within the same context and at different stages in the same basic activity. I fool around with the layout of a document, for instance, experimenting with different fonts and paragraph styles, the placement of illustrations, perhaps even the structural divisions of the paper. At the point at which I make a creative decision and wish to implement a certain aspect of the design, I experience a "mode swing" (like a "mood swing," only different) toward greater "seriousness." I may then swing back to a "fooling around" mode as I evaluate the effects of a choice on the evolving document.

The advent of the regular-human-friendly search engines made a different sort of mode-shifting possible. Before the World Wide Web, companies like AOL created "walled gardens" with their own content and email communities, safely encapsulated from the horrors of Gopher or File Transfer Protocols (FTPs).[11] The first truly robust search engines for regular folk (e.g., Lycos and Altavista) placed the human front and center as the "agent" of the action. Ask Jeeves (1997) attempted to re-characterize a search engine with a computer-based butler on top, but it was soon obvious that Jeeves was simply a cartoon intended to create the *feeling* of being taken care of. Jeeves' untimely demise demonstrated that emotional comfort may be achieved in better ways. Reliability and robustness have become criteria for good search engines, although we have made little progress to date in creating search engines that can assess the truth value of their findings. But "search" does allow us to see that the experience of *flow* is not necessarily disturbed when such shifts occur. Further, the experience of *searching* and *finding* has its own dramatic arc.

A dramatic approach need not be fuzzy or imprecise in its ability to produce results. It is potentially capable of supporting both serious and non-serious activities. Its evocative powers and even its ambiguities can be harnessed to enhance rather than to impede people's serious goals, and to create the possibility of surprise and delight—things that are rarely produced by exhaustive responses to crystal-clear specifications.

For many people whose way of working can be characterized as objective or scientific, the idea of employing an artistic approach is troublesome. It's hard to say how artists do what they do. The process seems to consist largely of imagination and inspiration, and there seems to be no forthright,

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11. And relatively unable to feed the voracious appetite of consumerism for big data that is gathered and recycled as targeted advertising today.

dependable methodology. Yet, as we observed in the Foreword, and as we will expand upon in the next chapter, there are ways in which art is "lawful"; that is, there are formal, structural, and causal dimensions that can be identified and used both descriptively and productively. The final goal of this chapter is to justify taking an artistic approach to the problem of designing human-computer activity.

An Artistic Perspective

In his classic book *The Elements of Friendly Software Design* (1982), Paul Heckel characterized software design as primarily concerned with communication. He observed that "among all the art forms that can teach us about communication, the most appropriate is filmmaking" (p. 4). Heckel chose filmmaking as an example over older forms (such as theatre) because it "illustrates the transition from an engineering discipline to an art form." He went on to observe that movies did not achieve wide popular success until artists replaced engineers as the primary creators. Heckel's book is filled with references to illusion, performance, and other theatrical and filmic metaphors with software examples to illustrate each observation. He gives the use of metaphor in interface design a different twist by employing filmmaking, writing, acting, and other "communication crafts" as metaphors for the process of software design.

In 1967, Ted Nelson examined the evolution of film in order to understand how the new medium he envisioned—hypertext—should develop. In considering the ways in which the stage had influenced film, he noted that "stage content, when adapted, was appropriate and useful," while stage techniques (such as the notion of a proscenium and an insistence on continuous action within scenes) were not (Nelson 1967). From the vantage point of today, we can see a migration of both techniques and content from film into the computer medium. If one takes the theatre and the film medium as subsets of a larger category, as representations of action in virtual worlds, then another key similarity between these media and computers are their fundamental elements of form and structure and their purpose.

Both Heckel and Nelson draw our attention to the centrality of "make-believe" in the conception and design of software. An engineer's view of software design is rooted in logic, realizing an orderly set of functions in an internally elegant program. In Heckel's view, the better approach is rooted in vision, realizing an environment for action through evocative, consistent illusions. In Nelson's, it is the creation of "virtualities"—representations for things that may never have existed in the real world before (Nelson 1990). The role of imagination in creating interactive representations is clear and cannot be overrated. In an important sense, a piece of computer software is a collaborative exercise of the imaginations of the creator(s) of a program and the people who use it.

Imagination supports a constellation of distinctively human phenomena that includes both symbolic thinking and representation making. There is a story about a monkey and some bananas that every undergraduate psychology student has heard. A researcher places a monkey in a room with a bunch of bananas hanging from the ceiling and a box on the floor. The monkey tries various ways of getting the bananas—reaching, jumping, and so on—and eventually climbs up onto the box. A person in a similar situation would rehearse most of the possible strategies in her head and actively pursue only those which seemed promising, maybe only the successful one. For the monkey, the focus of attention is the real bananas; for the human, it's what's going on inside her head. Imagination is a shortcut through the process of trial and error.

But imagination is good for much more than real-world problem solving. The impulse to create interactive representations, as exemplified by human-computer activities, is only the most recent manifestation of the age-old desire to make what we imagine palpable—our insatiable need to exercise our intellect, judgment, and spirit in contexts, situations, and even personae that are different from those of our everyday lives. When a person considers how to climb a tree, imagination serves as a laboratory for virtual experiments in physics, biomechanics, and physiology. In matters of justice, art, or philosophy, imagination is the laboratory of the spirit.

What we do in our heads can be merely expedient or far-reaching, private or intended for sharing and communication. The novels of Louise Erdrich, for instance, or the plays of Bernard Shaw, create worlds where people address issues and problems, both concrete and abstract, and enact their discoveries, responses, and solutions. These representations are wholly contained in the realm of the imagination, yet they transport us to alternate possible perspectives and may influence us in ways that are more resonant and meaningful than experiences actually lived.

Art is the external representation of things that happen in the head of the artist. Art forms differ in terms of the materials they employ, the way the representations are created, what they purport to represent, and how they are manifested in the world. Different forms have different powers—to engage, to provide pleasure and information, to evoke response. But all have as their end the representation of some internal vista that the artist wishes to create beyond the bounds of his or her own skull, making it available in some form to other people.

What are such representations good for? Aristotle identified catharsis as the end cause of a play. He defined catharsis as the pleasurable release of emotion,[12] specifically those emotions evoked by the action represented in the play. In his view, catharsis occurred during the actual "run-time" of the play, but some contemporary theorists disagree. The early 20th-century German dramatist Bertolt Brecht extended the notion of catharsis beyond the temporal boundary of the performance (Brecht 1964). He posited that catharsis is not complete until the audience members take what they have assimilated from the representation and put it to work in their lives. In Brecht's hypothesis, the representation lives between imagination and reality, serving as a conductor, amplifier, clarifier, and motivator.

It seems to me that computer-based representations work in fundamentally the same way: one participates in a representation that is not the same as real life, but which has real-world effects or consequences. Representation and reality stand in a particular and necessary relation to one another. In much contemporary thinking about interfaces, however, the understanding of that relationship is muddy. On the one hand, we speak of "tools" for "users" to employ in the accomplishment of various tasks with computers. We plumb psychology for information about how people go about using tools and what is the best way to design them. We arrive at notions like "cut" and "paste" and even "write" that seem to suggest that people working with computers are operating in the arena of the concrete. We often fail to see that these are representations of tools and activities and to notice how that makes them different from (and often better than) the real thing.

On the other hand, we employ graphic designers to create icons and windows, pictures of little hands and file folders and lassos and stitched leather covers for "calendars" and "address books," to stand in for us in the computer's world. Here the idea of representation is used, but only in a superficial sense (and Sir Ive at Apple detests it). Messy notions like "interface metaphors" are employed to gloss over the differences between representation and reality, attempting to draw little cognitive lines from the things we see on the screen to the "real" activities that psychologists tell us

12. That's not to say that plays must arouse only pleasant emotions; the pleasure of release makes even nasty emotions enjoyable in a theatrical context. Catharsis is discussed more fully in Chapter 4.

we are performing. Interface metaphors rumble along like Rube Goldberg machines, patched and wired together every time they break, until they are so encrusted with the artifacts of repair that we can no longer interpret them or recognize their referents.

This confusion over the nature of human-computer activity can be alleviated by thinking about it in terms of theatre, where the special relationship between representation and reality is already comfortably established, not only in theoretical terms, but also in the way that people design and experience theatrical works. Both domains employ representations as contexts for thought. Both attempt to amplify and orchestrate experience. Both have the capacity to represent actions and situations that typically do not and cannot exist in the real world, in ways that invite us to extend our minds, feelings, and senses to envelop them.

In the view of semioticist Julian Hilton (1993), theatre is "essentially the art of showing, the art of the index. . . . it involves the synthesis of symbolic and iconic systems (words and moving pictures) in a single indivisible performed event." Hilton employs the myth of Pygmalion and Galathea (familiar to many as the basis of Bernard Shaw's play *Pygmalion*, or the musical version, *My Fair Lady*) to express the relationship of the theatre to the domain of artificial intelligence. He describes the value of the theatre's ability to represent things that have no real-world referents in semiotic terms:

> Galathea in a literal sense imitates nothing, and as such defines a class of icon (the statue after all is a picture of itself) that can simultaneously be an index. It is this category of non-imitative index which enables the index to liberate its true power, whereby it has all the infinite valency of the symbol while retaining the immediate recognisability of the icon. (Hilton 1993)

Computers are representation machines that can emulate any known medium, as Alan Kay (1984) observed:

> The protean nature of the computer is such that it can act like a machine or like a language to be shaped and exploited. It is a medium that can dynamically simulate the details of any other medium, including media that cannot exist physically. It is not a tool, although it can act like many tools. It is the first metamedium, and as such it has degrees of freedom for representation and expression never before encountered and as yet barely investigated.

Thinking about interfaces is thinking too small. Designing human-computer experience isn't about building a better desktop. It's about creating imaginary worlds that have a special relationship to reality: worlds in which we can extend, amplify, and enrich our own capacities to think, feel, and act. Hopefully, this chapter has persuaded you that knowledge from the theatrical domain can help us in that task. The next two chapters are designed to give you a deeper understanding of some of the most relevant aspects of dramatic theory and to apply them to interactive forms.

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2

Dramatic Foundations

Part 1: Elements of Qualitative Structure

THE PURPOSE OF THIS CHAPTER and the next is to provide a framework of dramatic theory that can be applied to the task of designing human-computer experiences. They are structured around the fundamental precepts of dramatic form and structure and are based primarily on Aristotelean poetics.[1] We will take up each basic idea and then adapt it to the human-computer context, arriving at what may be described as a *poetics of interactive form* (remember that we defined "human-computer interaction" as enabling and representing actions with human and technological participants). Once we have constructed a theoretical base, we will go on to explore its implications in some selected areas of design.

This approach necessitates that you endure some delay of gratification. You will be forced to wade through a welter of analogies, definitions, and hypotheses before a coherent picture can emerge. Hopefully, the case presented in the first chapter is sufficiently persuasive to lure you into taking the journey. By the end of the next chapter we will be able to pull the various elements together into a useful theory.

Hoary Poetics

People often find it quite peculiar that I turn to a theory that is over two thousand years old to gain insight into a very recent phenomenon. Even those who can be persuaded that artistic and literary theories may be

1. The term "poetics" is used to describe a body of theory that treats a poetic or aesthetic domain.

useful in the computer domain have difficulty with what they perceive as an extremely antiquated approach. Why Aristotle? How can it be useful to us today to employ concepts that were defined in the fourth century BCE? Aren't there more contemporary views that would be more appropriate to the task?

I want to answer the latter question first. Without a doubt there are more recent theorists who have made major contributions to the body of dramatic criticism; the next few chapters will touch on the work of many of them. But none has provided a theory of the drama that is as wide-ranging, complete, and well integrated as Aristotle's; they haven't needed to. For most, the *Poetics* has been a jumping-off place—a body of ideas to tweak and elaborate on. For some, it has been something to bounce off of; many theorists (such as Bertolt Brecht, mentioned in Chapter 1) have persuasively amended Aristotle's poetics on certain points. But none has presented a fully formulated alternative view of the nature of the drama that has achieved comparably wide acceptance.

A second reason for looking to the *Poetics* as opposed to more contemporary theories (such as post-structuralism) is that the Aristotelean paradigm is more appropriate to the technology to which we are trying to apply it. In order to build representations that have theatrical qualities in computer-based environments, a deep, robust, and logically coherent notion of structural elements and dynamics is required, and this is what Aristotle provides.

Aristotle (384–322 BCE) was a student and successor of the philosopher Plato. His many works included the *Ethics*, *Rhetoric*, *Physics*, and *Metaphysics*. Natural Philosophy, as it was called in his day, eventuated in what we now know as science. His work encompassed what we now call both philosophical and scientific thought, and he explored subjects from biology to logic, government to art. He was tutor to Alexander the Great, whose assumption of power in 336 BCE ushered in the Hellenistic Age.

Aristotle worked and wrote in the century after the great blossoming of Greek drama, exemplified by the works of Aeschylus (525–456 BCE), Sophocles (496–406 BCE), Euripides (484–406/7 BCE), and Aristophanes (448–380 BCE). During the brightening days of the fifth century BCE, theatre seemed to spring full-blown from the brows of these early dramatists.

Looking back on that remarkable century, Aristotle set himself the task of understanding where the various forms of poetry, including narrative, lyric, and dramatic, came from and how they work. Aristotle's work was a response to criticisms of poetry leveled by his teacher, Plato. Plato asserted

What Is Structure?

We can start with the *Oxford English Dictionary* definition of structure (2013):

> *noun*
>
> 1. *the arrangement of and relations between the parts or elements of something complex: the two sentences have equivalent structure*
> 2. *a building or other object constructed from several parts: The station is a magnificent structure and should not be demolished*

Aristotle meant definition number 1 when he wrote about structure; both *arrangement* of elements and their *relations* (dynamics) are contained in his usage. For dramatic interaction such as this book proposes, a theory of dramatic structure such as we find in Aristotle's *Poetics* guides both the external and internal representation; that is, notions of structural elements and dynamics will be reflected in the code as well as the experience.

I talk about structure a lot, even going so far as to define myself as an unrepentant structuralist. What I mean is that I believe that the structural system of a particular work is foundational to its wholeness, intelligibility, and beauty. We might descend here into a long digression, but that's an argument for another time.

I *have* worn black and smoked *Gauloises* from time to time, but not as a signifier.

that the poetic process is fundamentally incoherent and defies explanation; Aristotle described the process of poetic composition in logical terms. Plato complained that drama and poetry did not "inculcate virtue"; Aristotle countered by describing and defending the value of the things that poetry does accomplish:

> [Poetry] aims at pleasure, but at the rational pleasure which is a part of the good life; by its representation of serious action it does indeed excite emotions, but only to purge them and so to leave the spectator

> strengthened; since art represents universals and not particulars, it is nearer to the truth than actual events and objects are, not further from it, as Plato maintained (Kitto 1967).

Aristotle is often referred to as the progenitor of western science because of the methods of observation and inquiry that he employed, as well as his insatiable and far-ranging curiosity. A common objection to his dramatic theory is that it is too prescriptive; the *Poetics* is mistakenly viewed as a book of rules (this is due, in large part, to the neoclassical critics of the Renaissance, many of whom distorted Aristotle's work to support their belief that drama should provide explicit moral instruction). The truth is that Aristotle's goal was to observe, analyze, and report on the nature of the drama, not to generate rules for producing it. His theories may be used productively, not because they are recipes, but because they identify and elucidate drama's formal and structural characteristics.

The Cultural Backdrop

The occasion for the great Greek tragedies of the fifth and early fourth centuries BCE was the festival of Dionysus, the Greek god of nature, fertility, and celebration. Students of popular culture may recognize Dionysus (also known as Bacchus) as the giddy wine-stained god astride the donkey in the wine-making sequence of Disney's *Fantasia*. While revelry was certainly a major part of Dionysus' gestalt, he was a somewhat more imposing figure than the Disney representation suggests. The spirit he represented was at the wellspring of life; his was the energy on which survival utterly depends.

The Festival of Dionysus was an annual event that celebrated the symbolic death and rebirth of the god and, hence, nature. Several plays were commissioned for performance at each festival as contestants for a prize for the best drama (see Figure 2.1 for a diagram of the Theatre of Dionysus in Athens). The theatrical people who were involved in the production of the plays (including actors, musicians, and costumers) maintained a strong connection to the Dionysian religion, eventually forming a guild whose head was usually a Dionysian priest.

Early Greek drama sprang from the intersection of philosophy, religion, civics, and art. The occasion was ostensibly religious, and there is reason to believe that at least some of the actors felt themselves to be "in possession of the god" as they performed in the festival that honored him. The subjects chosen by the great tragic playwrights for theatrical representation at the

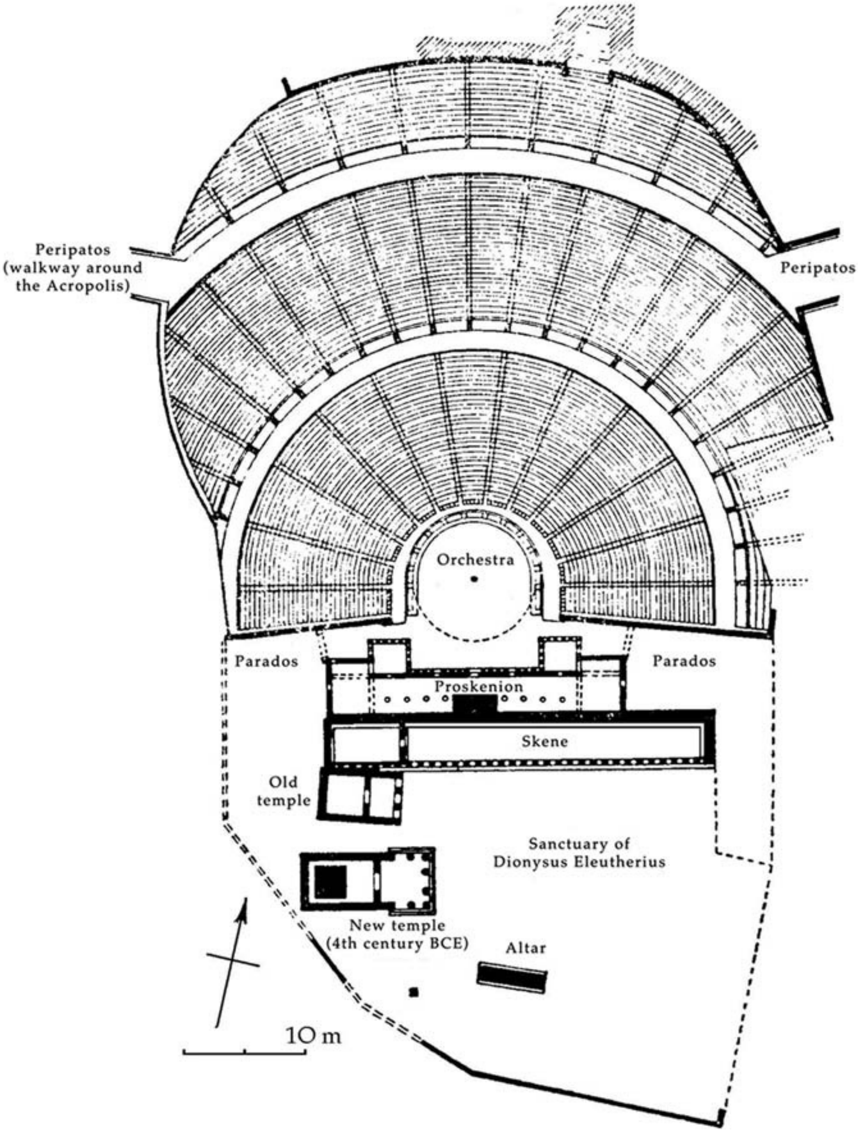

Figure 2.1. *The Theatre of Dionysus in Athens, where most of the great Greek tragedies were originally performed. The audience sat in a semicircular arrangement around and above the performance area, called the orchestra. The stage house or proskenion included elaborate facades and stage machinery (such as cranes that could lower "gods" from the "sky").*

festival were matters of serious import, depicting the evolution of Greek philosophy through their dramatic treatment of known myths and stories such as the tragedies of Agamemnon, Orestes, and Oedipus. They communicated philosophical and religious ideas and also provided the occasion for the collective experience of emotion.

It's important to recognize that most of the stories upon which the great tragedies were based were known to most of the audience; people were not going to the theatre to see how the plot turned out. The commissioned works were likely presented in response to the times, and their presentation formed a sort of public discourse. The Chorus in the Greek Theatre was like a mass character representing what might be cast as the citizens' responses through dance and song. The comedies of Aristophanes were clearly built around current events and issues. Greek drama was the way that Greek culture publicly thought and felt about the most important issues of humanity, including ethics, morality, government, and religion. To call drama merely "entertainment" in this context is to miss most of the picture.[2] The Greeks employed drama and theatre as *tools for thought and discourse in the Polis.*

Drama: Tragedy, Comedy, and Melodrama

Aristotle distinguished between tragedy and comedy in terms of the central emotions that they are intended to evoke. Tragedy has the power to arouse and purge *pity* and *fear*. These emotions are actually spelled out in Aristotle's *Rhetoric*. Fear is based on probability—uncertainty and suspense (*Rhetoric* 1382a, 20–29). Pity is our response to something destructive or painful happening to someone who does not deserve it (*Rhetoric* 1385b, 10–22.) In tragedy, the protagonist (main character) may have a tragic flaw—a characteristic that is often something admirable; for example, Hamlet's tortured concern over his father's death. It may also be a moral or intellectual flaw, or a mistake.[3] In tragedy, the purging of these emotions—*catharsis*—is the emotional release that comes with the ending of the play.

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2. It is interesting to note how our own popular culture reveals vestiges of these values, especially the civic, in some of our films and television shows (e.g., *Thin Red Line*, *All in the Family*, or *Angels in America*). Such productions can engage the whole culture in the consideration of matters of deepest import. Unfortunately, most of our media fare trivializes or ignores such concerns, thereby diminishing us by diminishing what we think about and how we think about it.

3. The Greeks used the word *hamartia* to refer to a mistake that is an error in judgment. Literally, the word means "to fall short." Interestingly, the same word was used in Greek versions of the Old Testament and was translated as "sin."

Comedy deals with "the ridiculous," which Aristotle defines as a "mistake or deformity not productive of pain or harm to others" (*Poetics* 1449a, 30–36). Its power is to deliver pleasure and laughter. Aristotle mentioned that both comedy and tragedy "work" because "it is natural for all to delight in works of imitation." He continued, "The explanation is to be found in a further fact: to be learning something is the greatest of pleasures not only to the philosopher but also to the rest of mankind, however small their capacity for it; the reason of delight . . . is that one is at the same time learning—gathering the meaning of things. . . ." (*Poetics* 1448b, 4–24)

Both tragedy and comedy, Aristotle asserted, had their origins in improvisation; comedy began with "phallic songs," says Aristotle (*Poetics* 1449a, 10–13). They probably began as village revels. People came in processions through the countryside and other towns brandishing phallic icons and hurling insults, a practice called *fleering* (e.g., "your mother was a hamster"). Eventually, over time, these comic performances earned a place in the Festival of Dionysus. They were the ancestors of the great Greek Comedies such as those written by Aristophanes.

The Comic form throughout its evolution was disrespectful, taunting, transgressive, and funny, meaning no serious harm. The great comedies of the Greeks, as well as those of the Elizabethan and Restoration periods, were wonderfully structured works of art that utilize the same causal patterns and structural characteristics as great tragedies but for different purposes, often with social and political referents. Aristophanes was a master at this. Among his many political plays, we're probably most familiar with *Lysistrata*. Performed in 411 BCE, the play protested the Peloponnesian War by depicting a political movement among women to deny sex to their husbands until they stop fighting. When we look now at transgressive and critical games, we see the descendants of Comedy in interactive form.

Melodrama as a form was not treated by Aristotle, but later scholars (including my mentor, Professor Donald R. Glancy) describe it as a form that is "seemingly serious" but which fails to rise to the level of moral and ethical choice that is characteristic of tragedy. Its power is to arouse and purge pity and terror. Terror is understood as an emotion that is intense but transient. Most often, characters in melodrama evoke sympathy (feeling *with*—that's awful for you and I'm glad it's not happening to me), but not empathy (feeling *into*—that *could be me*).

In summary, drama is not equivalent to tragedy. It exists in several forms—tragedy, comedy, melodrama, and various mash-ups.

SiSSYFiGHT! and the Spirit of Comedy

In 1998, the brilliant game designer Eric Zimmerman and his team created one of the most in-your-face, transgressive, satirical, and funny games I've ever seen. It was commissioned and launched by Word.com in 2000. Here's what Eric has to say about it:

> *In 1998, Word.com asked me to direct the creation of an online game for their site. The result was SiSSYFiGHT 2000, one of the earliest browser-based multiplayer games with real-time interaction. In SiSSYFiGHT 2000, each player takes the role of a bratty little girl vying for social dominance of the playground. Your goal is to reduce the self-esteem of the other girls, and one or two girls can end up the winners.*
>
> *The game uses a prisoners-dilemma structure in which players all decide on their actions simultaneously. Teasing only works, for example, if two or more players both tease the same target. At the same time, all of the in-game conversation and negotiation takes place via public chat. Since the success of your action depends on coordinating your actions with other players, winning a game of SiSSYFiGHT entails very savvy social maneuvering.*
>
> *SiSSYFiGHT was played by millions and quickly built a community of dedicated players, who took part in fan art and fiction, special game events, and real-world meetups. Diana Barbee selflessly and expertly managed this community for more than a decade, assisted by original SiSSYFiGHT developers Ranjit Bhatnagar and Naomi Clark. After Word.com closed, SiSSYFiGHT was managed by Gamelab for several years. In 2009, the game was taken offline by Gamelab, but SiSSYFiGHT lives on in the hearts and minds of its players (© Eric Zimmerman 2010).*

But surprise! In 2013, Eric Zimmerman, Ranjit Bhatnagar, and Naomi Clark—members of the original design team—have embarked on a campaign to relaunch the game in open-source format. *In the true spirit of Comedy*, they are ready to engage the discourse around sexism that the game so brilliantly put in front of us. You go, girls!

Screen image from the original SiSSYFiGHT 2000.

The Four Causes, or Why Things Are the Way They Are

In science as well as in art, the Greeks of the fifth and fourth centuries BCE were discovering and inventing a way to view a world of unprecedented scope and order through the rapidly evolving tools of philosophy. In exploring the nature of the drama and other arts, Aristotle employed the same conception of causality to which he attributed the forms of living things, and that is a good place to begin.

How does a representation of an action—a play or a human-computer activity—get to be the way it is? What defines its nature, its shape, its particulars? What forces are at work? Lest you be tempted to balk at this excursion into the theory, I want to remind you of the reason for taking it: Understanding how things work is necessary if one is to know how to make them. When a made thing is flawed or unsuccessful, it may not be due to poor craftsmanship. People have designed and built beautiful buildings that wouldn't stand up, people have written plays with mellifluous words and solid dramatic structure that closed after one night in New Jersey, and people have designed software with lovely screens and loads of "functionality" that leave people pounding on their keyboards in frustration. The reason for failure is often a lack of understanding about how the thing works, what its nature is, and what it will try to be and do—whether you want it to or not—because of its intrinsic form.

The Four Causes in Drama

The four causes are forces that operate concurrently and interactively during the process of creation. While Aristotle also applies them to living organisms, we will restrict our discussion to the realm of made things. We will begin with definitions of the four causes and then apply them, first to drama, and then to human-computer interaction.[4]

> **Formal cause:** The formal cause of a thing is the form or shape of what it's trying to be. So for instance with architecture, the formal cause of a building is the architect's notion of what its form will be when it's finished. Those formal properties of "building-ness" (or "church-ness," or "house-ness," etc.) that are independent of any particular instance of a building (or church or house) and that define what a building is,

4. I have employed the traditional terminology, not out of a desire to promote philosophical jargon, but because it is quite difficult to find synonyms that do these concepts justice, and also because more casual terminology can lead to confusion downstream.

serve as one component of the formal cause. They are filtered through the mind of the architect, where they are particularized by various design contingencies (there needs to be sunlight in the morning room, the conference room needs to accommodate a group of fifty, etc.), as well as his or her own values, tastes, and ideas.

Formal causality operates through an idea or vision of the completed whole, which will undergo change and elaboration as the process of creation unfolds; that is, there is a reciprocal relationship between the formal cause and the work in progress. The formal cause for a thing may be muddy or clear, constant or highly evolutionary, but it is always present.

Material cause: The material cause of a thing is what it's made of. So, to pursue the architecture example, the material cause of a building includes stones or concrete or wood, glass, nails, mortar, and so on. Note that the properties of the materials influence the properties of the structure; e.g., wood is more flexible than steel, but steel is stronger.

Efficient cause: The efficient cause of a thing is the way in which it is actually made. This includes both the maker(s) and the tools. For instance, two buildings with the same architectural plan and the same materials created by different builders with different skills and tools will differ in terms of their efficient cause.

End cause: The end cause of a thing is its purpose—what it is intended to *do* in the world once it's completed. In architecture, a building is intended to accommodate people, living or working or playing or performing operas or whatever, according to the kind of building it is.

Now let's apply these four causes to the theatre:

Formal cause: The completed plot; that is, the *whole action—with a beginning, middle, and end*—that the playwright is trying to represent. The "whole action" subsumes notions of form and genre and the patterns that define them.

Material cause: The stuff a play is made up of—the sounds and sights of the actors as they move about on the stage. Note that the material of a play is not words, as one might think from reading a script. That's because plays are intended to be acted out, and there's more to enactment than words. The *enactment* is the performance—that which unfolds before the eyes and ears of the audience.

Efficient cause: The skills, tools, and techniques of the playwright, actors, and other artists who contribute to the finished play.

End cause: The pleasurable arousal and expression of a particular set of emotions in the audience (*catharsis*).

As mentioned in Chapter 1, "pleasurable" is a key word in understanding catharsis; emotions aroused by plays are not experienced in the same way as emotions aroused by "real" events, and even the most negative emotions can be pleasurable in a dramatic context (the success of such film genres as suspense and horror depends on this fact). Various cultures, including the ancient Greeks, have included ideas like civic discourse to the end cause.[5] It is safe to say that since emotion depends upon the successful communication of content, then some level of communication is implicit in the end cause. We will explore this aspect further in the discussion of causality and universality in the next chapter.

The Four Causes in Human-Computer Interaction

How can we define these four causes for human-computer interaction? In this discussion it is difficult to avoid using computer-related terminology, which in many cases is already loaded with connotations that are not always appropriate. Among these terms are "functionality," "program," "application," "representation," and "agent."

In computerese, "functionality" refers to the things that a program does—a spreadsheet can make calculations of certain types, for instance, and a word processor can do such things as move text around, display different fonts, and check spelling. Interface designers often describe their task as representing a program's functionality. But this idea brings us to the tree falling in the forest again. A spreadsheet's ability to crunch numbers in certain ways is only *potential* until a person gives it some numbers to crunch and tells it how to crunch them, in fine or gross detail. Thus the definition of functionality needs to be reconceived as *what a person can do with a program*,

5. The theatre of Bertolt Brecht is a more modern example. Brecht held that the play was not finished until people acted upon it in their real lives.

rather than what a program has the capacity to do. This definition lands us back in the territory of interaction with human and computer-based agents. It also contains a word we haven't used yet: "program."

A program is a set of instructions that defines the potential actions that make up a human-computer activity and their representations. These actions and representations may change as the result of ongoing action (for instance, as the result of capturing or inferring people's preferences). A program also defines the environment for action and the other objects that inhabit that environment, including their representations and capabilities. Actually, the elements of action and environment and their representations are always the result of more than one program—in most computational devices, many aspects of the "interface" are embedded in the operating system and layers of intermediate software libraries. Of course, the potential of a program is also shaped by the language in which and the hardware for which it is written—what kind of computation it can perform, for instance, the qualities of its display, and its interface affordances.

In theatrical terms, a program (or a cluster of interacting programs) is analogous to a script, including its stage directions. A script is constrained by the physical realities of the kind of theatre in which it is to be performed and the capabilities of the stage machinery and actors. Program code is equivalent to the *words* of a script (including the theatre's own brand of jargon; e.g., "move stage left" or "counter-cross"). In his investigations of artificial intelligence, Professor Julian Hilton adds another dimension to this analogy:

> The text [of a play] therefore, is a combination of explicit and implicit notational systems which have as their initial purpose the enablement of an event in which performers and audience can share as partners. While obviously the notion of a computer was alien to Shakespeare, that of his theatre as a complex space-time machine was certainly not. . . . (Hilton 1991)

Functionality is equivalent to the script parsed, not by words but by *actions*. An apparent difference between programs and theatrical scripts is that programs are not intrinsically linear in form, while scripts generally are. At the highest level, this nonlinearity means that programs can cause different things to happen depending upon the actions of their interactors; that is, "authorship" is collaborative in real time (this aspect will be further explored in the discussion of plot, ahead). In summary, then, *functionality consists of the actions that are performed by people and computers working in concert, and programs and interface affordances are the means for creating the potential for those actions*.

An "application" is generally described as a distinct program designed to deliver a particular set of functionality to interactors, as opposed to programs that are not directly accessible to people, such as those which live deep in the bowels of missile silos and operating systems. Informal taxonomies of applications exist; e.g., applications for document creation and computer-assisted design (CAD) belong to the larger class of productivity applications; drawing, painting, and music programs are often classified as "creativity" applications; and adventure, action, and strategy games are "entertainment" applications. *The most important way in which applications, like plays, are individuated from one another is by the particular actions that they represent*. Applications are analogous to individual plays; the larger categories are analogous to genres and forms of plays (tragic, comic, didactic, etc.). Style is a more sophisticated concept that is used in both drama and computer applications, especially games.

We have used the word "representation" throughout the first chapter to distinguish the shadowy realms of art and human-computer activity from phenomenal reality. Webster's defines a representation as "an artistic likeness or image" (and also, incidentally, as "a dramatic production or performance"). The Greek word for artistic representation is *mimesis*. Both plays and human-computer activities are *mimetic* in nature; that is, they exhibit the characteristics of artistic representations. A *mimesis* is a made thing, not an accidental or arbitrary one: Using a pebble to represent a person is not mimetic; making a doll to represent him is. We often use the word "representation" followed by "of" and then the name of some object; e.g., a character is a representation of a person, or a landscape painting is a representation of a place. But in art as in human-computer interaction, the object of a mimesis (e.g., that which it is intended to represent) may be a real thing or a virtual one; that is, a thing that exists nowhere other than the imagination. A play may be a mimesis of events (literally, a series of actions) that are taken from history or that are entirely "made up." *Mimetic representations do not necessarily have real-world referents*.

In computerese, two kinds of representations are acknowledged: internal and external representations. For example, a page icon may serve as the external representation of a document. Both the document and the

What Is Style?

We know from satire that a play (or song or film) can represent the same actions repeatedly, but with a different style, leading to large differences in the meaning that people derive from the piece. One of my favorite plays at the Renaissance Faire, performed by an excellent company called Sound & Fury™, is "Testacles and Ye Sack of Rome." Parental Guidance is recommended. While not cleaving exactly to any particular text, the play takes the Odyssey as its spine, performed by be-wigged and silly fellows in such a way as to be hilarious and quite naughty. This is an extreme example that goes somewhat beyond the notion of style, but I mention it here to make the point that it is not simply the actions represented, but also how they are represented that distinguishes one play from another.

Sound & Fury in performance at the Northern California Renaissance Faire. Photo by Quinn Dombrowski (CC BY-SA).

"Style" is not an Aristotelean concept, but it can be defined in Aristotelean terms as the intersection between the "means" and the "manner" of a representation. The "means" include primarily music (pattern) and diction (language). In theatre, the actors and director strongly influence the "manner" of the representation. Manner includes things like gesture, posture, tone of voice, and cultural influences of the time. Style is also manifest in costume and scene design—elements of spectacle that are formulated with a certain point of view and within a particular cultural context.

Usually, the style of a production will be dictated by the cultural context of the time in which the play was written. We've all seen such horrors as *Hamlet on the Basketball Court* or some such stylistic hack that doesn't work because it's fundamentally goofy. In contrast, the 2000 film *Hamlet* directed by Michael Almereyda starring Ethan Hawke does a fairly persuasive job of resetting the action of the play in contemporary New York City. Likewise, Franco Zeferreli's 1968 film of *Romeo and Juliet*, set in contemporary Los Angeles, seems neither improbable nor out of place. In my experience, only the strongest, most organic dramatic action can stand up to being culturally uprooted.

To flip the bit for a moment, let's look at style in computer-land. Let's compare the minimalism of Sir Ive's designs for Apple with skeuomorphism as styles. Skeuomorphism delights in imitating materials or techniques different from those actually being used; for example, a computer-based address book application that features a graphical border representing stitched leather. Steam Punks love this sort of thing, but Sir Ive hates it and has banished it from his kingdom. Within computer games, differences in style can make significant differences in how the action is experienced and what sort of meaning is derived from it. For example, *Call of Duty* vs. *World of Warcraft*: Both represent versions of "hyper-masculinity," but style produces interesting differences in the experiences and constructions of players (Lau 2013).

icon have internal representations that consist of the code that defines them—how they look and behave. In keeping with the principle that "the representation is all there is," however, an internal representation has no value by itself, just as the working script for a performance is likely never seen by an audience. As a program, an internal representation is merely the potential for what may be manifest in the external representation—that which has sensory and functional properties. As it is used in this book, the term "representation" subsumes both aspects.

We have said that human-computer interactions can be defined as representations of actions with agents of both human and computer origin. The word "agents" has a particular meaning in computerese that is a derivation of the more general sense of the word. A computer-based "agent" is defined as a bundle of functionality that performs some task for a person, either in real time or asynchronously. "Bidding agents" on eBay are an example. Agents may be represented as "beings"—that is, as characters—but they need not be. The Aristotelean definition of an agent is the root of both of these permutations: *an agent is one who initiates and performs actions*. So in any human-computer activity, there is at least one agent—the human who turns on the machine—and if the machine does anything after it boots, then there are at least two. This book uses the more general definition because, as I will argue later in this chapter, computer-based agency is present in all human-computer activities, whether or not it is coalesced into coherent agent-like "entities" in the representation.

Given these definitions, we can now take a run at the four causes as applied to human-computer interaction:

Formal cause: The formal cause of a particular human-computer activity (that is, an extended set of interactions bound together) is the form of what it's trying to be. Human-computer interaction generally lacks the kind of well-known formal categories that drama offers (comedy, tragedy, etc.), although game genres like "first-person shooter" or tools like a "video editor" have formal characteristics.[6] What we can say, however, is that the *form* of human-computer activity is a representation of action with agents that may be either human, computer-based, or a combination of both. We will discover more of the characteristics of that form as we identify its structural elements and the relations among them.

Material cause: The material cause of a human-computer interaction, like a play, is the enactment—that which unfolds before a person's senses. As plays employ the sights and sounds produced by actors moving about in scenic environments, computers may employ animation, sound and music, text characters, or tactile and kinesthetic effects (e.g., force feedback). In the discussion of structural elements ahead, we will see how these sensory materials are shaped into more sophisticated constructs.

Efficient cause: The efficient cause of human-computer interaction is the skills and tools of its maker(s). Since a given application is probably based, at least in part, on chunks of program code that have been created by other people for other purposes, the computer equivalent of a playwright is usually a group of people. Both theatre and human-computer activity design are collaborative disciplines; both depend upon a variety of artistic and technical contributions. Some of those contributions may have already been produced, as in code libraries or scenery, whose makers may never be met by the production team, but who are nonetheless time-displaced collaborators. In both domains, the

6. Although application categories like "document creation" or "productivity" are sometimes invoked by designers as if they were formal criteria, I would argue that they are rather part of the end cause, since their definitions are essentially functional rather than formal. As most computer-using writers know, it is still impossible to derive the "canonical" form of a word processor from all of the instances that exist on the market; we can only speak about a word processor's expected or necessary functionality.

quality and nature of these contributions are strongly influenced by the available tools.[7] Perhaps the greatest difference between theatre and human-computer interaction is that the human interactor is also part of the efficient cause; that is, interactors are co-authors. We will return to this topic.

End cause: The end cause of human-computer interaction is what it is intended to *do* in the world. Thus the end cause obviously involves functionality; word processors had better spit out documents. But *experience* is an equally important aspect of the end cause; that is, what a person thinks and feels about the activity is part of its reason for being the way it is. In this sense, as Michael Mateas (2004) observes, the interactor co-shapes the end cause as well in terms of the kind of experience she wants. Or, to use Norman's famous doorknob, the end cause of the doorknob may be different for the person who opens it and the person who locks it. This aspect of the end cause, especially in "productivity" applications, seems trivial to many; it is too often handed off as an afterthought to harried interface designers who follow programmers around with virtual brooms and pails. At the very least, a person must understand the activity well enough to do something. At best, he or she is engaged, pleased, or even delighted by the experience. In this as in many other aspects of well-designed interaction, the world of computer games has been much more effective at producing pleasurable experiences. How much better it is to place the notion of pleasurable experience where it can achieve the best results—as part of the necessary nature of human-computer interaction.

The Six Elements and Causal Relations among Them

One of Aristotle's fundamental ideas about drama (as well as other forms of literature) is that a finished play is an *organic whole*. He used the term "organic" to evoke an analogy with living things, insofar as a whole organism is more than the sum of its parts, all of the parts are necessary for

7. Theatrical artists increasingly rely on computer-based tools for such tasks as lighting and scene design, lighting execution, moving scenery, designing costumes, storing and simulating dance notation and period movements, and, of course, writing scripts. Theatrical folk express the same frustrations with their tools as graphic designers and other artists who are working in the computer medium itself.

life, and the parts have certain necessary relationships to one another. He identified six qualitative elements of drama and suggested the relationships among them in terms of formal and material causality[8] (see Figure 2.2).

I present his model here for a couple of reasons. First, I am continually amazed by the elegance and robustness of the categories and their causal relations. Following the causal relations through as one creates or analyzes a drama seems to automagically reveal the ways in which things should work or exactly how they have gone awry. Aristotle's model creates a disciplined way of thinking about the design of a play in both constructing and debugging activities. Because of its fundamental similarities to drama, human-computer interaction can be described with a similar model, with equal utility in both design and analysis.

Figure 2.3 lists the elements of qualitative structure in hierarchical order. Here is the trick to understanding the hierarchy: Each element is the formal

ELEMENT	IN DRAMA	IN HUMAN-COMPUTER INTERACTION
Action (Plot)	The whole action being represented. The action is theoretically the same in every performance.	The whole action as it is collaboratively shaped by designer and interactor. The action may vary in each interactive session.
Character	Bundles of predispositions and traits, inferred from agent's patterns of choice.	The same as in drama, but including agents of both human and computer origin.
Thought	Inferred internal processes leading to choice: cognition, emotion, and reason.	The same as in drama, but including processes of both human and computer origin.
Language	The selection and arrangement of words; the use of language.	The selection and arrangement of signs, including verbal, visual, auditory, and other nonverbal phenomena when used semiotically.
Melody (Pattern)	Everything that is heard, but especially the melody of speech.	The pleasurable perception of pattern in sensory phenomena.
Spectacle (Enactment)	Everything that is seen.	The sensory aspects of the action being represented: visual, auditory, kinesthetic, tactile, and all others.

Figure 2.2. *Six qualitative elements of structure, in drama and in human-computer interactions.*

8. The explicit notion of the workings of formal and material causality in the hierarchy of structural elements is, although not apocryphal, certainly neo-Aristotelean (see Smiley 1971).

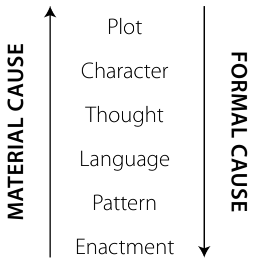

Figure 2.3. *Causal relations among elements of quantitative structure.*

cause of all those below it, and each element is the material cause of all those above it. As you move up the list of elements from the bottom, you can see how each level is a successive refinement—a *shaping*—of the materials offered by the previous level. The following sections expand upon the definitions of each of the elements in ascending order.

In his essay "A Preliminary Poetics for Interactive Drama and Games," Michael Mateas proposes two additional lines of causal relations from the player's perspective. On the side of material casuality Mateas adds "Material for Action," and on the formal side he adds "User Intention." In terms of "Material for Action," Mateas argues that affordances are necessary, but not sufficient. ". . . the interface must 'cry out' for the action to be taken. There should be a naturalness to the afforded action that makes it the obvious thing to do" (Mateas, 2004). This, I think, is an excellent heuristic for the deployment of material causation to constrain (or nudge) interactors into directions that are more likely to yield dramatically satisfying experiences. The idea that the player's intention serves as a force of formal causation also hits the mark. We will explore these ideas further in the section on Human-Computer Interaction as Mediated Collaboration in Chapter 4.

Enactment

Aristotle described the fundamental material element of drama as "spectacle"—all that is seen. In the *Poetics*, he also refers to this element as "performance," which provides some basis for expanding the definition to include other senses as well. Some scholars place the auditory sense in the second level because of its association with music and melody; but, as I will argue in the next section, it is more likely that the notion of melody pertains to the *patterning* of sound rather than to the auditory channel itself.

Morton Heilig: a Genius and a Member of the Crash Dummy Club

Morton Heilig is regarded as a pioneer in Virtual Reality. He invented the Sensorama Simulator (also called the Sensorama Machine) in 1957 as part of a larger plan to reinvent cinema, called Experience Theatre. The machine allowed interactors to view a stereoscopic video scene augmented with vibrating handlebars and a moving seat, wind effects, and scents. He created five experiences for the machine including a bicycle ride, a ride on a dune buggy, a helicopter ride over Century City, and a motorcycle ride through New York. The most amazing thing about Sensorama was that it was entirely mechanical; nowadays we think of VR as a computational system. I think it's also interesting that he called the genre "Experience Theatre"—a sort of blend between cinema, theatre, and arcade ride. Ultimately, Heilig couldn't get funded to build the rest of his dream. He died in 1996.

Sensorama

Heilig became a member of what I call the Crash Dummy club, to which I also belong. That's folks who had ideas to make things before they were economically feasible—things that were ahead of their time. Our work with VR at Telepresence Research (with Scott Fisher, Michael Naimark, Steve Saunders, Mark Bolas, Scott Foster, and Rachel Strickland) as well as the Placeholder VR project in Banff qualified us for the Crash Dummy club.

Being a Crash Dummy is an uncomfortable but fine, wild ride.

One probably temporary difference between drama and human-computer interaction is the senses that are addressed in the enactment.[9] Traditionally, plays are available only to the eyes and ears; we cannot touch,

9. Aristotle defined the enactment in terms of the audience rather than the actors. Although actors employ movement (kinesthetics) in their performance of the characters, that movement is perceived visually; the audience has no direct kinesthetic experience. Likewise, although things may move about on a computer screen, a human user may or may not be having a kinesthetic experience. In biology, the relatively recent discovery of mirror neurons in the brains of humans and some higher primates challenge this view. Science has shown that, when observing another individual doing something, "mirror neurons" in the observer's brain respond as if the observer were taking the same action. This may go a long way toward defining at least some of the physical basis for empathy (see Keysers 2011).

smell, or taste them. There are interesting exceptions. In the 1920s, for instance, director David Belasco experimented with using odors as part of the performance of realistic plays; it is said that he abandoned this approach when he observed that the smell of bacon frying utterly distracted the audience from the action on stage. In the mid-1960s, Morton Heilig invented a stand-alone arcade machine called Sensorama, which provided stereoscopic filmic images, kinesthetic feedback, and environmental smells; on a motorcycle ride through New York City, for instance, one could smell car exhaust and pizza.

In a much more serious vein, Jerzy Grotowski's Laboratory Theatre experimented with involving the audience in the production in a variety of ways in the 1960s and 1970s. The point was not so much to expand the sensory palette of the audience, but to create "unself-conscious" participation by the audience in the form of deep emotional engagement. In his masterful book, *Towards a Poor Theatre* (1968), Grotowski acknowledges that he has two ensembles to direct: the actors and the spectators. In the Laboratory Theatre's ground-breaking performance of *Doctor Faustus*, Grotowski had the audience seated at long banquet tables. The audience was "asked to merely to respond as people might at such a function."

A spate of interactive plays and "mystery weekends" in the late 1980s employed the scheme of having the audience follow the actors around a space, although only as observers and not participants in the action. In one "interactive" play of the period, *Tony and Tina's Wedding*, the audience was invited to follow the actors around from room to room (kinesthetic), to touch the props and sit on the furniture (tactile and kinesthetic), and to share in a wedding banquet (taste and smell). Another notable example is Chris Hardman's Antenna Theatre, an approach where audience members move around a set prompted by taped dialogue and narration that they hear through personal headphones. These works have roots in experimental theatre work in the 1960s and 1970s by such artists as Judith Melina and Julian Beck of the Living Theatre, Robert Wilson, John Cage, and many others. Contemporary performance art shares many of the same origins. It is interesting that the development of interactive theatrical genres has been concurrent with the blossoming of computer games as a popular form of entertainment.

In fact, it is at the areas in which dramatic entertainment and human-computer activity are beginning to converge that pan-sensory representation is being most actively explored. When we examine that convergence, we can see ways in which human-computer interaction has evolved, at

Robin Hood

In 1975, Bill Morton, a fellow theatre MFA student, and I wrote an interactive play based upon the tales of Robin Hood. I directed the play and staged it on the Ohio State campus around Mirror Lake. The play began as the audience gathered beneath one of the conveniently crenellated turrets of the Faculty Club. The Jester (played by Bill, a sort of Everyman character) announced the play. The Minstrel Alan-a-Dale began to strum her guitar and sing one of the many songs composed for the play as other cast members welcomed the audience (mostly children) to "Sherwood Forest."

Upon arriving, a little fellow about five years old looked up and touched a leaf on a low-hanging oak tree. "What's this?" I replied, "That's an oak leaf in Sherwood Forest." He reverently repeated my words and studied the leaf quite closely. I bet that was the first time he *really looked* at an oak leaf.

Following the Minstrel, the audience came upon scenes in progress at various venues. The first was on a small bridge where Robin and Friar Tuck were engaged in their notorious fight with staffs. Egged on by the other characters, the audience soon learned that they, too, could make comments or cheer, and that the actors paid attention to them, sometimes responding directly.

One day, we had a group of blind children in our audience. During a scene where the Sheriff's men were sneaking up on Robin, these children's acute sense of sound prompted them to interact with Robin more directly than most other kids. "Someone's right behind you!" "I hear somebody sneaking around over there!" Robin responded to their warnings and, making the choice to throw the choreography

Alan-a-Dale leads the children into the world of Robin Hood.

of the ambush out the window, turned and faced his attackers and staged a new broadsword battle on the fly.

At the end, Robin died, as some of the old stories told, near a convent where he had been hiding. As he lay in the grass, the "Deer" (dancers in fanciful deer costumes) gave him comfort and love. On that downer note, the children were led back around the lake toward the turret where they began. As they passed a giant rock, Robin arose on top of it, dressed in a stone-colored tunic spotted with live mosses.

> ***ROBIN:*** *I am like the turning of the seasons. The Robin that you know is an image of leaves and sunlight and summers long ago. . . . And still I live, as do we all, because each time that I have spoken, each time my hands have shaped the air, there have been echoes—echoes that will ring for as long as the sun makes mornings. We change the world by living, for better or for worse . . . and now I think it better that we dance. [MUSIC. The Company involves the audience in a dance.]*

Each step in the process was a learning experience in interaction design, from the writing of the script to the staging design and final performances. I learned about the places where the boundary between audience participation and the necessary action were elastic and where they couldn't be, and how to keep the plot on track with interactive "coauthors." The following year, I began my career in computer games, designing interactive fairy tales for the CyberVision computer; but that's another story.

least in part, as drama's attempt to increase its sensory bandwidth, creating the technological siblings of the kind of participatory theatre described in the previous sidebar.

The notion of "interactive movies" that gained popularity in the late 1980s had its roots in both cinema and computer games, and both cinema and computer games combine theatre and technology.[10] In drama, the use of technology to create representations goes at least as far back as the *mechane*

10. Earlier works, such as productions of Lanterna Magica and the branching movie at the Czech pavilion at the 1967 expo in Canada, were relatively isolated. The idea of interactive movies has been rekindled and transformed into a bona fide trend by advances in multimedia technology. Likewise, there were early experiments in interactive television in the mid-1970s (such as the failed Warner QUBE system). Interactive TV had to await similar technological advances before finally becoming a 1990s buzzword.

of the ancient Greeks. Cinema as a distinct form diverged from drama as the result of the impact of a new performance technology on form, structure, and style. In complementary fashion, computer games can be seen to have evolved from the impact of dramatic ideas on the technology of interactive computing, interactive affordances and graphical displays. Computer games incorporate notions of character and action, suspense and empathy, and other aspects of dramatic representation. Almost from the beginning, they have involved the visual, auditory, and kinesthetic senses (one need only watch a game player with a joystick to see the extent to which movement is involved, both as a cause and effect of the representation).

At the blending point of cinema and computer games in the 1980s and 1990s were such forms as arcade games like *Battle Tech* and *Poll Position*, as well as sensory-rich amusement park installations like *Star Tours* that used motion platform technology. Such systems involved tactile and kinesthetic senses; some even investigate the inclusion of the other senses as well through both performance technology and direct stimulation to the nervous system.

"Virtual reality" systems, as discussed in Chapter 6, increase intensity through techniques described as *sensory immersion.* Visual immersion is typically delivered through a wide-angle stereoscopic display; behind the scenes, the computer is generating the scene appropriately with tracking data from the immersant's movements and gaze. That same tracking data is used in delivering spatialized audio. Through the use of special input devices like specially instrumented gloves and suits, people can move about and interact directly with objects in a virtual world. Interestingly, the first virtual reality systems and applications were developed for non-entertainment purposes like computer-aided design, scientific visualization, and training.

The great days of arcade games tailed off when home game system technology began to include good 3D graphics and specialized controllers, such as the Nintendo Wii, released in 2006. The Kinect, a motion-sensing input device for the Xbox 360 console that also responds to spoken commands, was released in 2010. Such devices enhance kinesthesia and proprioception. They also demonstrate the functional use of gesture and speech, enhancing interaction at the level of language.

The level of enactment is composed of all of the sensory phenomena that are part of the representation. Because of the evolutionary processes described previously, it seems appropriate to say that enactment can involve all of the senses. Sensory phenomena are the basic material of both drama and human-computer interaction; they are the clay that is progressively shaped by the creator, whether playwright or designer, in collaboration with the audience or interactor.

Pattern

The perception of patterns in sensory phenomena is a source of pleasure for humans. Aristotle described the second element of drama as "melody," a kind of pattern in the realm of sound.[11] In the *Poetics* he says, "melody is the greatest of the pleasurable accessories of tragedy" (*Poetics* 1450b, 15–17). The orthodox view is that "spectacle" is the visual dimension and "melody" is the auditory one, but this view is problematic in the context of formal and material causality. If the material cause of all sounds ("music") were things that could be perceived by the eye ("spectacle"), then things like the vibration of vocal cords and the melodies of off-stage musicians would be excluded. Contrariwise, all that is seen in a play is not shaped solely by the criterion of producing sounds or music (although this may have been more strictly true in the performance style of the ancient Greeks than it is today). The formal-material relationship doesn't work within the context of these narrow definitions of music and spectacle.

In the previous section, we have already expanded "spectacle" into all sensory elements of the enactment. The notion of "*melody*" as the arrangement of sounds into a pleasing pattern can be extended analogically to the arrangement of visual images, tactile or kinesthetic sensations, and probably smells and tastes as well (as a good chef can demonstrate). In fact, the idea that a pleasurable pattern can be achieved through the arrangement of visual or other sensory materials can be derived from other aspects of the *Poetics*, so its absence here is something of a mystery. Looking 'up' the hierarchy, it could be that Aristotle did not see the visual as a potentially semiotic or linguistic medium, and hence narrowed the causal channel to lead exclusively to spoken language. Whatever the explanation, the orthodox view of Aristotle's definitions of spectacle and melody leave out too much material. As scholars are wont to do, I will blame the vagaries of translation, figurative language, and mutations introduced by centuries of interpretation for this apparent lapse and proceed to advocate my own view.

The element of *pattern* refers to patterns in the sensory phenomena of the enactment. These patterns exert a formal influence on the enactment,

11. This element is often translated as "music," "melody," or "rhythm."

just as semiotic usage formally influences patterns. A key point that Aristotle made is that patterns are pleasurable to perceive in and of themselves, whether or not they are further formulated into semiotic devices or language; he spoke of them, not only as the material for language, but also as "pleasurable accessories." Hence the use of pattern as a source of pleasure is a characteristic of dramatic representations, and one that can comfortably be extended to the realm of human-computer interaction.

Language

The element of *language* (usually translated as diction) in drama is defined by Aristotle as "the expression of their [the characters'] thought in words" (*Poetics* 1450b, 12–15). Hence the use of spoken language as a system of signs is distinguished from other theatrical signs like the use of gesture, color, scenic elements, or paralinguistic elements (patterns of inflection and other vocal qualities). In the orthodox view, "diction" refers only to words—their choice and arrangement. That definition presents some interesting problems in theatrical forms such as mime as well as in the world of human-computer interaction, many of which involve no words at all (e.g., most skill and action computer games, as well as graphical adventure games and graphical simulations). Are there elements in such non-verbal works that can be defined as *language*?

When a play is performed for a deaf audience and signing is used, few would disagree that those visual signs function as language. The element of language in this case is expressed in a way that takes into account the sensory modalities available to the audience.[12] A designer may choose, for whatever reason, to build a human-computer system that neither senses nor responds to words, and which uses no words in the representation. Hardware configurations without keyboards, speech recognition, or text display capabilities may be unable to work with words.

In human-computer interaction, graphical signs and symbols, nonverbal sounds, or animation sequences may be used in the place of words as the means for explicit communication between computers and people. Such nonverbal signs may be said to function as language when they are the

12. It is interesting that American Sign Language (ASL) is in fact a "natural language" in its own right, and not a direct gestural map of English or any other spoken language. If a language can be constructed from gesture, then it follows that spoken words are not essential elements of language. My non-deaf grandson started signing at about seven months—babies can sign before they can use words effectively.

Difficulties with *Winnie the Pooh*

Many years ago, I played the role of Kanga in *Winnie the Pooh* in summer stock. The play was offered as a matinée for kids. The company was good, and the play was usually a great success with young audiences.

One Saturday afternoon, however, things were not going well at all. The usual laughs were not coming, and there was a fair amount of random noise from the audience. An actor's spirits fall when this happens, but you gather your good intentions and carry on. One counter-intuitive lesson that actors learn is that when an audience seems to be losing interest our natural impulse is to speed up, but it turns out that this is exactly the wrong thing to do. If we slow down, we make the dialogue more intelligible, and we leave more space for gesture and affect. We slowed things down as the first act drew to a close, and began to feel a bit more response from the audience, but it was still way below par.

At the end of the act, we went down to the Green Room fairly dispirited, and tried to figure out how we were going off the rails. At that point the Assistant Director said, "Didn't you guys know that this audience is deaf children?" Hell no, nobody told us, and nobody had hired a signer. It explained a lot.

When we went back onstage, we continued with slowness of delivery, but really began punching up the physical side of our performance. Exaggeration of gesture and facial expressions turned the situation around. We sensed happier energy coming back at us. At one point, after a truly silly bit of business, I looked out at the audience and saw little hands in the air, flickering back and forth. It was only later that I learned that this gesture was the equivalent of applause in sign.

principal medium for the expression of thought. Accordingly, the selection and arrangement of those signs may be evaluated in terms of the same criteria as Aristotle specified for diction, e.g., effective expression of thought and appropriateness to character.

Thought

The element of *thought* in drama may be defined as the processes leading to characters' choices and actions—e.g., emotion, cognition, reason, and intention. Understood in this way, the element of thought "resides" within characters, although it can be described and analyzed in aggregate form (the element of *thought* in a given play may be described as concerned with certain specific ethical questions, for example). Although it may be explicitly expressed in the form of dialogue, thought is *inferred*, by both the audience and the other characters (agents), from a character's choices and actions. In his application of a theatrical analogy to the domain of artificial intelligence, Julian Hilton (1991) puts it this way: "What the audience does is supply the inferencing engine which drives the plot, obeying Shakespeare's injunction to eke out the imperfections of the play (its incompleteness) with its mind."

If we extend it to include human-computer interaction, this definition of thought leads to a familiar conundrum: Can computers think? There is an easy way out of it; computer-based agents, like dramatic characters, don't have to *think*, they simply have to *provide a representation from which thought may be inferred*.

When a folder on my Macintosh opens to divulge its contents in response to my double-click, the representation succeeds in getting me to infer that that's exactly what happened; i.e., the "system" understood my input, inferred *my* purpose, and did what I wanted. Was the "system" (or the folder) "thinking" about things this way? The answer, I think, is that it doesn't matter. The real issue is that the representation succeeded in getting me to make the right inferences about its "thoughts." It also succeeded in representing to me that it made the right inferences about mine.

Thought is the formal cause of language; it shapes what an agent communicates through the selection and arrangement of signs, and thus also has a formal influence on pattern and enactment. Language is the material of thought in two senses. First is the perhaps overly limiting assumption that agents employ language, or the language-like manipulation of symbols, in the process of thinking. This assumption leads to the idea that characters in a play use the language of the play quite literally as the material for their thoughts.

I favor a somewhat broader interpretation of material causality; *the thought of a play can appropriately deal only with what can reasonably be inferred from enactment, pattern, and language*. Most of us have seen plays in which characters get ideas "out of the blue"—suddenly remembering the location of a long-lost will, for instance, or using a fact to solve a mystery that has been withheld from the audience thus far. Such thoughts are unsatisfying (and mar the play) because they are not drawn from the proper material. In ancient Greek theatre, the *Deus ex Machina* (Latin for "god in the machine") serves as an excellent example. A god shows up, typically lifted by a crane, to provide the solution to a seemingly unsolvable problem.

Projective Construction

The notion of inference has a logical aspect, but that's not the whole picture. When I see red rocks in a canyon, I may *infer* things about their qualities—the type of rock, patterns of erosion and breakage that suggest exposure to flows of water or fracturing, etc. But when I look at red rocks in a canyon, sometimes I see faces or animals or objects. Anyone who has looked for petroglyphs knows the tricks that rocks can play on you. Something about the geometry or texture of the rock or its pattern of light and shade triggers the brain to construct a familiar shape. If you've looked at clouds or patterns in plastering, for example, likely the same thing has happened to you.

Petroglyph in Maui

My friend and colleague Rachel Strickland first gave me a name for this phenomenon during the Banff expedition to create *Placeholder*. She called it "projective construction." A stimulus with sufficient ambiguity can evoke in the mind of the perceiver the construction of something other than what is "actually" there. It may also be colored by what we *want* to perceive (e.g., hunting petroglyphs) or something that is on our minds (e.g., seeing an ice cream cone in the clouds when we are hungry).

Projective construction isn't limited to the realm of the visual. Most of us have had the experience of someone taking something we said "the wrong way." We're at a loss to explain how it could have happened. What we may not know is what was on that other person's mind or in their desires.

The *Placeholder* project provided a great example of projective construction in discourse. The narrative of the piece used the lore of magical animals or animal spirits, and some of its images were intended to represent rock art. A few of the more politically correct members of the community busted us for this, accusing us of appropriating First Nations stories and images. The critique was a projective construction. When I explained that most of the images had been inspired by the cave art of Western Europe, for example, a woman spluttered, "Well, that's even *worse* because you're relying on my ignorance!" I still don't know what she meant by that.

(continues)

> The lesson for us is that, while we may do everything possible to assure that thought is properly inferred from representations, we can never prevent projective construction. Interactive designs may actually wish to evoke projective construction in certain cases so that interactors can experience deeper, more personalized connections. By planning where and when we wish such constructions to occur, we may diminish the likelihood of their derailing the whole experience. Designing moments that invite projective construction may allow interactors to feel a difference between such moments and others when correct inference is of greater significance to the whole action.

Plays, like human-computer interactions, are closed universes in the sense that they delimit the set of potential actions. As we will see in the discussion of action ahead, it is key to the success of a dramatic representation that all of the materials that are formulated into action are drawn from the circumscribed potential of the particular dramatic world. Whenever this principle is violated, the organic unity of the work is diminished, and the scheme of probability that holds the work together is disrupted.

This principle can be demonstrated to apply to the realm of human-computer interaction as well. One example is the case in which the computer (a computer-based agent) introduces new materials at the level of thought—"out of the blue." Suppose a text messaging system is programmed to be constantly checking for spelling errors and to automatically correct them as soon as they are identified. Yes, you know this one—you want to type "hell" and the program changes it to "he'll," unless you know that you can disregard the program's respectful correction by taking the additional action of deleting its suggestion before the word is completed. If the potential for this behavior is not represented adequately, it is disruptive when it occurs, and it will probably cause the person to make seriously erroneous inferences—e.g., "something is wrong with my fingers, my keyboard, or my software." The program "knows" why it what it did ("thought" exists) but the person doesn't; correct inferences cannot be made.[13]

13. In human factors discourse, this type of failure is attributed to a failure to establish the correct conceptual model of a given system (see Rubinstein and Hersh 1984, Chapter 5). The dramatic perspective differs slightly from this view by suggesting that proper treatment of the element of thought can provide a good "conceptual model" for the entire medium. It also avoids the potential misuse of conceptual models as personal constructs that "explain" what is "behind" the representation; i.e., how the computer or program actually "works."

Other kinds of failures in human-computer interaction can also be seen as failures on the level of thought. One of my favorite examples comes from early text adventure games. Quite often, the parser did not "know" all of the words that were used in the text representation of the story. So a person might read the sentence, "Hargax slashed the dragon with his broadsword." The person might then type "take the broadsword," and the "game" might respond, "I DON'T KNOW THE WORD 'BROADSWORD'." The inference that one would make is that the game "agent" is severely brain-damaged, since the agent that produces language and the agent that comprehends it are assumed to be one and the same. This is the inverse of the problem described in the last paragraph; rather than "knowing" more than it represented, the agent represented more than it "knew." Both kinds of errors are attributable to a glitch in the formal-material relationship between language and thought.

Character and Agency

Aristotle maintains that the *object* of (i.e., what is being imitated by) a drama is action, not persons: "We maintain that Tragedy is primarily an imitation of action, and that it is mainly for the sake of the action that it imitates the personal agents" (*Poetics* 1450b, 1–5). In drama, *character* may be defined as bundles of traits, predispositions, and choices that, taken together, form coherent agents. Characters are the agents of the actions that, taken together, form the *plot*. This definition emphasizes the primacy of action.

In order to apply the same definition to human-computer interaction, we must first demonstrate that agents are in fact part of such representations, and second, that there are functional and structural similarities between such agents and dramatic characters.

In a purely Aristotelean sense, an agent is one who takes action. Interestingly, Aristotle admits of the possibility of a play without characters, but a play without action cannot exist (*Poetics* 1450a, 22–25). This suggests that agency as part of a representation need not be strictly embodied in "characters" as we normally think of them; i.e., representations of humans. Using the broadest definition, all computer programs that perform actions that are perceived by people can be said to exhibit agency in some form. The real argument is whether that agency is a "free-floating" aspect of what is going on, or whether it is captured in "characters"—coalesced notions of the sources of agency.

The answer, I believe, is that even when representations do not explicitly include such "characters," their existence is implied. At the grossest level, people simply attribute agency to the computer itself. "I did this, and then the computer did that." They also attribute agency to application programs, e.g., "My word processor trashed my file." They often distinguish between the agency of system software and applications ("My new operating system crashed my app"). They attribute agency to smaller program elements and/or their representations, e.g., "The spelling checker in my word processor found an error."

In social and legal terms, an agent is one who is empowered to act on behalf of another. In the mimetic world of human-computer interaction, this definition implies that, beyond simply performing actions, computer-based agents perform a special kind of actions; namely, actions undertaken "on behalf of" people. It also therefore implies that some sort of implicit or explicit communication must occur between person and system in order for the person's needs and goals to be inferred. I think that this definition is both too narrow and too altruistic. There may be contexts in which it is useful to create a computer-based agent whose "goals" are orthogonal or even inimical to those of human agents; for instance, in simulations of combat or other situations that involve conflicting forces. Agents may also work in an utterly self-directed manner, offering the results of their work up to people after the fact. For now, we will use the broader definition of agents to apply to human-computer interaction: *"Characters" can initiate and perform actions* based upon input from the program or the interactor. Like dramatic characters, they consist of *bundles of traits or predispositions to act in certain ways*.

Traits circumscribe the actions (or kinds of actions) that an agent has the capability to perform, thereby defining the agent's potential. There are two kinds of traits: *Internal traits* determine how an agent can act, and *external traits* that represent those internal predispositions. People take cues from the external representation of an agent to infer its internal traits. Why? Because traits function as a kind of *cognitive shorthand* that allows people to predict and comprehend agents' actions. Inferred internal traits are a component of both dramatic probability (an element of plot, as described in the next chapter) and "ease of use" (especially in terms of the minimization of human errors) in human-computer systems. Part of the art of creating both dramatic characters and computer-based agents is the art of selecting and representing external traits that accurately reflect the agent's potential for action.

Aristotle outlined four criteria for dramatic characters that can also be applied to computer-based agents (*Poetics* 1454a, 15–40). The first criterion is that characters be "good" (sometimes translated as "virtuous"). Using the Aristotelean definition of "virtue," a good character is one that successfully fulfills its function; that is, one that successfully formulates thought into action. A "good" character *does* (action) what it *intends* to do (thought). It also does what its creator intends it to do in the context of the whole action. Second is the criterion that characters be "appropriate" to the actions they perform; that is, that there is a good match between a character's traits and its actions. Characters may surprise us with their actions, but we should be able to see in retrospect that the potential for those actions was present. Third is the idea that a character be "like" reality in the sense that there are causal connections between its thoughts, traits, and actions. This criterion is closely related to dramatic probability. Finally, characters should be "consistent" throughout the whole action; that is, that a character's traits should not change arbitrarily. The mapping of these criteria to computer-based agents is quite straightforward—be they "applications," agents in the sense of personified "helpers," or characters in a computer game.

Finally, we need to summarize the formal and material relationships between character and the elements above and below it in the hierarchy. Formal causality suggests that it is action, and action alone, which *shapes* character; that is, a character's traits are dictated by the exigencies of the plot. Including traits in the representation that are not manifest in action violates this principle. Material causality suggests that the stuff of which a character is made must be present on the level of thought and, by implication, language and enactment as well.

An old but good example is the interface agent Phil, who appears in an Apple promotional video entitled "The Knowledge Navigator" (© 1988 by Apple Computer, Inc.). In the original version, Phil was portrayed by an actor in a video format. He appeared to be human, alive, and responsive at all times. But because he behaved and spoke quite simply and performed relatively simple tasks, many viewers of the video complained that he was a stupid character. His physical traits (high-resolution, real-time human portrayal) did not match his language capabilities, his thoughts, or his actions (simple tasks performed in a rather unimaginative manner). In a later version, Phil's representation was changed to a simple line-drawn cartoon character with very limited animation. People seemed to find the new version of Phil much more likable. The simpler character was more consistent and more appropriate to the action. Microsoft's paper clip, by comparison, looked too stupid to do anything meaningful.

Plot: The Whole Action

Representations are normally thought of as having objects, even though those objects need not be things that can or do exist in the real world. Likewise, plays are often said to represent their characters; that is, *Hamlet* is a representation of the Prince of Denmark, and so on. In the Aristotelean view, the object of a dramatic representation is not *character*, but *action*; *Hamlet* represents the action of a man attempting to discover and punish his father's murderer. The characters are there because they are required in order to represent the action, and not the other way around. An action is made up of incidents that are causally and structurally related to one another. The individual incidents that make up the play of *Hamlet*—Hamlet fights with Laertes, for instance—are only meaningful insofar as they are woven into the action of the mimetic whole. The form of a play is manifest in the pattern created by the arrangement of incidents within the whole action.

Another definitional property of plot is that the whole action must have a beginning, middle, and end. The value of beginnings and endings is most clearly demonstrated by the lack of them. The feeling produced by walking into the middle of a play or movie or being forced to leave the theatre before the end is generally unpleasant. Viewers are rarely happy when, at the end of a particularly suspenseful television program, "to be continued" appears on the screen. My favorite computer example is an error message that I sometimes encounter: "[your application] has unexpectedly quit." "Well," I typically reply, "the capricious little bastard!" Creating graceful beginnings and endings for human-computer activities is most often a nontrivial problem—how to introduce the premise for a game, for example, or how to end a session of video editing. Two rules of thumb for good beginnings is that the potential for action in that particular universe is effectively laid out, and that the first incidents in the action set up promising lines of probability for future actions. A good ending provides not only completion of the action being represented, but also the kind of emotional closure that is implied by the notion of *catharsis*, as discussed in the next chapter.

A final criterion that Aristotle applied to plot is the notion of magnitude:

> . . . to be beautiful, a living creature, and every whole made up of parts, but also be of a certain definite magnitude. Beauty is a matter of size and order. . . . Just in the same way, then, as a beautiful whole made up of parts, or a beautiful living creature, must be of some size, but a size to be taken in by the eye, so a story or Plot must be of some length, but of a length to be taken in by the memory (*Poetics* 1450b, 34–40).

J. J., It's Not Just About Blowing Up Vulcan

As the elders among you know, J. J. Abrams was the co-creator and director of *Lost*, a television series that ran from 2004 to 2010. Many viewers compared the show to crack in its addictive qualities and the special sort of ambiguity it engendered—*God, I'd love to get off the stuff, but it feels so* good. Although the show had fantastic viewership and many awards to its credit, it was actually crack.

Long ago I worked in summer stock for several years with one of the cast members of *Lost*, Sam Anderson (who played Bernard Nadler). I therefore demanded that Rob watch the entire series with me, mostly to get a glimpse of Sam on the tube. Despite the material he was given, Sam is an amazing actor.

At the beginning of Season 3, we knew it was crack, but I forced Rob to persevere. Each episode was a cliffhanger. The labyrinthine plot meandered in tighter and tighter coils around a particular mystery, then suddenly flew off with the introduction of some *deus ex machina*—a baby, a submarine, a nuclear weapon. But it was also like Viagra for your dramatic soul, utterly absorbing in the small, as it were, but unable to please over duration. The final episode had many millions of fans tied up in knots. It was the greatest *deus ex machina* of all, literally, and there was no dramatic satisfaction for enduring that six-year arc.

I saw J. J. speak at the Game Developers' Conference several years ago and again in 2007 at TED. Both times he told the story of his "mystery box." It was a gift from his grandfather that he has refused to open over all the years. It has become an inspiration to him. Thousands of critiques and blogs and comments about J. J.'s box have appeared over the years. He talks about the mystery box again in relation to his *Star Wars* adventure with Disney.

J. J. pulls things out of his mystery box, like the lame ending of *Lost* or the wanton destruction of Vulcan—a major component of the *Star Trek* bible—in his *Star Trek* reboot film of 2010. When things get boring for little J. J., he just pulls some virtual crap out of his mystery box.

J. J., this might be cool if you were ten years old.

When a playwright lets a plot meander and meander with no sense of what's in its mystery box, that's bad news. It's even worse news when the stuff that J. J. pulls out of his mystery box is some lame dirty trick. But friends, J. J. has a lesson for us. When things are lagging, as Rob and I often tell each other, you just need a baby, a submarine, or a nuclear weapon.

Open the box, J. J. Maybe your imagination is inside.

The action must not be so long that one forgets the beginning before one gets to the end, since one must be able to perceive it as a whole in order to fully enjoy it. This criterion is most immediately observable in computer games, which can often require a person to be hunched over a keyboard for days on end if he or she is to perceive the whole at one sitting, a feat of which only teenagers are capable. In good massively multiplayer games, design can assist the player in finding good intermediate "stopping places" where catharsis is possible, even though the potential of the game is not exhausted and the player intends to return to it. Similar errors in magnitude are likely to occur in other forms, such as virtual reality systems, in which the raw capabilities of a system to deliver material of seemingly infinite duration is not yet tempered by a sensitivity to the limits of human memory and attention span, or to the relationship of beauty and pleasure to duration in time-based arts.

Problems in magnitude can also plague other, more "practical," applications as well. If achievable actions with distinct beginnings and ends cannot occur within the limits of memory or attention, then the activity becomes an endless chore. Contrariwise, if the granularity of actions is too small, and those actions cannot be grouped into more meaningful, coherent units, the shape of the activity is either a forgettable *point* or an endless *line* of chores. These problems are related to the *shape* of the action as well as its magnitude, the first subject to be treated in the next chapter.

The notion of beauty that drives Aristotle's criterion of magnitude is the idea that made things, like plays, can be organic wholes—that the beauty of their form and structure can approach that of natural organisms in the way the parts fit perfectly together. In this context, he expresses the criterion for inclusion of any given incident in the plot or whole action:

> . . . an imitation of an action must represent one action, a complete whole, with its several incidents so closely connected that the transposal or withdrawal of any one of them will disjoin and dislocate the whole. For that which makes no perceptible difference by its presence or absence is no real part of the whole (*Poetics* 1451a, 30–35).

If one aims to design human-computer activities that are—dare we say—*beautiful*, this criterion must be used in deciding, for instance, what a person should be able to do, or what a computer-based agent should be represented as doing, in the course of the action. It also implies that leaving things out can be important in achieving a graceful organic whole.

In this chapter, we have described the essential causes of human-computer activity—that is, the forces that shape it—and its qualitative elements. In the next chapter, we will consider the orchestration of action more closely, both in terms of its structure and its powers to evoke emotional and intellectual response.

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3

Dramatic Foundations

Part II: Orchestrating Action

WHAT IS POSSIBLE IN A given representational "world"? In drama—on the stage, in film, or even on television—discovering what is possible is a twofold source of pleasure for audiences. First is the stimulation of imagination and emotion that is created by carefully crafted uncertainty. Second is the satisfaction provided by closure when the action is complete, if the plot has been successfully constructed. When representational "worlds" are interactive, whether they be avant-garde theatre productions or virtual offices, how people find the edges of the universe—discovering the limits of what is possible—is a central issue in design. This chapter deals with how plots—representational actions—are constructed so that they provide emotional and intellectual satisfaction and how these dramatic principles can inform the design of human-computer interaction.

Whole Actions

The notion of beginning, middle, and end presents an interesting riddle when one is using a computer with a multitasking operating system, or even launching and re-launching various applications in a sequential fashion. I may have several "activities" going on at once, leaping from one to another in midstream. I am using my word processor to work on an article, sending and receiving email, editing photographs, and playing a game. Where is the whole?

One answer is, to misquote the famous turtle, "it's actions all the way up"—that is, several whole actions are being braided into an even larger one, which is itself a whole, with all the associated formal and structural characteristics. The upper limit of this recursion is supplied, in part, by the notion of magnitude (something of a size that can be perceived as a whole) and in part by the context(s) of activity. While working on this book, for instance, all of the actions I undertake (and all of the applications I use) during a session with the computer are typically related to the activity of authoring the book. To the extent that the operating environment supplies a consistent context (its "interface"), consistent "tools" (like cut and paste), and some transportability (e.g., the ability to bring a Photoshop image into a Microsoft Word file), the system reinforces this sense of wholeness.

Contrariwise, I may simply get up in the morning, boot up the computer, and diddle around with various tasks: e-mail correspondence, journal entries, designing party invitations, or what have you. *The artificial bracketing events of turning the computer on and off are not equivalent to the beginning and end of a whole action; rather, there are several "whole actions" being pursued concurrently.* The possibility of multiple "whole actions" being undertaken in a multitasking fashion is not unique to computing; the same phenomenon occurs in the typical day of any worker, artist, or homemaker, and it is quite familiar to the sort of reader who has several books going at once, reading science fiction in bed and journal articles in the bathroom. *The point here is not to assert that there is necessarily a single "whole action" being constructed every time that a person uses a computer, but rather to suggest that the quality of wholeness has contextual, structural, and formal characteristics.*

The multitasking "user" may not experience whole actions. This may be due to the intent of the "user"; that is, whether or not the actions being performed in various applications or environments are related in some way to a common intent. Within a particular application, especially in games, the player may not experience a whole action when there are parallel plots or levels unless connections are designed into the game. Why do we experience frustration when we watch a film or TV show with parallel plots that do not converge or at least have some relation to each other? We expect a whole action. Having two separate actions (plots) intercut does not satisfy. We seek wholeness in dramatic experience. To graduate from one "level" of a game into another with different affordances and goals and without obvious connection to the previous levels does not satisfy. Likewise, action games that can never be "won" may leave us lacking the satisfaction of a whole experience with beginning, middle, and end. In an unpublished letter to Alan Kay at Atari Labs, science fiction author Harlan Ellison observed that it is not possible to meet that goal in many games if the bad

What Constitutes a Whole Action?

In the sense that I speak about "human-computer interaction," I mean enabling and representing actions with human and technological participants. I'm looking at a larger granularity than a single touch, swipe, or keypress. Events with such short duration cannot assume dramatic form in themselves, since *time* is an intrinsic factor in producing a dramatic shape. If we are looking for coherent wholes, we need to think about the whole actions of a human's interaction with a computer: for example, playing a chunk of a game, searching for information, doing the taxes, or writing a letter. Such whole actions may occur in one session or over a course of time-bounded sessions. My contention is that the session itself is more pleasurable if it has a dramatically pleasing shape, and that the completion of a whole action over several sessions may be measured by that same criterion.

Some genres of television—the "series," the "soap opera," or even game shows where winners may appear week after week—reveal a similar wrinkle in the notion of plot as a "whole action." Some series like "All in the Family" or "I Love Lucy" had recurring characters, of course, but typically featured self-contained plots in each episode. Other, typically later, series have what might be called "trans-episodic" story arcs, so typical of soap opera. Overarching several episodes, each with their local plots, may be a larger plot that takes several episodes to unfold. The series "Hill Street Blues" is an early example of story arc structure.

Another way in which plots may be intermingled, both in the theatre and in film and television, is when two or more seemingly unrelated plot lines are running simultaneously. In poor examples, the action simply takes turns focusing on one plot line or the other without any mutual touch-points or resolutions. In the best examples, the plot lines converge in unexpected and satisfying ways; in a famous *Star Trek* episode entitled "The Trouble with Tribbles," for example, Kirk is charged with guarding a shipment of grain to a planet that is contended for by both Klingons and the Federation. Klingons come to the station for shore leave. An independent trader shows up with some adorable little animals called tribbles, which love humans, but don't like Klingons. The tribbles multiply very rapidly, but then begin dying off to reveal that the grain has been poisoned. Finally, tribbles unmask the stealthy Klingon saboteur.

Human-computer interaction may involve the completion of an entire "plot" in a single session or, like multiepisodic story arcs, over the course of several sessions. Viewed in this way, the "plot" of human-computer interaction may be seen as the story an interactor tells herself about what has transpired in a session or a set of related sessions. Much of that story will depend upon the choices and actions of the interactor in collaboration with the materials, structures, and actions contributed by the computer as a coauthor or agent in the action.

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."

We can look to characteristics of good dramatic structure to inform us in designing the potential for whole actions in interactive media.

Dramatic Potential: The "Flying Wedge"

Assume for a moment that you have gone to the theatre not knowing what is playing. You sit in your seat. Anything is possible until the curtain goes up. When you face a computer screen, anything is possible until you turn on the device and see what sorts of applications and affordances are present.

The action of a play consists of a series of incidents that are causally related to one another. Those incidents are specified in the script and enacted by actors in performance. In the previous chapter, we likened a computer program to the script of a play, with one important difference; whereas the action specified in a given script will not change from performance to performance,[1] a computer application can lead to actions (composed of incidents) that can vary widely from session to session, depending upon the choices made and actions performed by human agents. In other words, programs generally contain more *potential* for action than plays. To understand the implications of this fact, we need to explore the nature of dramatic potential and how it is formulated into action.

Potential is defined as something that can develop or become "actual."[2] Dramatic potential refers to the set of actions that might occur in the course of a play, as seen from the perspective of any given point in time (that is, a location along the axis of time, as the action of the play unfolds). At the beginning of a play, that set is very large; in fact, virtually anything can happen. From the instant that the first ray of light falls on the set, even perhaps before an actor has entered the scene or spoken a single word, the set of potential actions begins to narrow. What could happen begins to be constrained by what actually does happen; the lights reveal a room in a

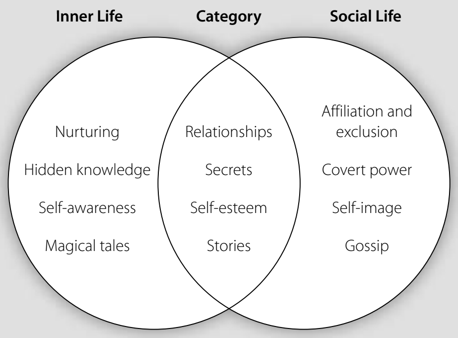
1. Of course, the qualities of the performances of the actors may vary, but not the action itself. There are exceptions, such as the interactive plays mentioned in the previous chapter.

2. For a deliciously different take on this statement, see the book *Make It So* by Nathan Shedroff and Chris Noessel (2012). They demonstrate how many interactive devices, forms, and affordances have been presaged—or even invented—in the media of science fiction film and television.

Purple Moon's Universe

In 1996, I cofounded Purple Moon, a media company devoted to girls. The company was based on four years' research on play, gender, and technology involving deep secondary research and primary research with over 1,250 kids and adults. At first, we thought simply to build a game—that was the beginning of what became our first title, *Rockett's New School*. But as we began conceptualizing the game, we realized that we were actually building a world; material in that particular game arose from constructions about the environment and characters that was larger than the content of the game itself.

We applied findings from our research about how "tween" girls (roughly ages 7 to 12) go about constructing their identities. Below is a diagram showing what we found.



A model of tween girls' identity construction from Purple Moon research

The "Rockett" series dealt with the right side of the diagram: social life. The goal of the series was to give girls an emotional rehearsal space for their social development. But the left side of the diagram—inner life—was not represented in that series because the construction of inner identity relied upon different environments and materials. That's when we began to design another series, *Secret Paths*, that created opportunities for emotional rehearsal with the same characters in the inner realm. Finally, we developed a Web site where the "whole" characters were represented (the center of the Venn diagram), with many opportunities for player interactions and player-created materials.

In this way, we gave girls opportunities to participate in a wide variety of "whole actions": playing one of the games, authoring materials on the Web site, engaging in social activities in-world with other players, and collecting and trading virtual "treasures" on the Web site. In fact, the trading of treasures (some of which were scarce) led to girls' putting together "black market" sites of their own to trade them.

The lesson here is that the larger and more coherent the imaginary world, the more opportunities there are for constructing whole actions within it, as long as the design provides the necessary affordances for participation.

Victorian house or a fantastic heath, for example, and a banker or a faerie walks onto the stage. The actions of the characters form incidents—coherent units of action—that further begin to constrain what may follow. As incident follows upon incident, and patterns of cause and effect begin to be perceived, rough notions of the shape of the whole action begin to emerge; that is, people in the audience begin to have expectations about what is to come in terms of the overall plot. Where is the play going, and what is it essentially "about"?

In Aristotelean terms, the *potential* of a play, as it progresses over time, is formulated by the playwright into a set of *possibilities*. The number of new possibilities introduced falls off radically as the play progresses. Every moment of the enactment affects those possibilities, eliminating some and making some more *probable* than others. When we learn, for instance, that Hamlet's father was murdered, it becomes probable that Hamlet will try to discover the identity of the murderer. Later in the play, it becomes probable that, once he has found the villain out, Hamlet will seek revenge. But will he succeed? At each stage of the plot, the audience can perceive more than one line of probability (that is, more than one probable course of events), creating engagement and varying degrees of suspense in the audience. At the climax of a play, all of the competing lines of probability are eliminated except one, and that one is the final outcome. At the climactic moment of *Hamlet*, the only remaining probability is that he will die, and Fortinbras will restore order to the kingdom. In this moment—the moment when probability becomes necessity—the whole action of the play is complete. Thus, over time, dramatic potential is formulated into possibility, probability, and necessity.[3]

This process can be visualized (highly schematically) as the "flying wedge" in Figure 3.1. How this pattern is accomplished in a play depends, in the main, upon the playwright's selection and arrangement of incidents and how they are causally linked. Reading the diagram from left to right shows the progression of material causality, by the way, and reading it from right to left shows formal causality at work, where the necessary end of a whole action functions as a kind of magnet, drawing the structure of the action toward itself.

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3. In the context of drama and as used in this book, the terms *possibility*, *probability*, and *necessity* have specific meanings that differ substantially from mathematical or scientific usage. Readers who wish to investigate the dramatic connotations further should review the *Poetics*, 1451a–b.

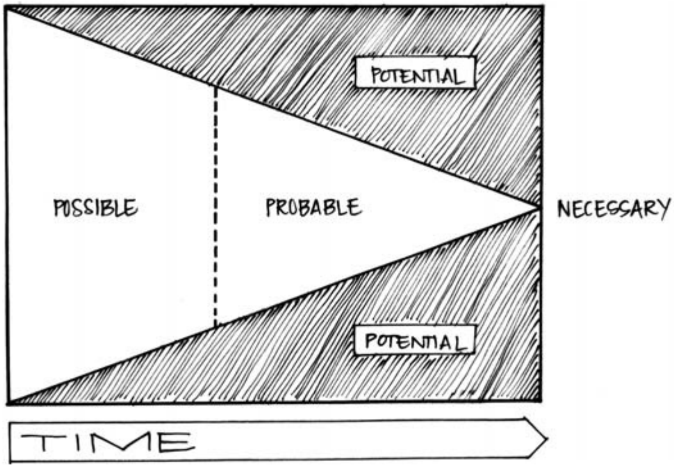

Figure 3.1. *The "flying wedge": A plot is a progression from the possible to the probable to the necessary.*

The shape of potential over time in human-computer interaction is similar to the "flying wedge." In a play, the result of this successive formulation is a completed plot—a *whole action*. What is the human-computer equivalent? As we noted previously, a "whole" human-computer interaction can be described, using the broad definition of a whole action, as having a beginning, middle, and end and being composed of incidents (one or more) that are parts of that whole. Thus, playing a computer game until it ends (or I end it) or a "session" with an ongoing computer game can be a whole action, and a "session" with my word processor can be a whole action (even if I don't finish the chapter I'm writing).

With adequate magnitude along the temporal axis, human-computer activities can be seen to formulate potential in the same way that drama does—as a progression from possibility to probability to necessity. The opening display (which may or may not be multisensory) begins the process of delimiting potential. Every action taken by an agent, including both human and computer-based agent(s), creates further possibilities and constraints as the activity takes shape (see Figure 3.2). Thinking about things this way helps us to focus on how incidents can be arranged and causally linked. A human-computer activity, unlike a play, may be formulated uniquely every time it is performed. The source of variability is people, through their choices and actions, which in turn reflect different goals,

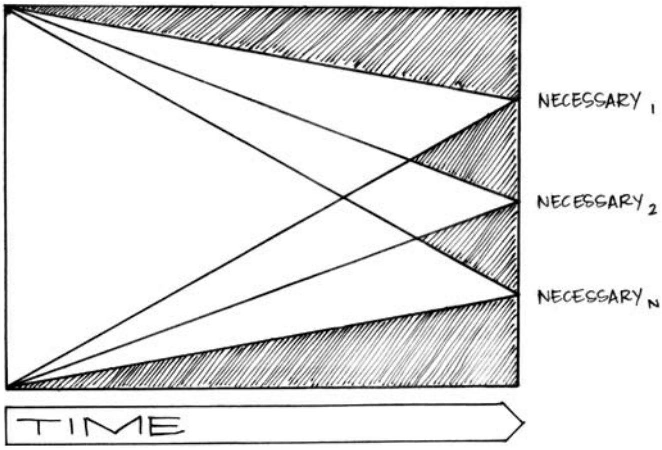

Figure 3.2. *In human-computer interaction, the shaping of potential is influenced by people's real-time choices and actions, pruning possibilities and creating lines of probability that are different from session to session and person to person. The "flying wedge" can be pointed off in different directions; thus, the program contains the potential for many whole actions.*

styles, and capabilities. Another source may be elements like learning or randomness that are built into an activity at the level of processing.

Many of the aspects of a play's *enactment* are the result of the rehearsal process, in which the director (and actors) determine where and when to move and what sorts of lighting and other technical effects should be produced. If these inventions were happening in real time rather than in the rehearsal process, plays could be seen as being far more "dynamic" in terms of the actors' relationship to the script. The displacement is temporal, but so are the constraints. What actors and directors typically cannot do is to change the order of events or the words spoken by the characters, either in rehearsal or performance, nor can they invent new ones. A program that reformulates the potential for action, creating new possibilities and probabilities "on the fly" as a response to what has gone before, is equivalent to a playwright changing a plot in real time as a collaboration with the actors and director and communicating new portions of script to them in real time through some automagical means. In other words, the way in which human-computer interaction is more dynamic than drama is in the aspect of formulating the action, rather than in its enactment.

In some ways, human-computer interaction is quite similar to the art of improvisational theatre. Improvisational actors have freedom to introduce anything they like, but they are judged on the grace and cleverness of their choices, not simply on their novelty. People can theoretically introduce anything they like into the potential of a given human-computer activity. Introducing new potential, especially "late in the game," has the capacity to explode the structure of the action. How can people be constrained to work only with potential that is inherent in (or amenable to) that which is already in the representational world? The problem of *constraints* is treated later in this book, but a key element in its solution is the deployment of dramatic probability and causality to influence (indirectly constrain) what people *think* of doing.

Probability and Causality

Causality is the connective tissue of plot.[4] In this context, causality refers to the cause-and-effect relationships within the action that is being represented. The causal relationship of an incident to the whole action is a requirement for inclusion. Causality also determines, in part, where an incident will be placed in the plot; causes are sometimes represented after effects, for instance, for the purpose of orchestrating audience response through such means as suspense and surprise. Incidents are said to be "gratuitous" if they have no causal relationship to the whole action; gratuitous incidents shed no light on why things have happened or why they happened as they did. They may also be the effects of causes that are not represented.

Gratuitous incidents have no direct bearing on the plot; for example, there is no reason to include a scene in which Hamlet brushes his teeth. Most of us have been annoyed by gratuitous incidents in films and TV shows, and many of us have been annoyed by the same kinds of incidents in human-computer interactions. A convention in the world of computer-aided

4. The notion of causality contains some cultural bias; that is, the notion of cause and effect is not so universal as Aristotle believed. Some cultures substitute temporal relations for causal ones, for instance. Likewise, many avant-garde playwrights of the twentieth century, especially the absurdists and surrealists, attempted to eliminate causality from dramatic structure. In the main, however, the notion of causality is pervasive and robust enough to justify our use of it as the basis of our theory. Of course, other theories have been formulated from the alternative views of other cultures and philosophies.

Gratuitous in the Heartland

Rob and I both came from the Midwest. Sometimes we have a good laugh over the gratuitous things that showed up in our childhoods. There was the matter of the living room. You are not allowed to sit in it unless there are guests. This is a vestige of the 19th-century sitting room. When sitting rooms disappeared from domestic architecture, some of their meaning migrated to the living room. Then, with no place to sit, later suburbanites began to have family rooms that actually functioned as living rooms. *Rules and customs can migrate over time, even when they become gratuitous.*

Some of our relatives put plastic covers on the sofa. Sometimes people put little plastic runners over the carpet where there was a lot of foot traffic. Sitting on a plastic cover in shorts in the summer is an experience I hope never to repeat. You have to peel yourself off the furniture and hope not to lose any skin in the process. Granted, putting plastic covers on things was not gratuitous to the women who did it—it saved them cleaning time and effort. But the custom functioned to prevent *consequences of actions*—something we don't want to do in plays or dramatic interaction.

When I go home to visit my parents' graves, the cemetery is littered with plastic flowers. There's a place behind the groundskeeper's house where decades of plastic flowers have been tossed into a gooey pile. You could say that plastic flowers are just tacky, but for those who leave them there, the duties of decorating the graves are attenuated by these long-lasting decorations. But they function to *deny the passage of time*, something we also want to avoid in dramatic action. When I visit, I leave fresh flowers. Life is change.

Homes and barns in the Midwest sometimes include Pennsylvania Dutch hex signs. Most of these are prefabricated, and the homeowners aren't Pennsylvania Dutch. The hex signs originated as a show of cultural solidarity in Pennsylvania at a time when the government was trying to remove the cultural attributes of these immigrants, also discouraging the speaking of German. The hex signs have particular meanings. People who use them elsewhere in the Midwest think of them simply as decorations. Here, *the significance of the signs is erased*. A counterexample is the current fashion of attaching metal stars to the home. These signify a particular current political view and work as semi-opaque signs for the initiated.

In the late 19th and early 20th centuries, little black "lawn jockeys" were all the rage. These are small figures, usually made of metal, that represent Black servants who are ready to take care of your horse. Apocryphal tales exist about the representation as an honorific sign of a brave young groom who served George Washington. But while I was growing up, they signified wealth and power. No one had horses to hitch to the ring any more. One of my girlfriends had one in her yard. When her father died, her mother painted the fellow's skin white. The *signifier was modified* to create complex new meaning.

Photo: *The Noble Lawn Jockey* (CC BY-SA) Living in Monrovia

On a visit to Graceland, I noticed that Elvis had a wall covered in shag carpet. I have no comment on this.

instruction (CAI), for instance, was to ask the student to enter his or her name at the beginning of an interactive session. The most that was usually made of this incident was a message that replied, "Hello there, Jimmy," before proceeding with the "meat" of the lesson. The name-entering incident (Jimmy and the computer saying "hi") had nothing to do with the plot (Jimmy learns his multiplication tables). I seriously hope that this kind of educational software isn't in use any more. Most of the time, eliciting the entry of "user" information is gratuitous for the "user," but not for the company who owns the application.[5]

This design strategy was often seen in early drill-and-practice educational programs of the sort that caused Tom Malone (1981) to write his canonical paper on intrinsic motivation. If Jimmy solves three arithmetic problems successfully, he gets to spend twenty seconds playing a starship-blaster action game. Either the math or the game segments are gratuitous, depending upon Jimmy's understanding of the central action. The solution

5. Try to order something online from a source you've never used before and escape getting email spam from them. Not to mention the Big Data problem.

is either to eliminate one of the activities, or to reshape the action so that it includes both in a *causally related way*—e.g., a starfighter simulation in which Jimmy solves math problems in order to operate the ship.[6]

Besides its function as a criterion for inclusion, playwrights deploy causality in the shaping of dramatic probability. The representation of certain causes makes certain effects probable. The possibility of conflict in the Neutral Zone (part of the dramatic potential of *Star Trek*) becomes a probability if a cause is represented—e.g., a Romulan incursion. In complementary fashion, the representation of effects leads people to expect that causes will be revealed—another way of constraining what is probable in the action.

A primary source of causality in dramatic incidents is the goals of the characters, that is, what the characters want and what they are trying to do (present on the level of Thought). The central action of a play is often best described in terms of the goal of its central character. The character tries various courses of action for achieving their goals. The obstacles and conflicts they encounter force changes in their behaviors and plans, and sometimes in the goals themselves. A detective character may start out trying to solve a murder and end up embroiled in an international espionage operation. Of course, by the end of the action, the audience can see that it was "about" the spy ring all along, because knowing about it makes all the details fall into place. The central character's goal has carried them along, and the revelation of the other characters' goals unifies seemingly unrelated incidents into a whole action through the interweaving of causality.[7]

Likewise, the agents' goals are most often the strongest source of causality in human-computer activity. What is each agent (human and computer-based) trying to do, get, or become? What obstacles and conflicts arise, and how do they constrain what the agents do? In human-computer activity, as in drama, goals usually lead to the formulation of plans (or strategies) for achieving them. These plans are either stated or inferred, and they provide a basis for understanding the action. The implementation, failure, revision, and formulation of plans are the "meat" of the action. To be probable, goals and plans must be plausible in terms of the characters that generate them (the "appropriateness" criterion for character, as discussed in Chapter 2).

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6. These three paragraphs are a slightly modified excerpt from "Interface as Mimesis," in Norman, D. A. and Draper, S., Eds., *User Centered System Design: New Perspectives on Human-Computer Interaction*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1986. Reprinted with permission.

7. One of the very best examples of the recognition of causality after the action is completed is the American film *The Sixth Sense* (1999). No spoilers here: If you haven't seen it, watch it!

In his dissertation, "The Dynamic Structure of Everyday Life," (1988) AI researcher Philip Agre argues that real people do not live their lives this way; that is, goals and plans do not explain most of human behavior. His observations lead him to posit that people are primarily involved in improvising what to do next, in a moment-by-moment way, and that everyday life is "always almost wholly routine." But everyday life is different from drama. And highly goal-oriented "real" behavior, as in the case of constructing a building or some other specific task (the kind of thing we often do with computers), can be seen to involve a greater proportion of planning activity than "everyday life" as well. Agre's understanding of everyday activity has enabled him to arrive at AI architectures that may do a remarkable job of emulating real life, and his ideas may lead to an entirely new paradigm for representing and orchestrating human-computer interaction.

Nevertheless, I employ the notions of goals and plans in this book for several reasons. One is the desire to see human-computer interactions as "wholes" with coherent structures. Constructing them as *dramatic* wholes allows us to take advantage of deeply ingrained conventions about understanding representations of action. These conventions are in fact the ways in which drama is *not* like life: elimination of the extraneous and gratuitous, clear causal relations among things that happen, and the notions of beginnings, middles, and ends. Agre wanted artificial reality to be lifelike, but there are good reasons why, at least in some situations and for some purposes, artificial reality should be—well, *artificial*.

Related to Agre's thesis is the work of Lucy Suchman. In her excellent book *Plans and Situated Actions: The Problem of Human-Machine Communication* (1987), Suchman contends that "purposeful" (or goal-directed) behavior is best understood, not as the execution of plans, but rather as *situated actions*: "actions taken in the context of particular, concrete circumstances." Plans are fundamentally ineffective because "the circumstances of our actions are never fully anticipated and are continuously changing around us." Suchman's observations lead her to conclude that plans are best viewed as "a weak resource for what is primarily *ad hoc* activity." Suchman does not deny the existence or use of plans, but implies that deciding what to do next in the pursuit of some goal is a far more dynamic and context-dependent activity than the traditional notion of planning might suggest. A dramatic view of human-computer interaction is amenable to the notion of situated actions in that it attempts to dynamically represent changing situational elements and to incorporate knowledge of them into both the decision-making processes of computer-based agents and the understanding of the actions of human agents in representational contexts.

In keeping with Suchman's analysis is the fact that many factors contribute to dramatic causality by dynamically influencing agents' choices and actions. Among them are natural forces, coincidences, situations, and conditions. Of course, "natural" forces represented in plays and imaginary worlds may be very different from those at work in the real world. Computer games select and modify the laws of physics, for instance. In computer-based simulations, scientific developments such as fractal geometry and mathematical representations of chaos theory make it possible to emulate the natural world with much greater detail and accuracy than formerly possible, but even these techniques must be deployed selectively in the process of representation-building; attempting to render the physical world (or a comparably robust alternative) *completely* would currently bring the world's most powerful computers (and programmers) to their (virtual) knees. Even when selectivity is not an artistic choice, it is nevertheless a necessity in computer-based modeling of physical worlds. The important thing is to know that one is in fact exercising selectivity—to be explicit about it, and to employ a notion of the *potential for action* in the world one is creating as the primary selection criteria. Representing a natural force makes certain kinds of actions more probable; for instance, simulating air flow around an aircraft wing in a CAD program suggests that changes in the wing will create changes in the air flow, implying both causality and potential action. If the potential for adjusting the wing in some way is successfully represented, then the possibility of adjustment becomes more probable. Turbulence remains a chaotic problem.

Representations of functionality that do not model the physical world still employ equivalents of natural laws in the ways that things behave. Windows open and close with animated embellishments that suggest real-world physical actions; folders appear to exert a gravitational force within a limited area that sucks documents into them (when the representation of such a force is flawed, the comparison with black holes may be unintentionally evoked); windows or documents are "shoved" around with manual swipes. Whether in plays, computer games, simulations, or virtual desktops, the representation of "natural" forces must be consistent and explicit enough to allow people to incorporate them into their understanding of the particular world's potential.

The construction of situations that possess strong dramatic potential is a central element in the playwright's art. Situations may have both physical and character-related components (a gun on the desk; a desire for revenge).

An obvious but easily overlooked element of situation building is the fact that all of the relevant aspects of the situation must be successfully *represented*. Watching a small child struggle with a "drawing" program on a computer is a case in point; her actions are limited by her ability to recognize the tools and the context. She is simply not able to do the kind of investigation of the environment and situation that a computer-savvy adult would be willing to undertake; she doesn't know what rocks (or icons) to look under. For her, the representation is all there is.[8]

That's Not a Computer, Lady

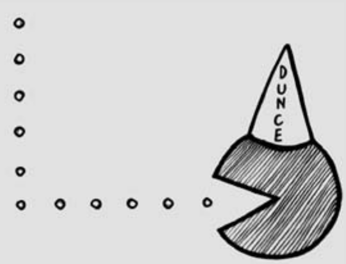
After I began working at Atari, I became interested in player research. A research group lived inside the marketing department, but they were working on how to sell things rather than how players responded to them. The software guys did alpha and beta tests, but often with themselves as players—and that sort of testing was done when the product was well on its way to being finished.

I asked myself, who plays these games? What are they getting out of it? Why do they do it? So I began to lurk in video arcades on my lunch hour, watching young boys play the early arcade games. If they seemed amenable, I would approach. "Hi, I work at Atari. Can I talk to you for a minute?" Now, today I would be arrested for this. "Do you love this game? Why? What fascinates you about it? How could it be better?"

One day I questioned a fairly young fellow, about 12 years old. He seemed quite bright. After I asked the usual questions, I was inspired to ask another. "Does playing these games make you want to be a computer programmer someday?"

The kid shook his head and looked down at his shoes for a minute. Then he met my gaze and said, "That's not a computer, lady. That's just a stupid videogame."

The bad news is, he called it a stupid game. The good news is, for him, the representation was all there was.



8. Finger-painting software works well for the little ones. Now look at these directions for an online drawing program: "Select a color (top left button), select a background color (next button). Then select the type of line you want to use, the width of the line. . . . NOTE: When selecting a color, watch carefully both circles: the main circle aims at choosing a tint and the second one aims at changing the depth of this tint."

Coincidences can also help to establish probability, but they are ineffective when they appear to be arbitrary. Outrageously arbitrary coincidences are the stuff of comedy and farce, in which the requirements for plausibility are significantly relaxed. People commonly assume that coincidences in non-comic representations *have causes that will be revealed*; that is, they are more than "random" accidents. In fact, seeming coincidences stimulate people to look for causal connections. If a sword shows up just when I need one in the enchanted castle, is the wizard protecting me? Fortuitous events imply agency, and that is essentially what they are good for: implying the involvement of characters or forces in the action.

The fact that people seek to understand causality in representational worlds provides the basis for Aristotle's definition of *universality*. In the colloquial view, an action is universal if everybody can understand it, regardless of cultural and other differences among individuals. This would seem to limit the set of universal actions to things that everyone on the planet does: eat, sleep, love, etc. Aristotle posits that *any* action can be "universalized" simply by revealing its cause; that is, understanding the cause is sufficient for understanding the action, even if it is something alien to one's culture, background, or personal "reality."

We need only look to works of fantasy to find obvious examples of how universalization via causality works. Actions that are patently impossible in the real world (such as a person flying) can be made believable and understandable in their dramatic context if probability is established. This fact led Aristotle to observe that in dramatic action, *an impossible probability is preferable to an improbable possibility*. We can believe that Peter Pan flies because of the way the potential of his world is revealed, through the way his character is established in the action, and through dramatic situations that provide him with causes to use his ability to fly. Conversely, it is *possible* that Peter Pan would try to have a conversation with Captain Hook instead of fighting with him (a Monty-Python-esque treatment), but the *improbability* of that course of action robs it of credibility. This is another reason why coincidences don't work; it's improbable, in all noncomic dramatic forms, for just the right thing to happen at just the right time (without some source of agency).

To summarize, probability is the key quality of dramatic action. The orchestration of probability and causality is the stuff of which dramaturgy is made. By manipulating probability, the playwright shapes the dramatic world, the plot, and (indirectly) the audience's involvement with it. Similarly, probability can be deployed by designers of human-computer interaction to shape what people do and feel in the context of a particular virtual world. To understand more about how dramatic probability can be shaped, we can look to the structural patterns that make probability manifest.

Dramatic Unfolding: The Importance of Time

Don Norman observes: "Drama has always considered the multiple dimensions of experience including one almost completely absent from the vocabulary of product and system designers and from computer design: time."[9] In Chapter 2, we discussed time in terms of magnitude. This chapter looks at the element of time as essential to drama; specifically, the passage of time permits the formulation of possibility into probability and necessity. The design of what passes within a particular period of dramatic time creates the emotional textures that keep us engaged.

Drama tends to compress time, while narrative tends to extend it. Temporal compression of incidents provides strategic guidance in the inclusion or exclusion of materials, thoughts, and actions. Compressed time intensifies dramatic action. Time plays an indispensable role in the shaping of structural qualities as described in the next section.

Dramatic Anatomy

How does one describe the shape of a particular play? What are its "anatomical" parts? The previous sections dealt with qualitative elements; that is, qualities that exist throughout the fabric of a play. This section deals with the identifiable patterns through which qualitative elements are expressed.

Complication and Resolution

The *shape* of a play can be visualized in terms of the pattern of emotional tension created in its audience. Typically, tension rises during the course of a play until the climax of the action and falls thereafter. As we observed in the previous section, the climax of a play is the moment at which one line of probability becomes necessity, and all competing lines of probability are effectively eliminated. Hence the climax is not only an emotional peak, but an informational one as well. In fact, the implicit assumption in this analysis is that there is a direct relationship between what we *know*

9. Personal communication, 2012.

about the action and how we *feel* about it. The manipulation of information establishes causality and probability, and it is the basis of such audience responses as suspense, surprise, and catharsis.

Gustav Freytag (1898), a German critic and playwright, suggested in 1863 that the action of a play could be represented graphically, yielding a visualization of dramatic anatomy that is referred to as the "Freytag triangle" (see Figure 3.3). The notion that the action of a play could be quantified was not unfamiliar to Freytag's contemporaries in Europe and America, whose "well-made plays" were often formulaic in the extreme (and which did not survive as examples of great drama). It is the underlying logic of Freytag's analysis, however, and not the recipe-book flavor of his techniques, that is useful in understanding the anatomy of dramatic action.

Freytag's visualization is based on the notions of rising and falling action.[10] The *rising action* is all that leads up to a climax or turning point, and the *falling action* is all that happens from the climax to the conclusion. The rising and falling action form the sides of the triangle, of which the dramatic climax is the apex. The horizontal axis of the graph is time; the vertical axis is complication. Various structural elements occupy different locations on the triangle. Contemporary versions of Freytag's triangle are more irregular and jagged, reflecting the differing patterns of complication and resolution within structural elements.

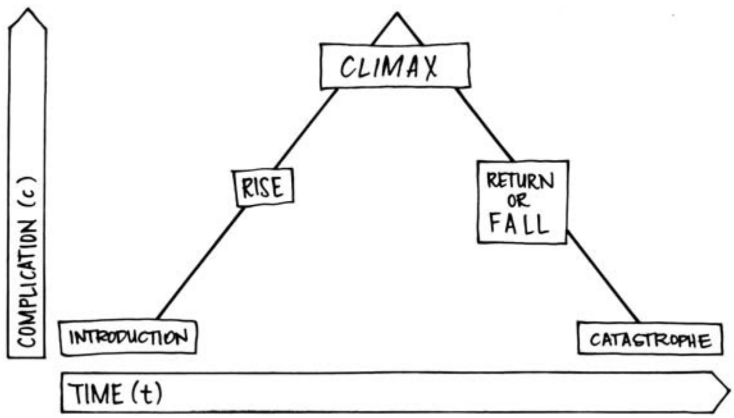


Figure 3.3. *Freytag's triangle (Freytag 1898)*

10. Freytag's actual terms were "play" and "counter-play," and they were based on Aristotle's "complication" and "dénouement" (literally, "untying," as a knot).

The "complication axis" of a Freytag graph represents the *informational attributes* of each dramatic incident. An incident that raises questions (e.g., the kidnapping of the heroine) is part of the rising action; one that answers questions (e.g., the confession of the villain) is part of the falling action. However, Freytag's analysis was overly simplistic; each dramatic incident may raise some questions and answer others, and the questions themselves may vary in importance to the plot. Freytag's primary contribution was to provide the beginnings of a visual representation of the shape of dramatic action.

More sophisticated Freytag-style graphs have been developed as tools for dramatic analysis. Each incident is represented as a line segment, the *slope* of which is derived from the relationship of the informational attributes of the incident (i.e., questions asked and answered) to its duration; for instance, a steep upward slope represents a good deal of complication in a short amount of time. We will use the following dramatic incident as an example.

A group of strangers have been invited by an anonymous person to spend the weekend in a remote mansion. During the night, one of the group (Brown) has disappeared. Some of the remaining characters are gathered in the drawing room, expressing concern and alarm. The butler (James) enters and announces that Brown has been found (see Figure 3.4).

JAMES: I'm affraid I have some rather shocking news.
SMITH: Spit it out, man.
NANCY: Yes, can't you see my nerves are absolutely shot? If you have any information at all, you must give it to us at once.
JAMES: It's about Mr. Brown.
SMITH: Well?
JAMES: We've just found him on the beach.
SMITH: Thank heavens. Then he's all right.
JAMES: I'm afraid not, sir.
SMITH: What's that?
JAMES: Actually, he's quite dead, sir.
NANCY: Good God! What happened?
JAMES: He appears to have drowned.
SMITH: That's absurd, man. Brown was a first-class swimmer.

Figure 3.4. *A sample dramatic incident*

Each informational component of the incident can be characterized in two ways. In terms of complication, the information is either positive (it asks a question) or negative (it answers a question). The importance of the information at the point at which it appears in the plot is rated on a numeric scale from 0 (completely unimportant) to 1 (extremely important). Thus an extremely significant piece of information that answers a question has a rating of –1, while a fairly insignificant piece of information that raises a question might have a rating of +.3. Figure 3.5 shows such an evaluation of the informational components of the example incident.

To represent the incident on a Freytag graph, the sum of the numeric ratings shown in Figure 3.5 can be used as the value for the variable C, representing complication. The duration of the incident in minutes (or pages of script) is used as the value of the variable T, representing time. The formula for computing the slope of the line segment that will represent the incident on the graph is: slope = C/T. In this case, C = 1.6 and T = 1 (one minute or beat of dramatic action). The sample incident is graphed in Figure 3.6.

This analytic technique can yield a detailed profile, represented numerically or graphically, of the *shape* of the dramatic action of a given play. The fact that this aspect of structure can be expressed quantitatively makes it potentially more amenable to computational representation. Given an informational analysis of the potential actions involved in a human-computer interaction, quantitative structural criteria could be used for orchestrating those incidents into the desired overall *shape*. This is possible because specific kinds of actions can be seen to have characteristic slopes or curves.

	Information	**Significance**
a.	James has shocking news.	0.4
b.	The news concerns Brown.	0.5
c.	Brown has been found.	–0.6
d.	Brown is dead.	0.9
e.	Brown has drowned.	–0.4
f.	Brown was a good swimmer.	0.8
Complication		**1.6**

Figure 3.5. *Informational analysis of a sample incident*

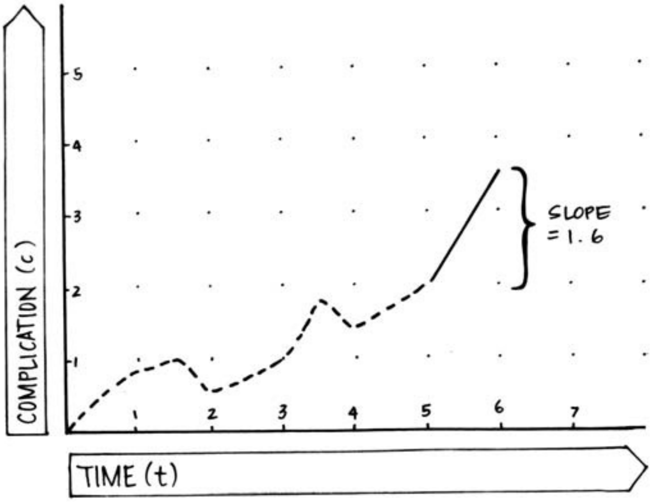


Figure 3.6. *Constructing a "modern" Freytag-style graph. Dashed lines represent previous incidents; the solid line represents the sample incident analyzed in Figure 3.5.*

Conventional Kinds of Action

Figure 3.3 indicates five types of action, with Freytag's terms for them. These "anatomical parts" of a play have been redefined and renamed by nearly every critic since Aristotle. Today, most theatre students learn a set of conventional categories and a less symmetrical (but still schematic) characteristic curve for dramatic action, shown in Figure 3.7.

The *exposition* (segment A) is the part of a play that functions to reveal the context for the unfolding action. It formulates potential into possibilities, introducing characters, environments, and situations. Exposition as the revelation of information continues throughout the play, but it diminishes as the action progresses; it becomes less and less necessary or appropriate to introduce new potential.

The *inciting incident* (segment B) is actually a small segment rather than a point (since it has some duration); it is the action or event that begins what will become the central action of the play. On the graph, it is the point at which the curve takes its first significant upward turn. In terms of the "flying wedge," the inciting incident initiates the first lines (vectors) of probability.

The *rising action* (segment C) follows the inciting incident. In this portion of the play, the characters pursue their central goals, formulating,

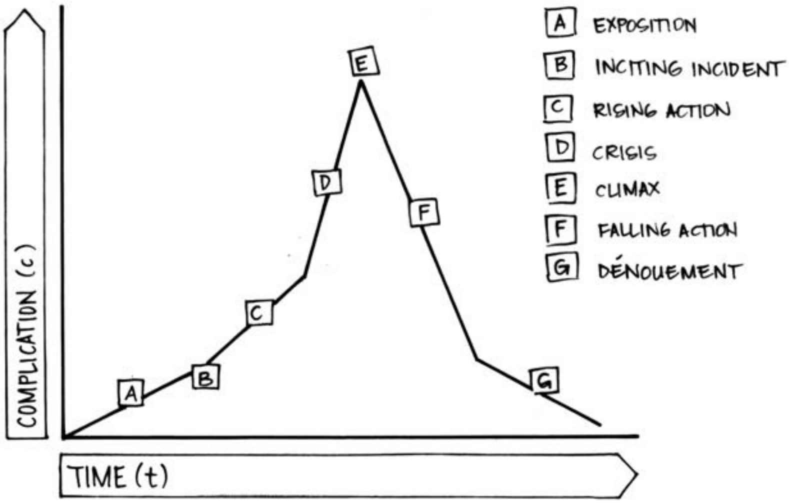


Figure 3.7. *A more contemporary version of the shape of dramatic action and its conventionally recognized parts*

implementing, and revising plans and meeting resistances and obstacles along the way. At some point, the action "goes critical"—that is, characters must make major decisions and take conclusive actions in pursuit of their goals.

The *crisis* (segment D) is a period of heightened activity and commitment, and it usually proceeds at a faster pace than the preceding action. During this segment, many lines of probability are pruned away. The *climax* (segment E) is the moment at which one of the lines of probability becomes necessity, and all others are eliminated. Characters either succeed or fail to achieve their goals (although those goals may have been reformulated during the course of the dramatic action). This key incident is the turning point of the action.

The *falling action* (segment F) represents the consequences of the climax, as they reverberate through character and situation. The slope of the falling action is characteristically rather steep; that is, things tend to fall into place quickly once the climax has been reached. The *dénouement* (segment G) can be described as the return to "normalcy" (the *status quo* of the dramatic world). In English, the word "dénouement" means "untying" or "unraveling." The dramatic potential is exhausted; its intrinsic energy has been used up by the action.

"Fractal" Qualities of Action

Plays can be seen to employ structural patterns in the same way that music employs themes and motifs. The overall graph of any given play is like its fingerprint; it is unique. An intriguing pastime for the quantitatively inclined is to observe how these fingerprint curves are reflected in the smaller incidents that make up larger anatomical parts. If one were to make a "blow-up" of any segment of the graph for a real play, one would see (depending upon the resolution of the underlying analysis) still more bumps and curves, representing the structure of the smaller component incidents that make up the larger anatomical parts. The exposition of a play, for instance, is made up of a number of incidents that reveal information with varying C/T values. The rising action is composed of smaller incidents that tend to have a higher average slope than incidents of the exposition. Here, a fractal quality can be observed: The smaller components of a given type of action tend to reflect "self-similarity at scale" (see Figure 3.8).

In *Hamlet*, for example, the overarching concern is revenge. The pattern of the plot could be described as a battle of forces: moral thinking, impulse, and deception. All of the major characters make choices in these realms. Hamlet, in his quest to avenge his father's death, careens between overthinking and impulsive action, resorting to deception in his arrangement

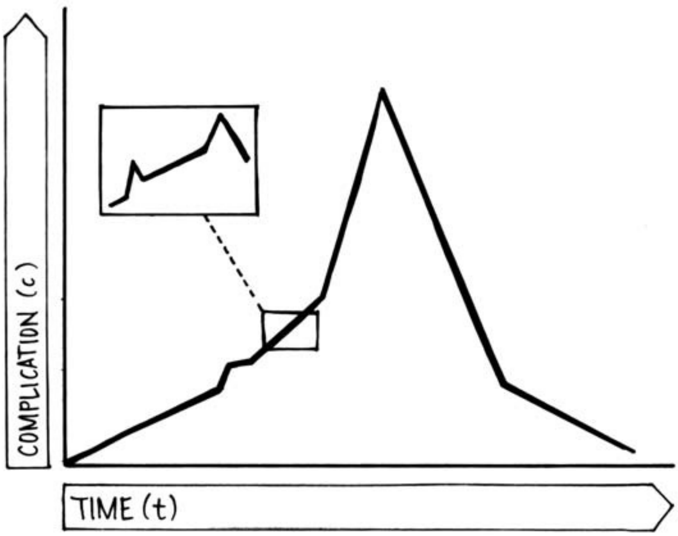


Figure 3.8. *Self-similarity at scale in a dramatic plot*

of the "play within a play." Claudius, who wishes to hide the murder of Hamlet's father, looks first to deception, is plagued by moral thought, and succumbs to impulse in the poisoning of swords. Regardless of the characters involved, the audience typically knows something that the characters don't. In most scenes, a plan made by a central character is thwarted suddenly by a reversal near the end of the scene. Patterns within patterns lay out these elements in different combinations. What we have, then, is a play with nested parts that rework its major themes in a particular manner involving reversal for the characters. Each of these scenes can be said to be self-similar at scale, even though the pattern of the scene or act may involve a recombination of forces.

Science tells us that such self-similarity of dimensions or parts of a thing in relation to the whole is pervasively true of natural phenomena. Richard Voss and John Clarke (1976) identified the temporal manifestation of fractals in the mathematical expression of 1 over *f* noise, commonly called "pink noise," which produces the pleasure of the fractal phenomenon on the auditory level. Mandelbrot and Frame (2002) tell the story of Voss' discoveries:

> As a graduate student at Berkeley, Richard Voss was studying this problem, using signal-processing equipment and computers to produce the power spectrum of the signal from a semiconductor sample. When one sample had burned out and another was being prepared, Voss plugged his signal-analyzing equipment into a radio and computed the power spectrum. Amazingly, a $1/f$ spectrum appeared. Voss changed radio stations and repeated the experiment—another $1/f$ distribution. Classical, jazz, blues, and rock all exhibited $1/f$ distributions. Even radio news and talk shows gave (approximate) $1/f$ distributions.

Mandelbrot and Frame have documented $1/f$ noise in Western music as well as African, Japanese, Indian, and Russian and through a range of times, from the Medieval period through the Beatles. They conclude:

> Voss uses these observations eloquently to bring closure to one of the classical Greek theories of art. The Greeks believed art imitates nature, and how this happens is relatively clear for painting, sculpture, and drama. Music, though, was a puzzle. Except for rare phenomena such as aeolian harps, few processes in Nature seem musical. Voss uses the ubiquity of $1/f$ noise to assert [that] music mimics *the way the world changes with time*.

Pollock's Intuitive Fractals

Jackson Pollock (1912–1956) did not know he was painting fractals. As a kind of pattern in nature, fractals were not yet well understood by the time of Pollock's death. Although mathematical ideas leading to the notion of fractals can be traced back to the 17th century, it was Benoit Mandelbrot who first coined the term in 1975 and who is credited with most of the Big Math (see Mandelbrot 1983).

In an article entitled "Fractal Expressionism," published in *Physics World* in 1999, Richard Taylor, Adam Micloich, and David Jonas were able to demonstrate that Pollock's paintings accurately represented fractal patterns. The authors observed that "experimental observations of the paintings of Jackson Pollock reveal that the artist was exploring ideas in fractals and chaos before these topics entered the scientific mainstream." Pollock's motion around the canvas and his application of paint by dripping were natural causes for the fractal nature of the work.

In 2008, Coddington et al. published a paper to demonstrate that "recent work has shown that the mathematics of fractal geometry can be used to provide a quantitative signature for the drip paintings of Jackson Pollock." In other words, fake Pollock paintings can be exposed as such by computing a measure of self-similarity across scale.

It is remarkable to me that such patterns can be evinced in *made* as well as *natural* phenomena. This tells us something about organic wholes, but also about the human mind—both as creator and beholder.

An important thing to note about this analytical technique is that it reveals a major source of a play's aesthetic appeal; that is, it provides some explanation of why a play *feels good*.[11] As Aristotle's analysis of the qualitative elements of structure (discussed in Chapter 2) suggests, *pattern* is a powerful source of pleasure. Designers of human-computer interaction can borrow concepts and techniques from drama (and nature) to visualize and orchestrate the structural patterns of experience.

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11. An interesting exercise in scientific (or artistic) visualization would be to create first-person versions of such graphs, so that one could experience them kinesthetically by "riding the curves." Would such abstractions *feel good* in and of themselves? If we represented them audibly, would they sound like music? Or surf?

It is relatively easy to see the relevance of orchestrating the shape of action in story-based human-computer activities like computer games or interactive simulations. But what about more pragmatic, "computer-like" activities—say, spreadsheets? Both Heckel and Nelson have extolled the virtues of VisiCalc and its descendants (e.g., Excel). Heckel (1982) identifies one source of the product's appeal as the immediate representation of the effects of users' actions: "While entering formulas, the user is continuously stimulated. Similarly, when changing a number, the user is stimulated by the effect of the changes as they ripple through the spreadsheet." This source of a good spreadsheet's appeal can be visualized as a Freytag-style curve. Let's say I'm using a spreadsheet to decide whether I can afford to buy a new house. Referring back to Figure 3.7, the various segments of the graph might correspond to the following actions:

A. *Getting started*. I enter the price of the desired house, the price that my current home is likely to fetch on the market, and any additional numerical data that I might have, such as interest rates, property taxes, and the costs of utilities.

B. *Preliminary evaluation*. I discover that the new house, in terms of the data already entered, will cost me $1,000 more per month. Things are looking bad, but I really want to be able to afford the house, so now I am going to start trying to think of things that will turn the picture around. Thus the "inciting incident" is the initial set of calculations, which leads to my decision to pursue a new goal: to make the numbers support the desired outcome.

C. *Entering new data and formulas*. Are there tax benefits that derive from the interest rates and increased debt? How will my utility bills change if I replace the new house's electric heating system with a gas furnace? I try different strategies with positive and negative effects.

D. *Making major trade-offs*. Things are still looking bad to iffy; now it's time to decide what sacrifices I am willing to make. Finally I decide that I can live without a new car, that I can forego furniture in the living room, and that I could borrow an additional chunk of down payment from my mother. Will any or all of these sacrifices be sufficient?

E. *Making the decision*. I "turn the crank" by implementing each of these sacrifice scenarios in turn and then in combination, until I arrive at one I can live with. Yes, there is a way to afford the new house.

F. *Creating an artifact*. I clean up the spreadsheet, do a little formatting, and print the whole thing out to show my husband so that he, too, will be convinced.

G. *Finishing up*. I save the document and exit the application.

The spreadsheet illustrates how the conception of the application and its functionality shape the action by providing elements of form. It also shows the way in which the application and the person collaborate to create a whole action with an interesting shape. It illustrates the fact that an application, in both its conception and its execution, defines the magnitude and texture of the whole action. Spreadsheets such as Excel are successful largely because they do an extremely good job of supporting whole actions with a satisfying degree of complexity, magnitude, and completeness. One could perform the same whole action as that in the previous example with a calculator, an abacus, or even a pencil and paper, but its magnitude (in the sense of duration) would be excruciatingly excessive. The action would lack organic wholeness; rather than the elegant Freytag-like curve, the action would more likely consist of long, flat-line segments of calculation punctuated by periods of analysis and planning with a completely different representational context and "feel." In contrast, word processors, especially those that admit only text manipulations, do a comparatively poorer job of supporting actions with interesting shapes in that they focus on only part of a larger task. Programs designed to support document creation fare better in terms of dramatic shape because one is more likely to be able to do what one visualizes.

Discovery, Surprise, and Reversal

The previous section illustrates how information is a key component of dramatic structure. The impact that new information has on people is determined, not only by the information itself, but also by how it is revealed and how it interacts with existing knowledge and expectations. Plays are full of discoveries of different types. The expository action at the beginning of a play provides the greatest number of discoveries for the audience, but the climax probably provides discoveries of the greatest significance. When one has no particular expectations, discovering new information is a simple and relatively unremarkable experience (oh, I see, the door is over there; this character is a doctor; the husband and wife are having trouble getting along).

Discovery becomes more interesting when the new information is not what one might have expected; in other words, it's a surprise (what's that scruffy bum doing at this fancy party? Why is the house suddenly shaking? A higher interest rate may give me a tax break!). Surprises have a higher potential for complication than do run-of-the-mill discoveries; that is, they often raise more questions than they answer. Although in "real" life surprises are as often nasty as they are pleasant (why is the house suddenly shaking?), in the context of *drama*, they are almost always pleasurable, in that they lead to excitement, vicarious feeling, engagement, and speculation—and we are "safe" from real-world consequences (there's an earthquake going on—don't worry, honey, it's only a movie). *Surprise* is that subspecies of discovery that is different from what one expected (or might logically have expected) to be true. Surprise is deployed by playwrights to turn up the gain on emotional and intellectual involvement—to quite literally give the audience a thrill.

A more rare and potent flavor of surprise is what Aristotle referred to as *reversal*: A surprise that reveals that the *opposite* of what one expected is true (that's not a man, that's a *woman*! The detective is actually the murderer! I thought that "formatting" would *tidy up* my disk, not *erase* it!). Reversals can cause major changes in our understanding of what is going on and our expectations about what will happen next; in other words, they can radically alter *probability*. In a play, an early reversal might serve as an inciting incident, causing a sharp upturn in the C/T slope (by raising a whole set of questions all at once). The climax of a play may be a reversal that causes a sharp downward turn in the slope (by answering a host of questions all at once).

In human-computer interaction, like drama, surprise and reversal are efficient and economical means for achieving radical shifts in probability. The reasons for wanting to create such a shift may be pragmatic or aesthetic. A reversal may be needed to turn a person away from an unproductive or potentially dangerous path of action. Surprise and reversal can also be deployed to create changes in the "slope" of the action in order to achieve a pleasing whole. Of course, it must be remembered that dramatic reversals have no serious real-world consequences. Obviously, one should avoid any 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.

Reversal with *Hors D'Oeurves*

At one of the colleges where I taught, we always had a large reception during our annual thesis show. We offered wonderful food—*hors d'oeuvres*, cheeses, and pretty good beers and wines. The array of food was usually right at the entrance to the studio, and plenty of people would stop in for a bite without really looking at the show.

One fellow in particular came every year. He was thin and small with long scraggly hair, always sporting the same dirty black jacket and worn out shoes. The first time he came, he put an entire bottle of wine and a big cheese inside his jacket and strolled out. The next year he showed up again. I walked up to him and introduced myself as the chair of the department, gave my name, and stuck out my hand for him to shake. He ignored me. I think he was too busy eating.

As the years went by, this fellow never missed a reception. There was a large homeless population around the campus, and we figured that he was probably homeless too. We started referring to him as "the homeless guy." We began to strategize about moving the food around so that it would be a little harder to get to, but nothing deterred him.

The last year I was there, I saw him coming down the hall toward our reception. "There's that homeless guy again," I said. "Hide the cheese!" A faculty member from another program heard my remark. "Oh," she said, "he's a professor here."

Then he came in and stuffed another fine cheese under his coat.

In this chapter, we have defined elements of form and structure that are characteristic of dramatic action and shown how they relate to human-computer interaction. In the next chapter, we will consider how dramatic theory can be employed to understand and orchestrate human action in representational worlds.

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4

Dramatic Interactors

Collaboration, Constraints, and Engagement

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, 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 sometimes criticize my approach by countering that a computer program can never be smart or sensitive enough to make a beautiful work of art. Yet artists use computational tools to do so, and those in turn are enabled by the artistry of designers and programmers.

These observations 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 of or create magnificence in art. Structure is not a wholly sufficient explanation for beauty. Human-computer interaction, like other art forms, requires artistry that can only be contributed by human imagination. Artistry is deployed within the constraints of the medium, the tools, and the formal and structural characteristics of the kind of thing that one 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 should drive the notion of *desired experience*, from which the design of technological components must be derived.

Human-computer interaction is like drama in the sense that the principal designer (or playwright) is not the only human source of artistry in the completed whole. In theatre, the director, actors, designers, and technicians who are involved in rendering a performance all make contributions that require artistry. In human-computer interaction, there may be a legion of programmers who have designed and architected programs on which a given kind of action depends, graphic designers who create images and animation, wordsmiths who authored text (or text-generating algorithms), and so on. A fundamental but sometimes overlooked source of human artistry is the people who actually engage in the designed interaction; that is, the *interactors*.

Human-Computer Interaction as Mediated Collaboration

Real-time human-computer interaction is a mediated collaboration between designers and interactors. Mediation occurs through the unfolding of the experience itself in terms of time-displaced collaboration or real-time intervention by designers. The plot can be described, in retrospect, as the story of the whole action that interactors tell themselves (in much the same way as one remembers a film or a day in the park). Wardrip-Fruin (2009) defines interaction "as a change to the state of the work—for which the work was designed—that comes from outside the work. Interaction takes place through the surface of the work, resulting in change to its internal data and/or processes." Designers and interactors co-create the whole action in intricate ways, even though they are not literally co-present. The final form—the element of plot—cannot be exclusively controlled by the designer; it will also be shaped by the choices and actions of interactors. In this sense, the designer loses a significant measure of formal, top-down control as the interactor's choices move the plot from possibility to probability to necessity—the ending of the particular plot that has been created in a player's traversal of a game (or the performance of an activity by a "user") (see Figure 3.2). Unlike branching tree structures, computationally intensive games may enable player outcomes that the designers could not have foreseen. Such was the case with the game "Prom Week" created in 2013 by students and professors at the Center for Games and Playable Media at U.C. Santa Cruz.[1]

The authorship of the designer(s) is of a different order than the creative inputs of the player; the designer authors the world and its affordances, while the player creates a distinct path through the game world that can be said to be the player's "plot." This is a stronger force than the reader-response theory, but weaker than the authorship of the designer(s). As Wardrip-Fruin (2009) points out, without players there is no game.

To explicate the diagram shown in Figure 4.1, I want to walk you through it in terms of the four causes (in gray). In Chapter 2, we discussed the *efficient cause* as the author and her tools. In human-computer interaction, the "authorship" of the interactor's particular experience is shared in

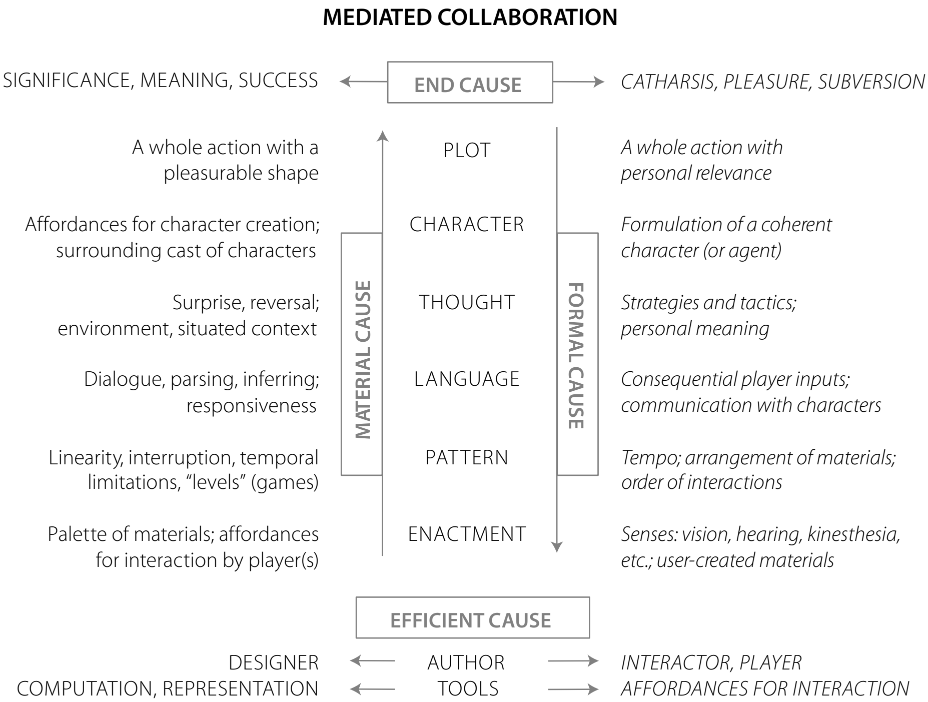


Figure 4.1. *A model of mediated collaboration between "designer" and "player" (or "interactor"). For both collaborators, the formal-material relationships between elements remain constant.*

1. Noah Wardrip-Fruin, personal communication, 2013.

interesting ways. Designers of interactive media are part of the equation, typically working as teams that include many specializations. Their "tools" can be described as representation, computation, and research. Tools for representation include those used for creating graphics, animation, audio, layouts, and interface affordances. Computational tools include the programming of the interactive application itself as well as the code that powers authoring tools for the design team. Another sort of tools, often overlooked, are the methods of design research—studying the intended audience, looking at comparable products, and creating and testing mock-ups and prototypes. Beta testing without the benefit of other design research methods is inadequate. Remarkable resistance to human-centered research persists in many areas—especially in the game industry, with "serious games" as a notable exception.

Interactors typically share in authorship to a lesser degree than designers in that they create under varying kinds and levels of constraints as provided by designers. Affordances for interaction are the most intimate level of collaboration between designers and interactors in the sense that they circumscribe the means, manner, and scope of the interactor's creative contributions and provide the tools whereby interactors can influence the action.

We have said that material causality reflects the influence of materials upon how they may be formulated at any level in the hierarchy of dramatic elements. The palette of multisensory materials offered up by the designer constrains the sort of patterns or rhythms into which they can be formulated, and those patterns or rhythms constrain how the semiotics or "language" of a piece can be formulated. Thought as expressed or available by inference constrains the formulation of characters, and so on.

Recall that formal causality works in the other "direction," where the most formal element—plot—constrains the sorts of characters, thoughts, etc. that are appropriate to the action. These two causal forces are at work simultaneously, rather like taking inductive and deductive approaches simultaneously in problem-solving. Game designers often iterate on the basis of observations of or interviews with play-testers and players. Their privileged position allows for intervening and tweaking a game over time. Will Wright famously strolled about *The Sims* in various forms to observe game play and provide new materials and functionality as he observed emerging play styles (Laurel 2004).

I refer again to the additional causal chains suggested by Michael Mateas (2004). He posits that the player's intention creates a new chain of formal causality. Mateas' formulation points to some key differences between drama and dramatic interaction in the operations of causality. But for my purposes, I see the player's intention as part of the end cause for the player as a co-creator. Mateas also suggests that "material for action" is a separate causal chain in that material requires some sort of interactive affordances in order to be usable by the player. I agree that such affordances are essential, but I see them as being provided by the designer at the level of enactment. If we look at things this way, we may not need to introduce additional complexity to the model.

The authors are working toward similar end causes—the representation of a whole action that produces pleasure. But differences exist. As Mary Flanagan (2009) observes, many players intend to subvert the game—that is, to deny the game's authority to set the player's goals. She has produced many games that deliberately leverage this subversive spirit to increase activism and cultural change. Other players may intend more than "winning" or "experiencing" the whole game; they may intend to find personal meaning that transcends a game's structure. Henry Jenkins, renowned for his work on fandom and popular culture, makes the point that, in order for people to become "fans," they need to be able to appropriate characters, elements of plot, etc. to construct their own meanings. Jenkins points to the "slash" phenomenon in *Star Trek* and other cultural properties where fans construct new stories that are personally relevant by writing stories or constructing videos from pieces of the originals that have new plots. Much slash focuses on creating relationships (usually homosexual) or backstories that are not supported in the official canon (see Jenkins 1992 and 2006a). Several sources of causality outside the purview of Figure 4.1 will be discussed ahead.

Interaction among Interactors

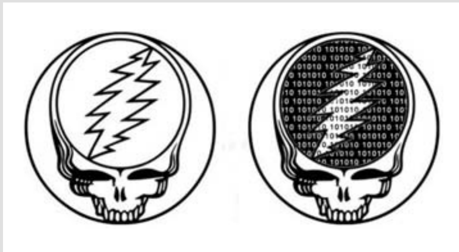
Interaction among interactors is not new, but it has become much more complex and significant since the widespread availability of the Internet. A little history is relevant. The ARPANET (Advanced Research Projects Agency Network), ancestor to the Internet, was conceived in the early 1960s and first deployed in 1969. Its general goal was to support communication and collaboration among scientists and companies in their work on government-related research and development. However, discouraging purely social communication by users did not prevent it.

Multiple interactors engaging in discourses of all kinds go back at least to the earliest BBS (Bulletin Board System). An early precursor to dial-up

Grateful Dead Fans and the Power of Appropriation

Barry Barnes, author of *Everything I Know about Business I Learned from the Grateful Dead* (2011), notes that in 1994—their last full year on the road before Jerry Garcia died—the Dead grossed $53 million in concert revenue. Barnes points to the Dead as progenitors of the "freemium" business model through choices like supporting fans in taping shows (the "taper" section next to the sound board at concerts was dedicated to tapers) and allowing fans to freely use and customize the band's signature graphic materials.

The creative efflorescence of the band's culture (including the omnipresent "parking lot" scene, where Deadhead vendors sold each other Dead-related stuff) formed a distributed community of wildly devoted fans. The band promoted healthy disrespect for "intellectual property" that liberated fans from the commercial swamp of the music industry. Many gleefully crossed boundaries by incorporating copyrighted images like that of Mickey Mouse in their Dead constructions.



Original and personalized "space your face" Grateful Dead images.

As a Deadhead, I know firsthand how this works, and it's brilliant. These scenes of mass appropriation and creative fandom continued with The Other Ones and now with Further. My strange collection of fan-created merchandise and gifts of great tapes resonate with personal meaning.

By the way, although it is a bummer to see tie-dyed folks using walkers these days, there's also a healthy influx of young people—many with children—coming to shows. The Dead just won't die.

BBS-like systems was the *Community Memory Project* in Berkeley, created by Lee Felsenstein in 1973, an electronic walk-up kiosk that worked like a physical bulletin board. Usenet, established at Duke University in 1980, supported threaded discourse among distributed interactors. A person could sign up for a "news feed" on any number of topics. Readers responses were emailed in for moderation, and if they passed the test, their responses would likely show up in the feed in the next few days.[2]

My traversal through some of this space began in the mid-1970s at CyberVision, when I was introduced to the Control Data PLATO system. PLATO was heralded as the first "computer-aided instruction system," created by the University of Illinois beginning in the early 60s. PLATO introduced me to multiplayer flight and maze games as well as message boards, real-time chat, and multi-person forums, some of which had the makings of early collaborative work environments. PLATO also provided me with my first experience of flame wars, in which two or more users would go at one another with ever-escalating vehemence, often "baited" by an original message intended to be provocative. Flame wars can be dramatic, but they pose great challenges to moderators.

The role of the moderator in these early forms was liminal and dynamic. Some of the earliest BBS systems were not moderated, or the "moderator" was likely to be a systems administrator just trying to keep things running smoothly. With the increasing complexity and scope of systems, the mediator's role tended to become more actively engaged with the community, struggling with governance, setting or enforcing policies, and censoring inappropriate comments, actions, or characters. There was also a pastoral side to the moderator in keeping the virtual community connected, vibrant, and safe.

Free speech and censorship have been abiding issues. Whether getting "toaded" on a MUD or mediated into silence on Usenet, people had things they wanted to talk about that didn't fit into "polite societies." Pornography was the leading topic (and probably still is), but all sorts of marginalized voices—from Furries to faeries—wanted to participate in these new forms of communication and community where their own voices can be heard. The alt.* hierarchy was created by John Gilmore and Brian Reid in 1987 in response to a reorganization of Usenet that would eventuate in greater censorship of topics. "Alt" referred to topics that were "alternative"; that is, not part of mainstream popular culture. Although sexual interests made up

2. I want to take a moment to honor Eugene Maia for inventing the FAQ ("Frequently Asked Question list") in the early 1980s. His inspiration was getting sick of people asking the same questions over and over; the canonical answers were posted once a month in any given Usenet discussion list.

Pavel's Reluctant Polity: LambdaMOO

In 1991 at Xerox PARC, a researcher named Pavel Curtis invented LambdaMOO as an experiment in technology that ended up being a grand experiment in government. I interviewed him in 2013, at least ten years after he ceased to be active in the LambdaMOO community. Pavel was primarily interested in implementing a MUD using object-oriented programming. His goal was to create a community around the resources of LambdaMOO to play with the tech:

> *To a large degree, I was in it for the technology. I thought it was just cool to have this language and this ability to* make *things—intelligent or interesting artifacts that people could* play *with, and it was just this great playground, and I was just assuming that everybody would be happy to be there.*

As the community began to form up, Pavel was surprised that he was getting demands for a "statement of manners." Implicit rules of conduct were being upheld by the "Wizards"—Pavel and several of the early players who had sys-admin powers that mere mortals lacked and who actually had physical possession of the server. Pavel figured that reasonable people might interpret the implicit rules differently, so it probably made sense to write them down. These were rules like "be polite," "don't try to take revenge on a person," "respect other players' sensibilities," and "don't hog the server" (Curtis 1992). Says Pavel in 2013, "some rules just came down to 'don't be an asshole.'" In the early years, enforcement for severe or repeat offenders was a process called "Toading"—literally turning off a player's account and leaving a Toad with the player's name on it in the world as an object; but that wasn't effective enough to protect the experience of what I would call sincere *play*ers.

> *There were people who were* invested *in LambaMOO who were just being* mean *to other people. I kept finding people coming to me and asking me to judge what was going on, and I tried to judge with as much wisdom as I could, but it wasn't something I wanted to do and it didn't make me feel powerful or gratified in any way. I think that's one reason why LambdaMOO was successful. The majority of MUDs were being run by college sophomores who were getting*

off on being lords of their domains. I just wanted everybody to get along. It might have been the first MUD run by somebody over 30. I felt more like a beleaguered sys-admin who sometimes had to be a babysitter.

The Wizards were pledged to serve the will of the community, but had no way to know what the community wanted. So in 1993, Pavel introduced a petition process. "It came out of necessity," he says. "I just needed some way to have the collective will expressible." The Proposition structure "worked remarkably well for providing at least some sense of order and process. I provided a structure within which change seemed possible." Rules for vetting were created to make petitions more effective (see Mnookin 1996). The Petition system was also highly controversial, but some extremely smart petitions were created and passed, and the community survives until this day with the process intact.

In retrospect, Pavel shares this wisdom:

LambdaMOO was just one more iteration on the great wheel of BBSs. None of these things ever really disappeared. There are still BBSs and MUDs and Blogs with lively comment communities, and Second Life will probably never die, but it is what it is at this point. We see these communities form when technology changes. Every time we give people another mechanism to communicate, they latch onto it. And then we see human nature happen again. People. Some of them will be assholes, some of them will care an enormous amount. Some will be beautiful and wonderful and some will be hateful and awful. There's such a hunger for these kinds of systems. Facebook is certainly an example. Then human nature does what we expect it to do if we're paying attention at all, and there will always be people who are disappointed because they thought, this time—this time it is pure.

a fairly large percentage of alt.* topics, many were (and are) also devoted to activism, human rights, and free speech issues.

The WELL (Whole Earth 'Lectronic Link), founded by Stewart Brand and Larry Brilliant in 1985, became a very tight community in which many of the digerati of those days found a home. The community was friendly toward the Whole Earth movement and reflected some of the distinguishing bits of Northern California culture (e.g., technology; the Grateful Dead). It was originally a dial-up BBS, morphing with technology into its current form as a user-owned virtual community on the Internet.[3] The WELL required that people use true names, removing the shield of anonymity that had characterized many early systems. As the World Wide Web became popularized, BBS systems and their kin tended to morph into or be replaced by wikis, Internet forums, websites, and social media.

Other forms of interaction among interactors happens in the domain of computer-supported collaborative (or cooperative) work (CSCW). The aim here is to facilitate collaboration on a particular problem or opportunity by people in different geographical locations. CSCW relies on any of a variety of computational tools: file-sharing, shared "whiteboards" and tailored work environments, VNC (Virtual Network Computing) as a way to share screens, specialized tools related to the task (e.g., industrial design, architecture, or any of the sciences), video- or voice-conferencing systems, blogs or email, and IRC (Internet Relay Chat), used heavily by such distributed communities as Linux programmers. The tools are varied and rich. Shared goals, the facilitation of collaboration, and working toward consensus distinguish CSCW interactors from participants in forums or social media.

This tiny history reveals the complexity and centrality of interactions among interactors in non-gaming communities. Once the architecture for a BBS or Usenet group or forum has been set up, its content (except that which is "moderated away") is entirely user-created.[4] Designers create formal constraints and affordances while interactors provide material all the way up to the level of plot, depending upon magnitude and shape. *Interaction between or among interactors may become the primary creators of the plot*—the whole action—complete with complication and resolution, discovery, surprise, and reversal.

Of course, many different kinds of "interactions among interactors" are possible in such systems. People may exchange information, opinions, or goods. One may respond to a post or start a new thread hoping to begin a discussion and possibly to form a new community. One may work with distant colleagues on an invention or a problem. Or one may search anonymously for providers of illicit goods under the anonymity afforded by the alt.net or various "black market" Web sites. In social networks, relationships

3. I am forced to recall a certain boss of mine, who in 1993 told a group of researchers that the Web would never be mainstream. He described it as for " . . . only a few geeks and WELL-heads like *you*, Laurel." Actually, I think his point was to look past the Web to possible new models. But at that moment, we were all stunned.

4. That is, until the onset of the advertising invasion.

Rob's True Name (and Sex)

I joined The WELL in 1990. A number of my friends in Silicon Valley told me "You should join—there are lots of smart and cool people, and there's this fun monthly get together up in Marin County." So I looked into it, using my 2400 baud modem and my Mac Plus, and observed that it did indeed look worthy—and decided to get an account.

This was during the height of my dress-in-black flirtation with post-modernism, body criticism, and neo-feminism, and was also when I was the father of a girl in preschool. I noticed that it might be possible to do some exploration with my personal voice, stripped of common signifiers that always lead to projective gender construction, and see what people thought of me from merely semantic communication, sans beard, blue eyes, or affect.

The WELL stated that its policy was always the "you own your own words," and required people to stand behind them in the online threaded discussion groups. A new account required one's name, and also an "M" or "F" denoting sex. As it turned out, I knew the sysadmin (Calliope Curious) through a mutual friend, and I persuaded her to make me an account with the name "Tau Zero," and to leave the sexual identity blank. Subsequently I was careful to avoid emitting anything that identified myself as either male or female in any discussions, which ranged from science and technology to business, the Grateful Dead, relationships, sexuality, and parenting. I merely expressed my opinions, backed up with the best evidence I knew.

After about a year a curious thing happened. Two people (one from Kansas, and one from the Bay Area) who were active posters in both the sexuality groups and the parenting groups started sending me private messages. These were friendly, and then started to become positively flirtatious—and even suggestive. Both of the correspondents were "out" lesbians, and had assumed, purely from the semantic content of my own postings, that I **must** also be a lesbian.

There was only one thing to do, as a responsible member of the community. I went to Calliope, and had her change the single ASCII character of my sexual identity from a blank to an "M."

The private messages stopped, rather abruptly.

—Rob Tow

are power, and groups of like-minded individuals can take meaningful political action. One may enjoy the lives of one's children by "friending" them on Facebook (ahem).

Habitat, developed by F. Randall Farmer and Chip Morningstar at Lucasfilm, was first launched as a prototype in 1986. It stands as an extremely important transitional form. More than a series of chat rooms or a community like the WELL, *Habitat* was a graphical virtual community that was both a descendant of the forum and an antecedent to massively multiplayer online games. They called their interactors "players" because they meant the world to be an environment for entertainment and play. Each player took on an "Avatar"—a graphical representation of a character with various signifiers—to represent them. One could also argue that *Habitat* foreshadowed what became "social media" in the early 2000s (avatars got *married* in *Habitat*—in-world only, of course). Randy and Chip's vision was to make a real instance of "cyberspace," which, they asserted, was "necessarily a multiple-participant environment" (Morningstar and Farmer 1991). Each of the thousands of "regions" in the game contained "a set of objects which define the things that an Avatar can do there." The object-oriented approach in building the system was the key to the sort of play that was enabled.

Chip and Randy were constantly observing and tweaking the prototype precisely because it was not a game with rigid rules:

> *Habitat* . . . was deliberately open-ended and pluralistic. The idea behind our world was precisely that it did not come with a fixed set of objectives for its inhabitants, but rather provided a broad palette of possible activities from which the players could choose, driven by their own internal inclinations.

The unexpected actions of players kept Chip and Randy busy, both writing new code and intervening in-world as Avatars. They, like Pavel Curtis, were working at the transformation point of the role of "moderator" from sys-admin to dynamic designer of a community. The success of the prototype and its influence on future forms demonstrate how robustly interactions among participants can shape the dramatic action.

Of course, "non-game" interaction did not end with *Habitat's* excursion into an entertaining, graphical, social world. But I see *Habitat* as a pivotal precursor to later online communities—the world of wikis, Web sites, and blogs—as well as graphical multiplayer games and even “social media.”[5] The spirit behind it was fundamentally experimental, even though the external driving force was to create a “product” for Quantum Link.

Interactions among Players

The following wee history is meant to provide a little background on the evolution of multiplayer gaming and some of its sub-genres. Note that many of the games mentioned are still being played in 2013. Interaction among multiple players is as old as *Spacewar!*, a two-person space combat game first developed in 1962. In the PLATO system, *Spasim* (1973) was one of the offspring of *Spacewar!*, with several planets and up to 32 simultaneous players. And PONG, of course, was a two-player action game created in 1972 that eventually led to Atari in all its magnificence.

MUDs (Multiple-User-Dungeons, originally based on Dungeons and Dragons gameplay, later revised to the more generic Multiple-User Domains) arrived on the scene in the late 1970s in the form of *Adventure* (1975) and *Zork* (1977). These were text-based multiplayer adventure-type games, and I personally loved playing them (age check). The PLATO system also hosted progenitors for MUDs and MOOs (MUD Object-Oriented) during this time period.[6] Massively Multiplayer Online Games (MMOGs) showed up in the late 1980s. An explosion of games in the genre followed, while the genre itself branched out to include great new acronyms like MMORTS (Massively Multiplayer Online Real-Time Strategy games) and MMFPS (first-person shooters). *Doom* is an example of the latter; later examples of the genre include *Halo* and *Call of Duty*. In 1991, *Neverwinter Nights*, published by America Online, was the first *graphical* online role-playing game (MMORPG). The MMORPG genre was popularized on the Internet by *Ultima Online* (1997) and *Everquest* (1999). MMORPG games dominate the landscape today, although the MMFPS and MMORTS forms continue vigorously as well.

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5. Social media is fundamentally narrative, to be discussed later in this chapter in the context of Character.

6. This and more information on PLATO games is available an the Universal Videogame List, www.uvlist.net/platforms/games-list/181 (©1998, retrieved 04/23/13).

Mr. Adams' Tricky Decision

In 1985, I was working for Activision as a Producer. One of my "lines" was the Lucasfilm Games (before they began publishing the games themselves). I had the opportunity to work on the game version of the upcoming Lucasfilm movie *Labyrinth*, directed by Jim Henson and starring David Bowie and Jennifer Connelly. The film was envisioned by Henson and awesome fantasy artist Brian Froud, and the original screenplay was written by Monty Python's Terry Jones. The game team included my old friend Steve Arnold (whom I met in 6th grade and had worked with at Atari). Steve had become the General Manager of Lucasfilm Games. The rest of the Lucasfilm team included David Fox, Charlie Kellner, and Christopher Cerf, who was at that time a writer for Sesame Street.

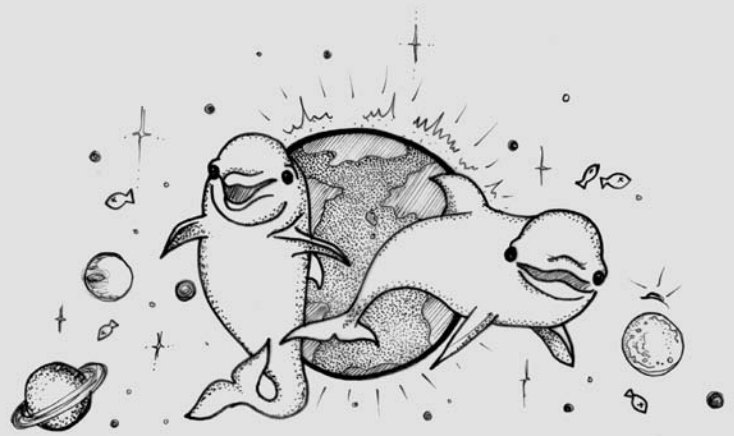
As we worked together on the game concept, Lucasfilm had the amazing idea of putting us together with Douglas Adams, renowned author of *The Hitchhiker's Guide to the Galaxy* and one of the funniest people I have ever met (we miss you, Douglas). So they sent the team over to spend a week in London with the man himself.

Adams was incredibly stimulating. Every day a fresh blast of his wild and intelligent humor stoked up the creativity of the team. We would start off with a piece of the design to brainstorm about in Douglas' living room. By the time we'd eaten our morning croissants, Douglas was off and running, cracking us up until our sides hurt. His humor made us all want to be funny, and we all tried—but it was like singing with Pavarotti. (Douglas also made me eat eel pie at a little shack on the bank of the Thames, but that's another story.)

The peak of the brainstorming was reached when we were working on ideas about how the game might start. Douglas proposed that we begin it as a text adventure game in which the player would navigate to the theatre where Labyrinth was playing and buy a ticket (THERE IS A MARQUIS HERE. :GO LEFT, etc.). The player goes into the theatre, the curtain opens, and a full graphic adventure game begins! The game, although not a blockbuster, was a greater hit than the movie in the United States, although I will never understand why the movie was pulled early from theatres.

On our final night in London, we dined at a high-class London restaurant (pheasant with buckshot was my entrée). Terry Jones sat next to me, and I learned from him that he felt pretty negative about the extensive rewrites of his original movie script. As we spoke about it, he became increasingly overheated and eventually took off his jacket. Presently a waiter appeared and asked Terry *sotto voce* to put his jacket back on. Etiquette, you know. “It’s warm in here,” Terry replied. “I’m sorry, sir, but I really must insist,” said the waiter. Breaking into that high female voice he often used in Monty Python, Terry loudly exclaimed, “I *won’t*!” He rose, knocking a $100 bottle of wine off the table. In the same voice, he addressed the patrons of the restaurant. “This is a *stuffy* place! You shouldn’t be eating here!” Then he strode defiantly out the door, only to slink back in about 10 minutes later to ask his wife for “a couple of quid” to buy himself dinner somewhere else.

At our closing party, Jim Henson talked with us enthusiastically about the future he envisioned for interactive games (we miss you too, Jim). At the end of the night, as Henson was leaving, he presented Douglas with a large package of smoked salmon. “Say it,” Henson demanded. After a moment, Douglas replied, “So long, Jim, and thanks for all the fish.”



The elephant in the marketplace is *World of Warcraft*, originally introduced in 1994 and going strong with over 10 million subscribers in 2013—the largest MMORPG in history. Various types of interactions are enabled by the various “realms” of the game, each with distinctive play properties to suit the palate of the player (for example, how much fighting they want to do). Non-player characters (NPCs)—often with fairly sophisticated AI structures—serve as enemies, friends, wizards, familiars, monsters, and other sorts of forces on the level of character to shape dramatic action.

Through devices like deeds, quests, and guilds, *WoW* as well as many other games of its ilk, provides affordances—often necessities—for significant interaction among players, to work together for common goals or against common enemies.

Lord of the Rings Online (*LotRO*, launched in 2007) employs similar structures that necessitate collaboration. Player-characters have vocations and talents, and most quests cannot be completed by a solo player because they don't have the requisite talents. For example, the "vocation" of the player-character consists of two talents that go together and one that does not. A Tinkerer, for example, can find ore, make jewelry, and collect wood. She can't make anything out of wood, but someone who can will trade her for it. "Everybody gets good equipment out of exchanges," says regular *LotRO* player Lisa McDonald. Trade and commerce—the internal economy of the game—are extremely important to gameplay.[7]

Beginning in the early 2000s, Voice over Internet Protocol (VoIP) has grown as part of multiplayer game experience. Players use a voice channel to shorten communication time, for example. They also use it in-game for social chat and networking. This channel of communication is human-to-human, not to be confused with speech recognition. Voice can enrich the game experience in many ways, from direct impact on the strategies and actions of a player or group to emotional depth and social interaction as well as opportunities for shared criticality.

Like other kinds of properties, multiplayer games engender enthusiastic fan activities outside of the game world, including fan art, conventions, Cosplay, and intertextual fan activities (Jenkins 2006a). These activities form economies of attention as well as legitimate commerce. They provide ways for fans to extend their personal constructions of meaning. Purple Moon provides an earlier example, but one near to my heart. Near the end of the company (and its eventual acquisition), we discovered multiple fan sites where "scarce" gifts and objects from the Web site were being traded by girls. In 2012, the mother of one of the original players alerted me to a Facebook Community called "I Miss Purple Moon." Sweet!

Of course, interaction among players has its dark sides. Sexual harassment continues to be an issue. Cheating in various forms continues as a thriving parasite industry. The ready availability of "legitimate" cheat books and websites suggests that the game industry has had to give up on

7. Interview with LotRO player Lisa McDonald, April 2013.

Kimberly Lau on "Camping Masculinity"

I recently had the pleasure of listening to a fascinating talk by Dr. Kimberly Lau, a professor and provost at Oakes College, and a professor in the Literature Department and an affiliated faculty member in Games and Playable Media at UCSC. She intends to publish a larger piece on the work she previewed for us. Her proposition is that:

> . . . *hypermasculinity might be closely aligned with camp in* World of Warcraft and *that a camp masculinity might share the goal of disrupting hegemonic constructions and constraints, in this case by enabling alternative forms of masculine sociality and opening up spaces for prohibited heteromasculine desires.*

Lau uses the term "camp" in two ways. In *WoW*, players can hang out ("camp") where a character died and whack him every time he re-spawns "as a form of sabotage." Using Susan Sontag's work, Lau gives us a second definition of "camp" as "a cultural practice and a theory of exaggeration, excess, and play." These two definitions come together for Lau in her analysis of in-game interactions and ethnographic studies of *WoW* players.

She began her talk by showing us some examples of hypermasculine figures from MMFPS like *Call of Duty* and *Gears of War*—hyper-hard-bodied fellows with narrow waists and bulging muscles. She observed that these are normative hypermasculine images that are not intentionally "camp." Then she showed us some characters from *WoW*. "I mean, how can a really powerful hypermasculine human frost mage named Chuck Norris—who also happens to be wearing a dress—not be about play and extravagance, about camp?" The scales fell from my eyes. She also screened some highly "camp" commercials from Blizzard featuring William Shatner, Mr. T., and Chuck Norris himself, all with an in-your-face but tongue-in-cheek hypermasculinity based on the "camp" characteristics that many attribute to these actors retrospectively in their "serious" work.

She told us about the cult of Chuck Norris in *WoW*, and mentioned the fact that "Chuck Norris is among the most common, if not the most common, avatar name in *World of Warcraft* with 1081 Chuck Norrises." But I advise caution here; Chuck Norris might be mighty angry if we called him "camp." His commercial was by far the least "camp" of the three we viewed. Further, his affiliations with the NRA and Tea Party

(continues)

lead me to believe that there's more going on with the cult of Chuck Norris than "camp" in *WoW*. Mr. Norris could not be reached for an interview.

Lau's early ethnographic work with adult men who play *WoW* regularly "seems to suggest that *World of Warcraft*'s ability to generate a hypermasculine environment that simultaneously camps heteronormative masculinity opens up a space for alternative forms of masculine sociality." She gave us the example of two long-time adult male friends who decided to play *WoW* together. In-game, the two began to have conversations about their lives with greater intimacy than when they were face-to-face. They were able to communicate in ways that are proscribed in the normative, real-world definition of masculinity. "In essence," she says, "I'm arguing that the very culture of masculine camp that surrounds *World of Warcraft* loosens gender restrictions."

Here is where the two meanings of "camp" come together:

> *. . .I'm suggesting that* World of Warcraft*'s camping of masculinity—its exaggerated, playful, anti-serious representations of masculinity—result in a cultural camping (in the first sense of the word), or sabotage, of hegemonic masculinity.*

I've touched on only a few points of Dr. Lau's analysis, and I look forward to more. Her work sheds new light on masculinity and games and suggests how the "camp masculinity" frame in *WoW* can change interactions among players—as well as how players see themselves—in potentially profound ways.

controlling many forms of cheating and find ways to embrace them. Some forms of cheating may be "blessed" as "subversive play," but not all. In many cases, the player simply wants to "get ahead" without breaking a sweat—and that's not subversive, just lazy in a human sort of way.

"Black market" activities are a constant plague for players and companies alike. The sale of virtual gold for real-world money in *WoW* has been a flashpoint; Blizzard (publisher of *WoW*) and Antonio Hernandez, a *WoW* player, have both filed suit against companies for such practices. Hernandez' suit, filed in 2007, was meant to be a class action against Internet Games Entertainment (IGE). Patentarcade.com, a website devoted to IP protection and the gaming industry, reported that:

> The amended complaint in the Hernandez suit alleged that "IGE's calculated decision to reap substantial profits by knowingly interfering with and substantially impairing the intended use and enjoyment" of *WoW* through its gold-farming, camping spawns, and spamming chat . . . led to lost time, competitive disadvantage, and diminished experience for honest game subscribers (Patentarcade Staff 2009).

Both of these suits were settled, but such practices continue to pop up in ephemeral companies that form fluid but irrepressible parasitical industries, including the sale of accounts with highly valuable characters—a practice forbidden but not snuffed out by most publishers of multiplayer games.[8] Hey, sounds like a good game premise to me. I'm sure somebody's done it.

In conclusion, the previous two sections are intended to illustrate many of the ways in which interactors or players exert causal influences *through their interactions with one another* that are outside of the direct control of designers. By providing affordances for discourse and discussion as well as affordances that encourage or require group action within multiplayer games, designers create conditions for an efflorescence of possibilities for action and experience. At the same time, designers rely on the social, strategic, and artistic actions of individuals to enhance the dramatic shape of incidents and whole actions. Both designers and players can fall prey to parasitic forces that intend to subvert the intended experience. In many cases, designers have had to "embrace and enfold" such forces because of their power (e.g., sale of in-world materials for real-world money) or popularity, as in the case of "cheats," acknowledging to varying degrees that they have become normative. Both designers and interactors are constantly called upon to deal with the various dark economies that plague (and tempt) them. It is up to the designer (or publisher) as well as the virtual community of interactors to safeguard the experience.

8. Like the "ask" for donations to political candidates and even to parties trying to advance legislation, it seems that gaming—like democracy—comes with corrupting influences that must be borne (for the time being) by players and citizens. Of course, opinions may vary.

Constraints

Everyone who participates in an artistic endeavor, be they playwrights, actors, visual artists, or human agents, exercises creativity. One of the most vital contributions of structure is its role in *constraining* the creative process. The relationship between creativity and constraints is mysterious and symbiotic. In multi-interactor forms, social relations among interactors can create powerful constraints on the actions of individual players—in-world, through VOIP, or in dedicated Blogs, for example.

Constraints—limitations on people's actions—may be expressed as anything from gentle suggestions to stringent rules, or they may only be subconsciously sensed as intrinsic aspects of the thing that one is trying to do or be or create. People are always operating under some set of constraints: the physical limitations of survival (air to breathe, food, and water); the constraints of language on verbal expression; the limitations of social acceptability in public situations (e.g., wearing clothes, usually). The ability to act without any such constraints is the stuff of dreams—the power of flight, for instance, or the appeal 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. Good designers are more likely to argue for than against constraints on their own work; constraints give us things to push against and may call up our highest creativity.

Why Constraints Matter

People engaged in designing and participating in human-computer interaction are subject to some special kinds of constraints. Some constraints arise from the technical capabilities and limitations of the programming environment and the delivery system: If the system has no speech processing capability, for instance, people may be constrained to employ the keyboard for verbal input, and further 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. What one can do in a given application environment such as a document creation program, photo editing program, or computer game is but a subset of all that one might be able to do with one's computer.

The design of human-computer interaction should be informed by an analysis of constraints to determine what kinds of constraints are most appropriate. That analysis begins with understanding the various reasons why constraints are necessary.

The platform-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 may have a limited range, constraining people to stand within range of a receiver. The Wii and Kinect are examples of systems that extend human physical involvement; the constraints surrounding their use must be manifested effectively. For example, Nintendo tried to control the all-too-common accident of throwing the controller at the TV by adding a strap, but this did not control people who ignored the strap or got sweaty palms. Physical acts like running or manipulating objects in a Virtual Reality world require conventions whereby 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 design 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 19th-century London (e.g., no computational spyware). Any human-computer system, no matter how elaborate, cannot be expected to comprehend all possible worlds simultaneously. *Constraining how or whether people can introduce new potential into a dramatic interaction is essential in the creation and maintenance of dramatic probability.*

Constraints and Creativity

What is the relationship between the experience of creativity and the constraints under which one performs creative acts? In fantasies and fictions about human-computer systems, we may imagine spaces where we can do whatever we wish.[9] Even if such a system were technically feasible—which it is not, at the moment—the experience of using it might be more like an existential nightmare than a dream of freedom.

9. From someone who did just that: "Cyberspace. It sounded like it meant something, or it might mean something, but as I stared at it in red Sharpie on a yellow legal pad, my whole delight was that I knew that it meant absolutely nothing."—William Gibson, on his invention of Cyberspace, from his talk at the New York Public Library on April 19, 2013.

Many thinkers have explored the relationship between creativity and limitations in some depth. In general, the literature continues to argue for the value of constraints in encouraging creativity, in the arts, business, and life. Patricia Stokes (2005) says:

> I like to think of constraints for creativity as *barriers that lead to breakthroughs*. One constraint *precludes* (or limits search among) low-variability, tried-and-true responses. It acts as a barrier which allows the other constraints to *promote* (or direct search among) high-variability, novel responses that could prove to be breakthroughs.

In his classic book *The Courage to Create* (1975), psychologist Rollo May asserted 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 that 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.

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 whatsoever, 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 one's imaginative power by reducing the number of open possibilities. Limitations, May says, provide the security net that enables a person 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.

The nature of a mimetic world provides a similar security net. Generally speaking, people know that things work better when they respect the limits of a mimetic world as indicated by its structure and affordances as well as the model of it that people are building through experience. 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 characteristics of open systems (like "real life"). People may likely push on the edges of a mimetic world as part of exploration or even in an effort to hack it.[10] Designers need to be flexible and to apply new constraints when they observe actions that disturb the desired structure of experience.

Characteristics of Good Constraints

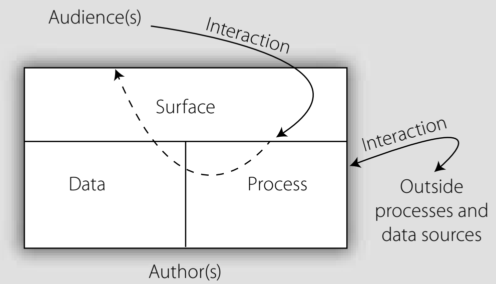
May's analysis suggests that constraints—limitations on the scope and nature of invention—are essential to creativity. Some constraints on interactors' choices and actions are technically essential to any designed interaction. The question is how those constraints should be determined and expressed. Some explicit techniques for introducing constraints—instructions, error messages, or unresponsiveness, for instance—can be destructive of people's *engagement* in the activity by forcing them to "pop out" of the mimetic context into a meta-context 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. In terms of what Wardrip-Fruin (2009) calls the "surface"—the appearance, affordances and behaviors of the delivery system, peripherals, and controllers—explicit constraints may be straightforwardly expressed (although one may still have to consult a manual). In game and non-game environments, explicit constraints may be expressed during the "setup" phase or in the exposition. Exposition in a game can be as simple as the descriptive text on a cover or Web site. Implicit constraints, on the other hand, must be inferred by interactors and players from the behavior of the software system. Implicit constraints exist in the presence or absence of affordances for making certain kinds of choices or performing certain kinds of actions. For example, in most combat-based action games (FPS), it is not possible to negotiate with the enemy.

10. Since I first wrote this book, subversive game-play has become quite a bit more popular. Initially, there were scandals over black-market sites for illegitimately acquiring more powerful characters. The designers of "America's Army" were taken by surprise when players hacked themselves unforeseen superpowers. Since those days, subversive gaming has been (subversively) legitimized as a genre in its own right.

Noah's Surface

The diagram below shows a model of interaction proposed by Noah Wardrip-Fruin in his book *Expressive Processing* (2009).



Interaction in digital media. From *Expressive Processing* by Noah Wardrip-Fruin (MIT Press, 2009). Used with permission.

Noah explains:

When playing a console game, for example, the surface includes the console and any indicator lights or other information it provides, the television or monitor and any image it displays, the sound hardware (e.g., television speakers, stereo, or headphones) and any sound produced, and the controller(s) with their buttons, lights, and perhaps vibrations.

He also notes that other sorts of input devices may be part of the Surface, especially in (but not limited to) videogame consoles, including "dance mats, simulated musical instruments, or cameras." Wii and Kinect fall in this category.

Noah's book focuses on processing, but I find his definition of the Surface quite useful primarily because he includes two distinct sources of interaction: the interactor and outside processes and data sources. In this sense, QR codes as portals could be seen as part of the Surface. The second source opens up the field interaction to inputs from simulations that employ real-world data or direct sensor data from the natural world. I'll expand on the importance of this in Chapter 6.

For the purposes of this book, I exclude the specific images, sounds, and other outputs created by the system in running a particular program and narrow the definition to include simply the affordances for such outputs. With these reservations, I think that Noah's Surface is the best notion of the "interface" (old word) that I have found. It is the affordances of the Surface that explicitly constrain input from the interactor.

Explicit constraints can be used without damage to engagement if they are presented before the action begins. Arguments about rules can seriously disrupt the flow of both work and play. Both activities feel better when the "rules" or "operational principles" of an activity are clearly articulated as a frame for action. An interesting exception is the ongoing process of rule-making and enforcement that is sometimes an element in children's play—a sort of *meta-game* that provides its own distinct pleasures. In my research on play, I've learned that kids generally do not experience disruption as they shift from play to meta-play.[11] A similar meta-game 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 meta-game 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 meta-games or meta-plays do not necessarily violate engagement, but may enhance it through the same means as the mimetic "core" activity.

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 an interactor. Constraints should not be left entirely to the interface affordances of the hardware. 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 a theatrical scene without the use of language (as an exercise) is an extrinsic constraint designed to improve the actors' acuity in physical expressiveness—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.[12] The technique should be used cautiously in human-computer interaction, however, because it has the potential to set up a secondary context that demands part of a person's attention, disrupting "flow."

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11. For example, I once observed the following with a couple of six-year-olds: "Oh I am the princess in the tower and you must save me." "Okay, I am coming on my horse to save you." [some action ensues] "Okay, now we are married and we have a baby!" "Give me the baby. I want to hold it." There was no evidence of disruption in this sequence.

12. See, for example, one of the first best-selling books in this genre: W. Timothy Gallwey, *Inner Tennis: Playing the Game* (New York: Random House, 1976).

Extrinsic constraints can be made to appear intrinsic when they are expressed in terms of the mimetic context. If the "escape" key in a game is identified as a self-destruct mechanism, for instance, the constraint against pressing it in the course of flying one's mimetic spaceship is intrinsic to the action. A person need not shift gears to consider the effect of the key upon the computer or the game. Expressing constraints this way may preserve the contextual aspect of engagement.

Designer Emily Short (2013b) describes the extrinsic and intrinsic qualities of an interactive storytelling system called *Versu* in different terms. She refers to "extrinsic" representation as "information about the extrinsic narrative part of the story," and intrinsic representation as "character files that contain the intrinsic content." In *Versu*, interactors can create stories using these two forms of representation, in which the story is dynamic within the larger narrative frame by getting people "to remix aspects of the story."

Ideally, intrinsic constraints should not shrink people's perceived range of freedom of action, but rather enhance them: *intrinsic constraints should limit, not what people can do, but what they are likely to think of doing*. Intrinsic constraints, when successful, reduce the need for explicit limitations on people's behavior. Context is the most effective medium for establishing implicit constraints. The ability to recognize and comply with intrinsic, 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 a person uses to determine what to say and how to act when he interacts 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 one's 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 a person's actions and expectations. In summary, then, constraints that are implicit and intrinsic to the mimetic context are least destructive of engagement and flow, although explicit and extrinsic constraints can be successfully employed if they frame rather than intrude upon the action.

We can 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 his 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 his 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 legendary acting teacher Michael Chekhov (1953):

> . . . 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.

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 standard scenarios provide *formal* constraints on the action, in that they affect the actor's choices through formal causality. Conventionalized costumes for each character, a collection of scenic elements and properties, and a repertoire of *lazzi* (standard bits of business) provide *material* constraints on the action.

Character as a Constraint System

In human-computer interaction, creating and enacting a user- or player-character is an alchemical dance between designer and interactor. In Aristotelean terms, a character is a bundle of patterns of choices and behaviors that can be described in terms of traits and predispositions. Traits and predispositions provide materials from which action is formulated. They also give form to thought, language, and enactment, and they provide the material for the plot. Specific objectives or motivations on the part of interactors constrain the action in both games and non-game applications.

For instance, a person interacting with a simulation of a space station might be trying to redesign it, 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; a well-designed system assists in bringing that plot to life. When an interactor's objective has been established with a high degree of confidence, the system might kick off a specific scenario by presenting a tailored exposition or *inciting incident*.

Mateas' thesis regarding new lines of causation (Mateas 2004) submits that an interactor's intentions form a new vector of formal causality, and I asserted earlier in this chapter that the interactor's intention may be understood as part of the end cause—that is, what the interactor desires at the end of the day. But there are subtleties in the domain of intention and motivation that make their influence on causality even more slippery to pin down. The overlapping nature of the interactor as a person and also an agent (character) in a mimetic context creates complexity.

Let's work through a few examples. As a person, I want to create a budget plan for my household. As an agent (or character), I wish to use the affordances of my application(s) to do so in a clean and effective way. As a person, I begin to discover dependencies and categorical subtleties that I have not foreseen. Perhaps I have categorized both household products and food together as groceries, or perhaps I have remembered that sales tax has an impact on my income tax, but I have not recorded where I bought certain items and which sales taxes they have been subject to. As an agent, I recognize that I can't meet my goal with mushy categories and incomplete data (change in thought). As a person, my goal changes to create a more precise set of categories and to figure out how to do better accounting of sales tax. At this point, I revise my motivation from planning a budget to creating a better record and understanding of what I am spending now (change in end cause). As an agent, instead of a planner, I am now a researcher and record keeper (change in character). I find myself dealing with different affordances to take different actions for different goals.

Several things are going on here. On the face of it, we have a relatively simple state machine. The subtlety is how a stalled state on the part of the agent (thought) causes the person to change their end cause as an interactor. A change in the *purpose* of the activity will change its *plot* (the whole action). That exerts a *formal* force on the *"character"* of the agent—its traits and predispositions—in order to produce appropriate actions.

Character serves as a constraint system in rather a different way in a multiplayer online game. If, as in *LotRO*, a character with a particular vocation needs to find folks whose talents and possessions lead to fruitful exchanges and group actions, then the character's needs constrain the player to behave in certain ways—to find things to trade, to become more visible to potential partners (reputation), to show oneself to be trustworthy, and so on. In *WoW*, the PvP (Player versus Player) realm assumes combat as the norm; players must fight and can be attacked at nearly any time. Those characters constrain their players to develop combat skills, create alliances, and acquire battle gear and powers. The PvE realm (Player versus Environment) allows players to choose whether or not their characters battle with other characters. *WoW* is much more complicated and subtle than this, but the mode of play as well as affiliations and commitments among characters constrain players' choices and actions in both simple and complex ways. It is not surprising that many players run multiple characters in different realms to experience different kinds of play.

Persona and Character

In social media, people construct *personas*, both for themselves or for other participants in the system. "Persona" and "character" are closely related, but they differ in subtle ways. The word "persona" has its origins in Latin, meaning "mask." The *Oxford English Dictionary*'s (2013) first definition of "persona" is "the aspect of someone's character that is presented to or perceived by others." Most of us have a panoply of personas that we have honed for different situational contexts. I present one persona to the audience at a speaking engagement, another at a party where I know few of the guests, and yet another to a gathering of close friends (I fancy that the latter is closest to my "true self").[13]

"Character" has two meanings that problematize things further. The first meaning is one's authentic moral or ethical nature, as in "he has a good character." The second meaning is drawn from drama and narrative—the way we have used "character" in this book—to mean representation that is made up of the material of thought and performs actions that contribute to the plot, or whole action. I have tried to make the case that an interactor in a non-game environment is performing "character" in essentially the same way. Persona comes about in a different manner. Persona creation consists of acts of collage in social media. Even in multiplayer games, a player may have character (in both senses of the word) as well as a persona. For example, I may perform a very bad-assed, tough-guy character (dramatic sense) in a multiplayer game, but because I don't cheat or camp or behave

13. One of the hardest personas to shake is the one a parent takes on when children are young. As the children grow up, there is a strong pull to change the persona to one that is more equal or genuine, complete with bad behavior. A fine line is walked by parents who are also tugged at to protect and advise their grown children.

in otherwise dubious ways, other players may judge that I as a *player* am a person of good character. In voice communication or on boards related to the game, I may present a persona to other players—e.g., expert player, mentor, activist, etc.

The construction of personae in social networks that are not games is a tricky business. Let's use photography as an example. We all see the enormous changes that have been wrought by point-and-shoot cameras that can enable unskilled folks to make high-quality (if not high-art) images. The coupling of cameras with smart phones makes the point-and-shoot practice even more tempting because it enables near-instantaneous sharing of one's "here and now." The ability to distribute images through various social networks has accelerated the proliferation of photography as a way to play and communicate as well as a way to create one's *persona*.

In terms of technology, one may be an expert in using a sophisticated camera and editing suite, or one may choose to point and shoot, then apply any of a plethora of "effects" applications to create interesting-looking images with much less investment in time or expertise. Both can be engaging activities when the tools and their affordances are well designed. They do differ, however, on the level of character. A "professional" photographer intends to express complex ideas with greater depth—to create "fine art."[14] A casual photographer intends, usually, to express the here-and-now with less planning and attention to expression. As a persona, "expert photographer" will likely not be a good match for the casual photographer who uses quick effects. Although the lucky casual photographer with an excellent eye may be able to get away with it, the casual photographer is more likely to earn a persona identified with a sort of visual gregariousness. In this hypothetical example, we can see how character can constrain persona: A person's "character" (choices and actions) may constrain the sort of persona they may credibly create. Since social networks are so much about personae, I see them as more narrative than dramatic in structure. It may be, however, that the action of constructing a persona has its own dramatic arc.

In this section, we can see that Character operates as a lynchpin in holding the structure of the experience together. Character is where the interactor's and the designer's intents meet. So, in addition to the forces of the four causes shown in Figure 4.1, we can view the level of character as an important locus of constraints.

14. Hilary Hulteen (professional photographer and my grown daughter), personal communication.

Engagement: The First-Person Imperative

Engagement is fundamental to dramatic interaction. It has both cognitive and emotional components. It implies sustained attention as well as a degree of emotional involvement that is shaped as the plot unfolds. Why should all human-computer activities be engaging? What is the nature of engagement, 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 early 19th-century critic and poet Samuel Taylor Coleridge.[15] It is the state of mind that one 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). He noticed that, in order to enjoy a play, one must temporarily suspend (or attenuate) one's knowledge that it is "pretend." One does 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 our*selves* 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 memory or on a storage medium) and hard copy. The artifacts are real (as are actors, lighting instruments, and scenery in a play), but the rules involved in working with the *representations* of dramatic actions or interactions are distinct from the

15. For an analysis and thorough bibliography of Coleridge's criticism, see *Literary Criticism: Pope to Croce*, pp. 221–239.

artifacts. Why? First, the fact that they are representations is the key to understanding what we can do with them. Second, their special status as representations affects our emotions about them, enabling experiences that are, in the main, much more pleasurable than those we regularly 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*.[16]

Further, 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 photo editing suites and document creation software. 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. In the age of the Internet, taking something back once it is *published* is nearly impossible. We and our children need to understand that; fooling around is playful, but publishing is forever.

Engagement is what happens when one is able to give oneself 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 one can rely on the system to maintain the representational context. A person should not 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 designers are often engaged in the wrong activity: that is, representing what the *computer* is doing. The proper object of interaction design is what the *interactor* is doing and experiencing—the action. Thinking about things this way automatically avoids the trap doors into meta-level transactions with "the system."

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16. This principle suggests that activities like running a nuclear reactor or launching a spacecraft—things with real potential in the real world—should be taken off the table when we talk about dramatic interaction. For example, the control system on a nuclear reactor involves many, many representations of the state and operations of various system components, but in the context of real-world consequence, these representational affordances are much more about human factors and tele-operations than they are about the pleasure of interaction.

Characteristics of First-Person Experience

The quality of *first-person* experience generally enhances engagement in interactive media. 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: "He did this; 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, usurping the role of agency.

Agency is a key component of first-person experience. Mateas and Stern (2005) provide an excellent description in relation to the development of their experimental game, *Façade*:

> Like contemporary games, Façade is set in a simulated world with real-time 3D animation and sound, and offers the player a first-person, continuous, direct-interaction interface, with unconstrained navigation and the ability to pick up and use objects. More importantly, as in successful games, the player is intended to have a high degree of agency. A player has agency when she can form intentions with respect to the experience, take action with respect to those intentions, and interpret responses in terms of the action and intentions; i.e., when she has actual, perceptible effects on the virtual world.

Although one may describe experiences in which one is 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 virtual-reality systems.[17] 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, a programmer would submit a program and data on punched cards and come

17. Rob Tow formulates what he calls "The Principle of Action" in terms of sensation and action in virtual reality (Laurel, Strickland, Tow 1994).

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 numbers, programmers were not experiencing a feeling of agency. Today, imploring a system to do something in highly constrained, formal language can engender a similar feeling that somebody (or something) else is in control.

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. Trends of technical evolution in the output of simulators and games—toward higher resolution graphics and faster animation, greater sound capabilities, and motion platforms, for example—seem to confirm this notion. Likewise, mimetic input devices like force-feedback controllers, controllers that enable computers to detect motion in 3-space, and affordances for recognizing speech, gestures, and faces provide a greater sensory palette (and greater "directness") for the interactor.[18]

Sensory first-personness, then, is clearly not limited to the system's "output"; it includes the modalities that people can employ when they take action in mimetic worlds. The desire for symmetry between "input" and "output" modalities is strong. Engagement may be disrupted when an application talks to me (especially if it asks me a question) and I can't *talk* back, at least until conventions of communication have been successfully (and hopefully painlessly) communicated. Further, 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 should make noise when they pop.

When we contemplate the complexity involved in creating first-person experiences, we are tempted to see them as a luxury and 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

18. An interesting exception is the "big-pixel" look currently popular in Indie games like *Sissyfight*. In this genre, it is likely that lower visual definition and imitation of the look of early games act as signifiers for the Indie Games movement.

As the Crow Flies

Body and imagination make for powerful constraint systems. How do you become a crow? Chris Milk's answer was a large-scale video triptych called *The Treachery of Sanctuary* (2012) using Kinect and laser technologies. You see yourself in the panels: in the first, your real-time body image dissolves into a flock of crows; in the second, the crows attack you; and in the third, the crow's luscious wings are mapped onto your arms. The piece shows these transformations as if you were looking at yourself in a mirror.

But what if you want to become *embodied* as a crow who could fly? Here's a pretty gnarly design example that stands the test of time, I think. I include it because of the several interrelated "interface" problems that had to be solved in order to create an embodied affordance for flight.

One of the features of the Placeholder Virtual Reality project (1993) was the ability of interactors to assume the bodies of animals. In fact, the only way you could *have* a body in Placeholder would be to put on one of the "smart costumes" for spider, fish, snake, or crow. You would arrive body-less in a cave, with petroglyphs of these creatures trying to get your attention by calling to you and describing their fine qualities. As you approached a petroglyph, its voice would become louder, encouraging you to "put your head in it." As soon as you did so, you would take on the shape of that petroglyph-animal, including some of its sensory-motor characteristics.

I set about designing how a crow could move by asking people how they flew in their dreams. This was a mistake.

Three versions of dream flight: the airfoil, the superman pump, and the swimming-in-air model.

In the system, each person had a head-mounted VR display with a sensor on it for head tracking, a torso sensor for body tracking, and two "grippees"—these were little strips of plastic that, when flexed, could give an approximation of hand movement. Earlier systems had been "single-handed" with datagloves. We knew

(continues)

that the sense of having both hands would result in greater freedom of movement. We were using hand movement mimetically and practically rather than symbolically or gesturally. These turn out to be important in first-personness in VR worlds.

Anyway, while musing over my failure to come up with a clear "UI" for crow flight, I heard some crows goofing around in the sky above me. I looked up and saw my solution. People may fly differently in their dreams, but everybody knows what flapping means.

Now all we had to do was to figure out how the system could understand a "flap." First, it would require a memory of your actions, at least long enough to notice that both arms had been low and were then high and low again, more or less in synch and within a certain interval. The program would take your "ground" location and set you back in the same place, not letting you fall through the bottom of the simulation. When the code was written, I got to test it. First test: three strong flaps got me about three feet off the "floor." Second test: three strong flaps took me about a "mile" above the whole simulation—I could see it glimmering below me like a marble. And so we tested and tested until we got it right. And I got very strong armpit muscles.

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 movements 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, multi-sensory representation and a representation that squashes sensory variety into a dense and overheated glob (see McLuhan 1964).

Multi-sensory experience offers advantages that go beyond engagement, as media theorist Tom Bender (1976) 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's observations have been supported quite persuasively in computer-based educational activities. Educational simulations 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, multi-sensory 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 interaction.

Empathy and Catharsis

In drama, the audience experiences 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 then-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!"[19]

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 a person's 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 co-makers and participants. Systems that incorporate this sensibility into their basic structure, open up to us a cornucopia of dramatic pleasures. This is the stuff of dream and desire; of life going *right*. It is the vision that fuels our love affair 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, document design, and printing technology that allow me to engage in more of the *whole* action, from inception to final result. In the days of typewriters (age check), one created documents that would be happily transformed in appearance through the process of publication. Through the addition of document design to the application of word processing, and with the assistance of a good 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.

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,

19. Many years later, we went to the Borg Invasion, a motion-platform ride that was part of the now-defunct Star Trek Experience at the Hilton in Las Vegas. At one point, live actors impersonating Borg appeared through a ceiling panel and grabbed a hapless girl (ringer) and pulled her away. My younger daughter was REALLY scared—for a few moments.

fear, and terror are mainstays of non-comic forms. It is not the emotion itself, but its release that is deemed "pleasurable." Further, emotions aroused by a play differ in context and expectation from those experienced in real life. When one is viewing a play or film or even riding a roller coaster, one expects 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 one's ongoing life. Brecht's ideas have been interpreted primarily in a political and social light. Many contemporary "serious games" use a Brechtian approach to catharsis. For example, *Inside the Haiti Earthquake* (PTV Productions 2010), the companion to a documentary film, "challenges assumptions about relief work in disaster situations." The goal of *EVOKE* (McGonigal 2010) is "to help empower people all over the world to come up with creative solutions to our most urgent social problems." These games are part of the "Games for Change" movement. Catharsis could be defined as actions a player may take that influence things outside of the in-game experience.

Catharsis depends upon the way that probability and causality have been orchestrated in the construction of the whole, as well as 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 experiences completion (by "winning," finishing a journey, or other means), and they are the worst when the action is truncated because it could not continue.[20] 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, even when they opt to do it in definable chunks. 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, unless the training goal is simply to help a pilot learn to accomplish some mid-flight 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.

In this chapter we have 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.

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20. Here again, it seems that the designers at Lucasfilm were in the forefront. Ron Gilbert (1989) counseled game designers to avoid situations in which a player must "die in order to learn what not to do next time." In a presentation at SIGGRAPH 1990, 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 inside of 30 seconds.

5 Design Heuristics

most art forms characteristically involve representations of real-world phenomena. As Aristotle observed, art represents *not what is, but a kind of thing that might be*; environments, objects, situations, characters, and actions are represented within a wide range of deviation from real life. The degree and types of deviations are the result of the form, style, and purpose of the representation. In drama, only a few styles (predominantly of the last two centuries) venture far afield from representing characters, situations, and actions that are recognizably human or human-like. Likewise, non-representational styles in painting and sculpture are largely modern developments in Western culture. One reason for the preference for real-world objects in artistic representations, at least in popular culture, may be that they impose relatively less cognitive overhead on their audiences. The principle at work is that real-world objects make representations more accessible, and hence more enjoyable, to a larger number of people. Non-representational styles require exposure to and practice with subtle inferential constructions that many people aren't prepared for by their education.

Computer as Medium

Computers are an interactive representational medium. Wardrip-Fruin (2009) says that modern computers are designed to make possible "the continual creation of new machines, opening new possibilities, through the definition of new sets of computational processes." Indeed, much of the innovation going on today is happening at the level of processing. Understanding what computers are really *doing* is an ongoing definitional process that heavily influences the kinds of representations that we make with them. Uses in such areas as statistical analysis and database management have led to the notion of computers as representers of *information*. Scientists use computers to represent *real-world phenomena* in a variety of ways, from purely textual mathematical modeling to simulations that are symbolic, schematic, or realistically multisensory.

The "outward and visible signs" of computer-based representations—that is, the ways in which they are available to humans—have come to be known as the human-computer interface, or the Surface in Wardrip-Fruin's (2009) analysis. The characteristics of the interface for any given representation are influenced by the pragmatics of usage and principles of human factors and ergonomics, as well as by an overarching definition of what computers are. Interface styles that are indirect—that is, those in which a person's actions are defined as operating the computer, rather than operating directly on the objects they represent—spring from the notion that *computers themselves are tools*. The logic behind the "tool metaphor" goes like this: regardless of what people *think* they are doing (e.g., searching for information, playing a game, or designing a cathedral), they are *actually* using their computers as tools to carry out their commands, as are computer programmers. It follows, then, that what people are seen to be interacting with is the computer itself, with outcomes like information retrieval, document design, learning, or game playing as secondary consequences of that primary interaction.

As McLuhan (1964) observed, a new medium begins by consuming old media as its content. For example, the newspaper gobbled up the broadside in the 17th century as well as the story/report and aspects of the letter (Stephens 1988). Early film, with its fixed cameras and proscenium-like cinemas, began with theatre sans speech as its starting point, with the addition of titles and motion photography; now it is a medium in its own right with its own conventions and techniques that the theatre could not imitate. Both forms survive, but film has found its own language; it has become its own medium. One may say that computers imitate other media: film, newspapers, journals, and the like. But computers, like film, have developed their own unique methods of representation and experience. True, they have embraced and enfolded media like film and newspapers, but have given them a new twist in terms of authorship, distribution, production methods, and interactivity.

DESIGN HEURISTIC

Think of the computer not as a tool, but as a medium.

The notion of the computer as a tool obviously leads to the construction and inclusion of concepts in all application domains that are inconsistent with the context of the specific representation: file operations, buffers, data structures, lists, and programming-like syntax, for example. For purposes of comparison, think about how people use "real" tools. When one hammers a nail into a board, one does not think about operating the hammer; one thinks about pounding the nail. But in the computer medium, the "tool problem" is compounded by existential recursion; the medium can be used to *represent* tools. Some, like virtual paintbrushes, are more or less modeled on real-life objects. Others, like the omnipresent cursor in most of its instantiations, have no clear referents in the real world. It is especially in these cases that interface designers are tempted to represent the tool in terms of computer-based operations that are cognitively and operationally unnecessary for their use. Why? Because the computer-oriented representation is seen as an "honest" explanation of what the tool *is* and how it works, and because that's how the *designer* understands it. People quickly become entangled in a mass of internal mythology that they must construct in a largely *ad hoc* fashion, in contrast to Rubinstein and Hersh's notion of a clear and consistent "external myth" (1984). As an interactor, one may quickly fall through the trap door into the inner workings of the computer or the software.

DESIGN HEURISTIC

Interaction should be couched in the context of the representation—its objects, environment, potential, and tools.

Interface Metaphors: Powers and Limitations

The notion of employing metaphors as a basis for interface design has partially replaced the notion of computer as tool with the idea of computer as *representer of a virtual world or system*, in which a person may interact more or less directly with the representation. Action occurs in the mimetic context and only secondarily in the context of computer operation. Metaphors can exist at every level, from the application (your remote is a gun) to the whole system (your screen is a desktop). The theory is that if the interface presents representations of real-world objects, people will naturally know what to do with them.

I can't resist including this old quote. In 1990, Ted Nelson delivered a deliciously acerbic analysis:

> Let us consider the 'desktop metaphor,' that opening screen jumble which is widely thought at the present time to be useful. . . . Why is this curious clutter called a desktop? It doesn't *look* like a desktop; we have to tell the beginner *how* it looks like a desktop, since it doesn't (it might as easily properly be called the Tablecloth or the Graffiti Wall).
>
> The user is shown a gray or colored area with little pictures on it. The pictures represent files, programs and disk directories which are almost exactly like those for the IBM PC, but now represented as in a rebus. These pictures may be moved around in this area, although if a file or program picture is put on top of a directory picture it may disappear, being thus moved to the directory. Partially covered pictures, when clicked once, become themselves covering, and partially cover what was over them before.
>
> We are told to believe that this is a 'metaphor' for a 'desktop.' But I have never personally seen a desktop where pointing at a lower piece of paper makes it jump to the top, or where placing a sheet of paper on top of a file folder caused the folder to gobble it up; I do not believe such desks exist; and I do not think I would want one if it did.

The reaction to Nelson from the Xerox PARC inventors would likely be something on the order of "Geez, Ted, lighten up. It's a *magical* metaphor, and it's *fun*!"

The problem with interface metaphors is that they are like reality, only different. Why should this matter? Because we usually don't know precisely *how* they are different. Some of the applications built with Wii affordances—playing tennis or directing an orchestra—actually *do* work metaphorically. The primary reason is that the affordances of the controller in the context of the application are designed to closely match the affordances of the object and activity being represented. The interactor can forget about the controller and feel secure in suspending disbelief.

Historically, however, interface "metaphors" have usually functioned as *similes*; whereas a metaphor posits that one thing is another, a simile asserts that one thing is *like* another. But what is being compared to what? Now there is a third part to the representation: the simile (say, a representational phone and address book), the real-world object (a real phone and address book), and the thing that the representation really *is*—a bundle of functionalities that do not necessarily correspond to the operations of the real-world referent, augmenting it with "magical" powers like the ability to "search" for a name or number, click on a number and make a call or send a text message, or display a current photo of the contact that is automagically updated. This phenomenon is well illustrated in Nelson's comment, where he never uses the word "folder" at all, but refers to it as a "disk directory." The simile becomes a kind of cognitive mediator between a real-world object and something going on inside the computer. What Ted misses is that the "disk directory" as presented in a command-line interface is as much a metaphor within *that* interface as it is when presented as a "folder" within the desktop interface; it is a presentation of information to and a mediator of actions with the user in a medium of otherwise invisible entities.

What happens to people who are trying to use interface similes? Alas, they must form mental models of what is going on *inside the computer* that incorporate an understanding of all three of these questions (What is the object being represented? What is the representational object's qualities? How is the representational object different from the object of the representation?). In this way, interface "metaphors" can fail to simplify what is going on; rather, they tend to complicate it. People must explain to themselves the ways in which the behavior of mimetic objects differs from the behavior of their real-world counterparts.

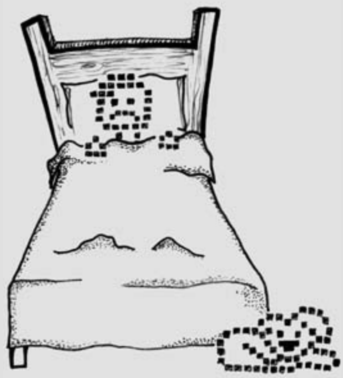
To put it another way, the problem with interface metaphors (or similes) is that they often act as indices (or pointers) to the wrong thing: the internal operations of the computer. John Seely Brown (1986), former head of Xerox PARC, puts it this way:

> . . . it is not enough to simply to try to show the user how the system is functioning beneath its opaque surfaces; a useful representation must be cognitively transparent in the sense of facilitating the user's ability to 'grow' a productive mental model of relevant aspects of the system. We must be careful to separate physical fidelity from cognitive fidelity, recognizing that an 'accurate' rendition of the system's inner workings does not necessarily provide the best resource for constructing a clear mental picture of its central abstractions.

Feeding the Little People

In 1985, when I came to Activision as a producer, I inherited a great little product called Little Computer People. It had already been published on the Commodore 64 and was in the process of being ported to other platforms when I made its acquaintance. Designed by David Crane and Rich Gold and originally produced by Sam Nelson, the game was a short-lived hit. It inspired other games and toys in time, especially The Sims by Will Wright.

The Little Computer Person lived in a little pixilated house on your screen. He was said to live in your computer all the time, but the software let you play with him. He remembered your name. He would tap on the screen to see if you wanted to play poker with him, although he sulked when he lost. If you asked nicely, he would play piano for you too. You could coax him to feed his dog, but if you didn't supply him with adequate food and water, he would grow weak and take to his bed.


The little dude would take to his bed.

Of course, the sales and marketing folks at Activision took the Little Person on the road with them to demo at various conventions like CES. But there was a problem. The sales folks never remembered to feed him. There they'd be on the show floor while this little guy was getting sadder and sadder. In fact, he often died on the road.

Our solution was to make a fake Little Computer Person who never got hungry or thirsty for the sales folks. I still wonder whether that was the right thing to do. Maybe they needed some character development.

Brown's observations are as relevant today as when he initially made them. The term "central abstractions" seems to be roughly equivalent to what I call the representation. The point, then, is that the object of the mental model should not be what the computer is doing, but what is going on in the representation: the context, objects, agents, and activities of the virtual world. Users do not need to understand what a POSIX file link "is," nor how a journaled file system protects against disk-drive write errors.

Another strength of good interface metaphors is coherence—all of the elements "go together" in natural ways. Folders go with documents, which go with desktops. To the extent that this works, the mimetic context is supported, and people can go about their business in a relatively uninterrupted way. But there are two ways to fall off the desktop. One is when you start looking for the other things that "go with" it, and you can't find them. In the original version of this book, I mentioned filing cabinets, telephones, blotters for doodling and making notes, or even an administrative assistant; today, that would be a terabyte hard drive, Skype, Stickies, and agents like Siri (whom I would fire, by the way). I still can't doodle very well on my Mac, but that's probably about me (and the fact that I don't have a tablet peripheral). The metaphor may in fact have played some positive role in the development of these deskly affordances. The more common way to fall off the desktop is to find something on it that doesn't "go with" everything else, thereby undermining or exploding the mimetic context; for example, a trashcan that either (1) works to "throw away" files *or* (2) works to eject disks or drives: fundamentally differing operations overloaded on to a single "object."[1]

A third, highly rated strength of interface metaphors is their value in helping people learn how to use a system. The difficulty comes in helping a person make a graceful transition from the entry-level, metaphorical stage of understanding into the realm of expert use, where power seems to be concentrated specifically in those aspects of a system's operation for which the metaphor breaks down. In this context, the usefulness of a metaphorical approach can be understood as a trade-off between the reduced learning load and the potential cognitive train-wrecks that await down the track.

DESIGN HEURISTIC

Interface metaphors have limited usefulness. What you gain now you may have to pay for later.

Alternatives to Metaphor in Design

A dramatic notion of representation provides a good alternative to metaphor in at least three ways. First, we can effectively represent actions that are quite novel by establishing causality and probability (the notion of probable

1. The fix for this in OSX is still clumsy. Dragging the icon for a disk drive towards the trash icon on the application bar causes the trash icon to change from a trashcan to an "eject" button; an improvement, but still confusing.

impossibility). True, representations may not have any real-world counterparts, but they may exhibit clear causal relations. Second, effective representation of such objects or actions probably requires a sensory (visual or multisensory) component. The sensory component may even be expressed in text, as interactive storytelling applications have demonstrated. Third, a represented action or object must be self-disclosing in context, even if its attributes or causes can only be determined through successive discovery in the course of a whole action.

The Primacy of Action

One shortcoming of many metaphorical interfaces is that their design tends to be guided by the goal of representing *objects and relations among them* as opposed to representing *actions*. Often, the former seems easier to do.

Strategy and Tactics

I have found a strategic approach helpful in keeping focus on the action. The foundations of strategy as I use the term are essentially military, as expressed by Sun Tzu in *The Art of War* (written around 500 BCE) and more explicitly by Liddel Hart in his book *Strategy* (1954, revised edition 1991). But we apply strategic thinking to the work of design as well. Figure 5.1 shows a basic diagram.

The grand strategic goal is the main event. Tow (2004) calls this "a three-level top-down structure." Strategies are "distinct patterns of action" in support of the grand strategic goal. The third level down gets us to tactics, more detailed actions in support of strategies.

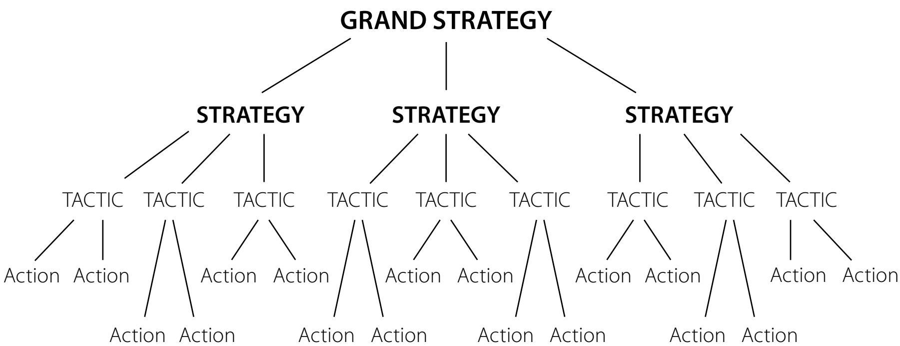


Figure 5.1. *A model of grand strategy, strategy, and tactics drawn from Lidell Hart*

Strategy and Tactics in War and Tech

Following Lidell Hart's structure, the grand strategy in World War II was to defeat the Axis powers. An example in design would be Microsoft's desire to dominate the PC desktop. The next level down is that of "strategies." Lidell Hart described strategy as "the art of distributing and applying military means to fulfill the ends of the war." The bottom level is "tactics."

A grand strategy has more than one strategy in support of it. In war, strategies are the types of battles that are fought and how they are conducted. Examples from World War II include daylight strategic bombing, unrestricted submarine warfare, and blitzkrieg combined-arms maneuvers. In research, examples include Edison's strategy of methodically testing thousands of substances for the filament of the incandescent light-bulb and or Goodall's careful observations of chimp behavior. Both of these latter examples are "dialogues with Nature," where previous understandings lead to a choice of observations and measurements, with expectations that may be contradicted by what Nature actually does. In design, think of Apple's push-on-touchscreen technology for the iPhone, deployed when everyone else had keypads.

Strategies are supported by tactics. These are the details in the smallest of battles, the day-to-day struggles. They change rapidly. Examples include the infantry assaults on pillboxes on Omaha Beach on D Day and the adoption of MP3 as a format by Rio in the 1990s to sell music hardware.

A key innovation in strategic thinking in World War II was the development of "operational research," a kind of meta-strategy that is applied in general to the conduct of a strategy. It consists of marshalling logistics according to Bayesian probabilities, and is sometimes counter-intuitive. An example is the development of the convoy system during the Battle of the North Atlantic. German U-boats were sinking much of the transport shipping from the United States to Britain, and supplies were perilously low. In fact, it looked for a time as though Germany would win the battle, and Britain would surrender without being invaded. Bunching ships together meant that they were statistically better protected by escort destroyers; even if a U-boat wolf pack found a convoy, it couldn't sink as many ships on average as it could by sweeping the sea for isolated freighters. Another simple change was painting aircraft white rather than black; lookouts on the U-boats were not able to see the aircraft until they were 20% closer—this one change increased the number of U-boats destroyed by aircraft by 30%.

(continues)

> Many workers in research and in design start their efforts by falling in love with a whizzy strategy—or worse yet, a mere tactic—and then try to dream up something grand to do with it. This is like the Polish obsession with the glory of horse cavalry tactics at the eve of World War II, doomed to failure in competition against Guderian's panzer divisions when the blitzkrieg came across the border.
>
> —Rob Tow

I've added into my graph the level of "actions." In a military sense, logistics operate on the same level as strategy because the logistics plan goes toward supporting the grand strategic goal in a more general way. How to get supplies, food, and fuel to many areas in the "theatre of war" is not specifically tied to any given strategy or tactic, but works in parallel to serve many operations in different locations. Here I am using the term "action" to refer to what is necessary to meet a particular tactical goal.

Figure 5.2 is another version of the same graph with some new information. First, a given strategy can support more than one grand strategic goal. Likewise, a particular tactic may serve more than one strategy.

Figure 5.2. *A strategy may work in support of more than one grand strategic goal, just as a tactic may serve more than one strategy.*

My old company Purple Moon provides a good example. Our original goal was to create an engaging computer-based activity that would be enticing enough to get "tween" girls (ages 7 to 12) to use a computer and become comfortable with it. You may be old enough to recall that the landscape of computer games and videogames in 1998 was dominated by games specifically addressed to the interests and play patterns of boys. Our gender studies revealed that girls and boys exhibited some strong differences in how they thought of "play," hence our desire to create content with play patterns that would appeal to girls' play preferences. But as we were doing the research and designing the games, we were hearing from girls that they often felt "stuck" in their social and emotional lives. Many experienced a sense of inevitability about things that happened with friends. So our second grand strategic goal emerged: to provide an *emotional rehearsal space* for girls that would allow them to try out different social choices. Most of our strategies served both grand strategic goals.

Figure 5.3 is yet a third diagram that replaces the generic terms with some specific ones, in this case related to game design; we could make such a diagram for non-game interactions as well, but I think you get the point.

One of the ways in which strategic analysis of this sort is useful is to give us criteria for the inclusion or exclusion of materials at any level of

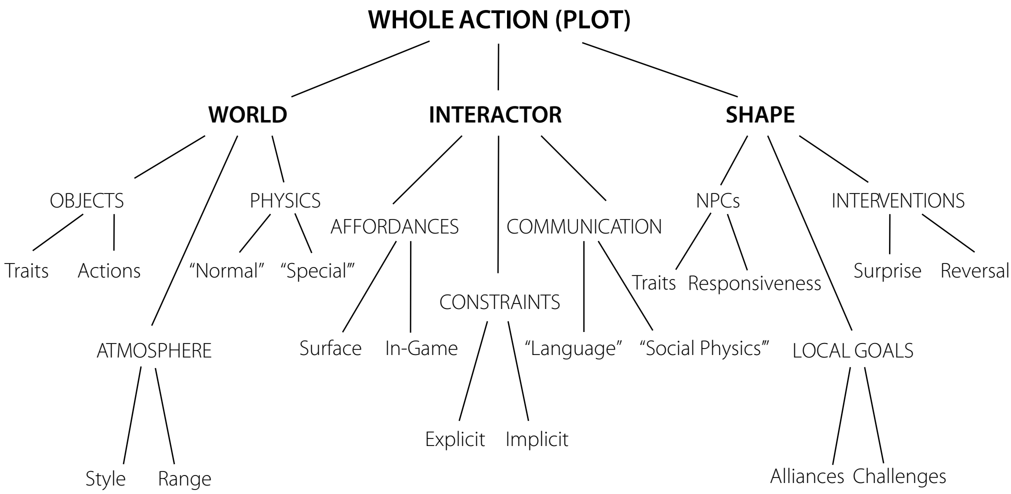


Figure 5.3. *A strategic diagram with elements at strategic, tactical, and supporting levels drawn from game design. Many such diagrams are possible.*

formulation. For example, if a particular tactic is interesting and fun to the designer, but does not serve any strategy, then it is extraneous and should be eliminated or rethought, “for that which makes no perceptible difference by its presence or absence is no real part of the whole” (*Poetics* 1451a, 34–35).

DESIGN HEURISTIC

Focus on designing the action. The design of objects, environments, and characters must all serve this grand strategic goal.

Action with a Dramatic Shape

In the section on constraints, we spoke about designing what people *think* of doing as a way to help create dramatic action. Interventions by the designer in the form of discovery, surprise, and reversal are also effective. Responsive non-player characters (NPCs) that can adapt to players’ choices in games can also be designed to push the slope and speed of dramatic action under specific conditions.

Game designers still puzzle over the question of dramatic shape. The greatest successes that I know of in this regard lay out a story arc “in the large” through the selection and arrangement of challenges, venues, NPC behaviors, and elements of action like quests and levels. In Aristotle’s view, the authoring of plot consisted of the selection and arrangement of incidents. A designer of interactive media has the same power; it is in what way and how much that power is used that influences an interactor’s experience of agency.

Game designer and scriptwriter Clint Hocking (*Splinter Cell*, *Splinter Cell: Chaos Theory*, *Far Cry 2*) proposes a generative view of the shape of an interactive plot (2013). He describes the “region of story” as “low frequency, high amplitude” shifts or curves. The “region of choice” he sees as “high frequency, low amplitude” curves. Combining these curves can give us the shape of a game, but that is only possible if the two regions of the game are aligned with one another. Part of Hocking’s proposed solution is to “align verbs”—that is, to express interactive choices with verbs that correspond to those in the overarching narrative.

As I listened to Hocking speak, I wondered if one might simply nudge the shape of the region of story into one that looks more like the shape of a dramatic plot. When I contacted him, he explained to me how that was exactly what they were trying to do in *Far Cry 2* with the development of *infamy*, a condition in which a player who needs cooperation from NPCs becomes both very powerful and feared by them, thus the fall. Hocking's description reads like classic tragedy.[2]

Hocking thinks that "consequentiality" may be a better axis to track than complication and resolution over time. Consequentiality is what the low-frequency, high-amplitude curve is mapping. In that sense, he is talking about causality and probability. I realized that causality isn't mapped in the Freytag diagram, and the shape of the plot over time isn't mapped well in the "Flying Wedge" diagram. We need a new way to visualize it.

A "consequential" incident may be a "small" event in terms of dramatic intensity that impacts the probability of something "large" happening later on. Playwrights can plant such incidents (either as causal over time or as foreshadowing) and lead us to the conclusion that, in retrospect, a seemingly inconsequential action causes a great change later on. In a land where thieving and smiting are fairly common, a man beset at a crossroads kills all but one of the folks who seem to be holding him up. Later he learns that he has killed his own father. After the consequences occur, we can trace "causality" back to the consequential incident, but we can't predict it beforehand.

In games, by creating environments and NPCs with specific behaviors and rules, the designer can increase the possibility for consequential incidents to be generated through the player's interactions with the environments and the NPCs. When a player makes a particular choice that may seem inconsequential, the possibility for certain actions to occur is transformed into probability. Hocking (2013) provides this example:

> In *Thief* (which is a highly consequential game) the low level action of leaving a body unhidden might cause a group of guards much later in the level to become agitated—changing the way I navigate a subsequent series of rooms.[3]

Now, this is not as hairy as what happened to Oedipus, but it might lead to other challenges or transform another possibility into probability for an action or event to occur later on.

2. For an in-depth analysis of the tragic component of *Far Cry 2*, see an excellent essay by Cesar Bautista (Penn State, CS) at http://ceasarbautista.com/essays/far_cry.html.

3. Hocking, personal communication, May 18, 2013.

Hocking's notion of "consequentiality" is a sort of simulated butterfly effect,[4] a term coined to describe a central idea in chaos theory developed by Edward Lorenz (1963). Lorenz's phrase "sensitive dependence on initial conditions" means that a small change in one place (such as a butterfly flapping its wings in Brazil) can cause much larger changes later on, and that these changes are unpredictable (such as a tornado in Texas).[5] The butterfly seems innocuous, but in retrospect it is highly consequential. In dramatic terms, such incidents may be discoveries, surprises, or even reversals, all potent elements in the shape of dramatic action (see Figure 5.4).

Depending upon how the environments and NPCs are designed, the designer can tip the scales toward consequentiality and shape dramatic action.

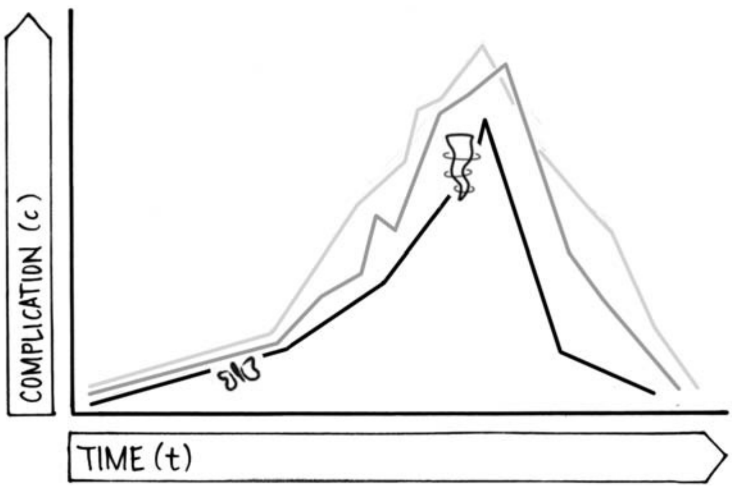


Figure 5.4. *An early incident (the butterfly flapping), although it may seem inconsequential, can increase the probability of a highly dramatic event later on (the tornado). If the butterfly doesn't flap (or the player doesn't make that particular choice), the plot may take other directions and shapes.*

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4. When I mentioned this to Clint, he laughed and said that his original title for *Splinter Cell: Chaos Theory* was *Splinter Cell: Butterfly Effect*. And here I thought I was being so smart.

5. At a meeting of the American Association for the Advancement of Science in 1972, Philip Merilees suggested a title for Lorenz's paper: "Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?"

In the world of text-based interactive storytelling, Emily Short (2013b) takes a unique approach with *Versu* (discussed in Chapter 4). At the bottom level, *Versu* contains genre definitions—a collection of information that includes the ethics and "rules of conduct" for different story types. The next level up are "story files":

> *Story files* contain premises, situations, and provocations. They lay out locations and objects that characters might encounter, and provide narrative turning points that might depend on how characters currently relate to one another. Story files create opportunities for characters to change their views of one another, come into conflict, and have to make difficult choices, or perhaps to discover what is going on in the narrative scenario.

Character files "contain character descriptions, preferences, traits, habits, [and] props unique to that particular character" as well as the character's hopes and goals. Characters' goals may change during the course of the action. Emily introduces the notion of "social physics" to describe the network of relations among characters and how it may change.

I am struck by the interesting differences between Hocking's and Short's thoughts in terms of the granularity of player (or "character") actions and the workings of the overarching narrative scenario. Both approaches seek to retain the sense of agency through interaction, while bounding the dramatic shape of the whole. Short (2013a) mused that she would like to design a "drama manager agent" that could create new situations.

DESIGN HEURISTIC

Choices for (and by) interactors can transform possibility into probability for dramatic action later on.

Designing Character and Thought

Let's begin at the beginning. Who or what is the source of these messages?

```
Are you sure?
Loading.
Your application has unexpectedly quit.
I DON'T KNOW THAT WORD.
```

Who or what is the receiver of these messages?

```
Insert text box.
Check spelling.
Quit.
```

Who is the agent of these actions?

```
Logon.
Save.
Apply style.
Delete *.*.
```

And now, for the million-dollar question: Who said the following?

```
Pay no attention to the man behind the curtain.
```

Free-Floating Agency

Without clear agency, the source and receiver of messages in a system are vague and may cause both frustration and serious errors. Without clear agency, the meaning of information may be seriously misconstrued. Without clear agency, things that happen are often as "magical" and fraudulent as the light show created by *The Wizard of Oz*—and the result of accidental unmasking can be unsettling, changing (as it did for Dorothy and her friends) the whole structure of probability and causality.

There are two primary problems involved in the vague way that agency is often handled in human-computer interaction. The first is that unclear or "free-floating" agency leaves uncomfortable holes in the mimetic context—holes that people can fall through into the twilight zone of system operations. The second is that these vague forces destroy the *experience* of agency for humans. Typically, these sorts of transactions require that people set parameters or specify the details of a desired action in some way, but the *form* of the transaction is one of supplication rather than cooperation; one might as well apply to Central Services for permission to sit down (age check). As the Cowardly Lion says, "let me at 'im"; let me confront the source of all this bossing around, face to face. Unclear agency places the locus of control in a place where we can't "get at it." Even though we are in fact *agents* by virtue of making choices and specifying action characteristics, these shadowy forces manage to make us feel that we are *patients*—those who are done unto, rather than those who do.

DESIGN HEURISTIC

Represent sources of agency.

Collective Characters

As we discussed in Chapter 4, interactions among interactors make distinct contributions to the unfolding of the whole action or plot. In computer-supported collaborative work applications, for example, Löwgren and Reimer (2013) remark on the relative lack of literature treating computers as a medium for interactions among people. In CSCW as well as in multi-player games, groups of people with common goals form and reform to act in concert, for a time. These groups may be considered "characters" in their own right. Once a group has formed—to carry out a quest, for example—there are still very active dynamics among its members (perhaps including treachery and secession), but the quest group as a whole tends to take actions as a unit toward reaching a particular in-game goal.

Technically, we can understand such "collective characters" in terms of the aggregate of thought that is the material cause of their actions. We can understand the quest as the action, and its success or failure has implications for the plot. By providing potential goals for collective characters, designers create formal constraints that encourage their formation, adding a new level of richness to the action.

DESIGN HEURISTIC

Groups of interactors with common goals may function as collective characters where group dynamics serve as traits.

Affordances for Emotional Interaction

Aristotle identified the end cause of drama as catharsis—the arousal and release of emotion. Emotional expression and communication are essential in dramatic art. It follows, then, that designers of dramatic interaction pay close attention to the emotional dimension of their work. Certainly, the scripting of game scenarios, situations, and characters shows strong evidence of game designers' ability to incorporate emotion through gameplay. I want to look at a few other aspects of emotional interaction, beginning with facial expression.

In his book *The Expression of the Emotions in Man and Animals* (1872), Charles Darwin meticulously explored the commonalities and differences among emotional expressions as well as the "why" of the ones he identified as basic. Darwin posited that emotional expressions (primarily facial) were universal among humans and not dependent upon culture or learning. Long opposed by cultural relativists, Darwin's work has reemerged as good science, stimulating new interest and research in recent years. In the preface to the third edition, scholar Paul Eckman notes that since the mid-1970s, "systematic research using quantitative methods has tested Darwin's ideas about universality."[6] Eckman's research confirmed Darwin's conclusions. While gesture is much more culturally relative, Darwin said, facial expressions related to basic emotions are legible to all humans.

Of the many emotions treated in Darwin's book, at least six are seen to be fundamentally universal: happiness, sadness, fear, disgust, surprise, and anger. Images of masks worn in the Greek theatre exist for each of these emotions. Both Darwin and Eckman discuss many more emotions as candidates for universal expression, including amusement, contempt, contentment, embarrassment, guilt, shame, pride, and relief. Facial expressions of many of these emotions can be seen in the leather masks used for "stock" characters of the Commedia dell'Arte, including the pompous doctor Il Dottore, the miserly merchant Pantalone, or the amorous wit Arlecchino. The Commedia was a semi-improvisational street theatre form that reached its zenith in 16th-century Italy. The stock characters may be traced back at least to Roman Comedy and continued through the Middle Ages via wandering Medieval entertainers (Duchartre 1966). The Greek and Italian masks—along with masks from Africa, Asia, and around the world—attest dramatically to the "universal legibility" of emotional facial expressions.

Since the original version of this book, we have developed sophisticated technological means for recognizing faces and facial expressions. Likewise, animation techniques have given us the ability to represent them with great acuity. It follows that one way we can use these affordances is to "read" emotional facial expressions of interactors and to respond to them

6. Eckman was, by the way, science advisor to the remarkable and too-short television series *Lie to Me* (2009-2011), centered on the work of an investigator (played by Tim Roth) who is uncannily skilled at reading facial and body cues.

It's All About Feelings

At the founding of Interval Research in 1992, we were charged with "inventing something as different from the personal computer as it was from the mainframe"—basically, to repeat in a new wave what Xerox PARC had done with the Alto and the Star systems.

I proposed that we build things that, in contrast to the PC, communicate emotionally (facial expressions, affect sound, bodily gestures), have a multiplicity of senses, move about in the world, express by movement and actions an experience of a social world shared with others of its kind and with people, and exhibit flocking behavior.

I got permission and a budget, put together a team of programmers and a mechanical engineer, and set to work to do historical, design, and experimental research to inform the building of emotional robots.

There were two main inspirations. The first was Charles Darwin's wonderful book *The Expression of the Emotions in Man and Animals*. The second was Chuck Jones cartoons. We were familiar with the "uncanny valley," in which humanoid robotic faces become creepy if they are too similar to real faces, yet not indistinguishable. So we went the opposite way, in terms of design, and studied cartoons to see what were the minimal line elements to communicate emotions. We ended up with an expressive face, with six degrees of freedom, that was a physical cartoon in brushed aluminum and polished steel. We had a big debate about the importance of a nose (we left it out—and found that made expressing disgust difficult).

Our first experiment was to build the Mark One Severed Head (after our mechanical designer, Mark Scheeff), a cube with camera eyes, eyelids, eyebrows, and lips that were servo controlled from a computer keyboard. We asked people to use the control keys to move the facial elements to make the robot happy, sad, angry, afraid, etc., to build up a table of control points for the robot. Much to our surprise, people mimed the same expressions on their faces as they caused on the robotic face. Looking back, I think we found evidence of "mirror neurons"—the internal modeling of the feeling and intent of an "other."*

We proceeded to make a full-up robot, with a body. It had two gendered voices, a male and female set of utterances audio morphed with a trombone, like the old Snoopy TV character. It had a sense of touch with two sub modalities of an

* Rizzolatti and Craighero (2004). "The Mirror-Neuron System," *Annual Review of Neuroscience* 27: 169–192.

(continues)

accelerometer and capacitance. Finally, it had twin color cameras that provided stereo depth perception. It had a blackboard architecture with a multitude of perception/action daemons, and a state machine that had seven emotions with a three level "adrenalin" excitation.

We then made another interesting discovery about how people perceived and interacted with the robot as both moved through space and time. Our robot had no memory; it was what we called a "Zen bot"—it always acted on the Now of its senses. Yet people insisted that it remembered them, and would say "See? It remembers me! It acts differently with me than it does with you!"

And we realized that the last statement was true—*because the person was the robot's environment*—and the coupled system of person and robot always behaved differently from a different dyad—*because the person felt differently.*

—Rob Tow

in the same way—through facial expression. So, for example, mirroring the facial expression of another person is a way of establishing empathy or connection. In acting exercises, actors carry on entire "conversations" with the use of facial expressions alone.

Of course, our voices, words, and gestures communicate emotion as well, often refining what our faces are saying about us. Klaus Scherer has done canonical work in "The Expression of Emotion in Voice and Music" (1995):

> Vocal communication of emotion is biologically adaptive for socially living species and has therefore evolved in a phylogenetically continuous manner. Human affect bursts or interjections can be considered close parallels to animal affect vocalizations. The development of speech, unique to the human species, has relied on the voice as a carrier signal, and thus emotion effects on the voice become audible during speech.

Scherer has compelling evidence of "listeners' ability to accurately identify a speaker's emotion from voice cues alone." He has identified some of the acoustical components of various emotional expressions through voice. These acoustical components can be both recognized and reproduced, giving us the ability to infer emotion in a general way from acoustics alone. So if speech is an affordance, we can learn a lot about the emotion of both players and NPCs, even when the words may not be entirely intelligible.

DESIGN HEURISTIC

Explore new methods for enabling emotional expression and communication among agents.

Thinking about Thought

While the element of Thought cannot be provided entirely by the author, the design of the world and its denizens—or the application and its affordances—materially constrain Thought in a variety of ways. Up the ladder of material causality, Thought is the result of the successive shaping of Enactment, Pattern, and Language. In this regard, exposition plays an important role. It may be provided implicitly during the early action, providing a way for interactors to discover "physical" and behavioral aspects of a mimetic world, characters, and past events. Patterns emerge as the action unfolds, and communication affordances and conventions become clear. These are the obvious sources.

Perhaps not so obvious (unless the design is specifically political) are the assumptions made by the designer, consciously or not, that influence each of these elements and also play directly into the thought processes of the interactor. Mary Flanagan addresses many of these in her book *Critical Play* (2009):

> As a cultural medium, games carry embedded beliefs within their systems of representation and their structures, whether game designers intend these ideologies or not. In media effects research, this is referred to as "incidental learning" from media messages. For example, *The Sims* computer game is said to teach consumer consumption, a fundamental value of capitalism. *Sims* players are encouraged, even required, to earn money so they can spend and acquire goods. *Grand Theft Auto* was not created as an educational game, but nonetheless does impart a world view, and while the game portrays its world as *physically similar to our*

> *own* . . . the game world's value system is put forward as one of success achieved through violence, rewarding criminal behavior and reinforcing racial and gender stereotypes.

This is probably the sternest language Flanagan uses in her book; generally, it is extremely scholarly, thoughtful and insightful—a must-read for everyone who is serious about interaction design, especially games and interactive art. That said, few could contest her comments quoted here.

DESIGN HEURISTIC

Examine your assumptions and biases. Everybody has some.

Understanding Audiences

One of the most common difficulties that young designers have is a compulsion to design for themselves. I know that might sound crazy. Of course, you want to use your own aesthetic and skill, to exercise your own notion of play patterns, and to build something that will be pleasurable. But you are not necessarily designing it for yourself, unless you are designing for people exactly like you. In fact, that's what happened in the early days of the videogame industry. The industry was vertically integrated all the way up to the audience. Young men designed games for young men under the direction of slightly older men. The games were sold to men in male-dominated retail environments. In those days, it was a truism that women and girls did not play videogames. That may be because vanishingly few were designed with women and girls in mind, at least until the brief surge of "girl games" in the late 1990s.

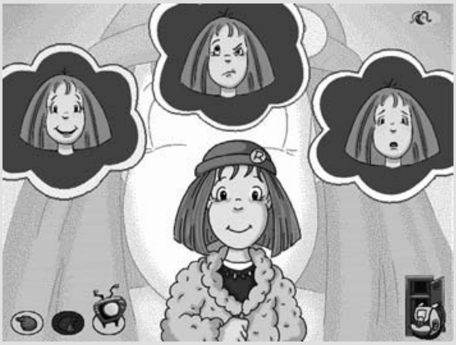
Today, women and girls make up the bulk of the market for casual games, and many more are playing games like *WoW*, *Minecraft*, and even MMFPS games. But that doesn't mean our work is done. People are different. Obvious differences are gender and age; others include socio-economic status, ethnicity, personal interests, and politics. Who are you trying to reach?

Human-centered design research can help you understand your intended audience in both general and subtle ways. If you are working for a big corporation that does not have a design research department, you will be fighting an uphill battle to convince your publisher that design research has value, especially if they have been successful doing exactly what they

Emotional Navigation

Purple Moon games were developed during a time in which the industry was beginning to morph from branching tree architectures to more process-intensive games that employed forms of AI in various ways. We were at the tail end of the world of branching trees, it seemed. Because we were explicitly trying to create "emotional rehearsal space" for girls in the Rockett games, we needed to find a way to match the form of navigation to the emotional landscape. Thus "emotional navigation" was born.

Instead of making explicit choices like "give a gift to Miko" or "read Nicole's diary," we decided to use facial expression and inner monologue as ways to make choices in the game.



Format of the "emotional navigation" screen for the Rockett games

When a player came to a choice point, she could mouse over the three facial expressions on the screen and hear her character's inner musings. "Yeah, that sounds great to me!" "I'm not sure I trust this. I'm suspicious." "Oh NO, this makes me feel like crying!" The design was extremely successful with players. They could explore how their emotional reactions influenced the action, escaping the sense of social inevitability that tween girls often reported to us in our interviews.

You couldn't "win" the Rockett games; there was no "right" way to play them. Sometimes whining got you want you wanted. Sometimes getting angry got you to a place where the cutest boy in the school would play you a sweet song on the piano. Sometimes being kind to someone changed their entire outlook. In this way, we encouraged emotional experimentation and flexibility.

Years later, I learned that one of the uses made of the Rockett games was to aid children and adults afflicted with autism. Recognizing the differences between "mad," "sad," and "glad" can make all the difference in the world.

Can You Do This for Boys?

Purple Moon was born of four years of research conducted through Interval Research Corporation with the collaboration of Cheskin Research. We exhaustively studied secondary research in areas as diverse as gender in play and brain-based gender differences. We interviewed dozens of experts identified during our secondary research. We interviewed over 1000 girls and boys across the United States as well as about 500 adults. All of the research was intended to discover differences between how boys and girls play, to the end of understanding, we hoped, why girls weren't using computers nearly as much as boys and why the vast majority of girls weren't playing computer games. It was only after the second year of research that we began to realize that we really wanted to make some games for girls, and so Purple Moon was born. We presented research updates to Interval's funder when he was in town, and Interval's CEO, David Liddle, was an active member of the research team.

When the first two games were released, we made the top-50 list with both of them. We also got some interesting reviews. Feminists complained that the girls in the game were acting, well, like *girls*. Male critics often asked, "Why a game just for girls?" All the games in the world struck them as just *games*, period. Hello, all the games in the world were *for boys*, a fact that seemed to escape many critics. The (male) *New York Times* reviewer complained about the lack of fast action and the "emotional navigation" interface. The bad press wasn't part of our plan, but the reviewer's response demonstrated that we had accomplished at least one thing we set out to do: to create a game that gave boys "cooties" (age check). That is, we wanted to make games that were clearly *not* for boys. We had learned in our research that a girl wouldn't touch a game that her brother had judged to be "lame." We didn't want boys to touch it at all.

After the first games launched, we showed our prototype Web site to Interval's founder. He sat down at the computer and spent about fifteen minutes clicking around. "This is cool," he said, as he swiveled his chair to face us. "Can you do this for boys?"

Given that the research had cost upwards of $3 million, we assumed that he would know that every little thing about the games was crafted for girls, down to the deep play structures. We wondered whether he thought we had just been fooling around with color palettes and art styles. Or maybe he just couldn't get cooties.

do. You will likely find that play testing or beta testing is the only kind of research such companies do. But that happens after the egg has hatched, so to speak, and such research likely does not shape the game itself beyond some tweaking.

Human-centered design research shares many of the methods common to market research, but deployed for a different purpose. To oversimplify only a bit, market research looks at how to sell something, while design research looks at what should be designed and how. It comes much earlier in the process, so as to inform design as it proceeds.

To begin, you really need to block-erase your preconceived notions about your audience. Be ready to be surprised. You may find out things that disturb you. Don't worry; your main objective is to meet your audience where they are, and as all designers know, there are ways to finesse what you might think of as bad habits or bad ideas in your audience.

DESIGN HEURISTIC

Check your preconceptions and values at the door. You will pick them up later, after you have findings and are ready to turn them into design principles.

Most of the methods of design research are fairly straightforward. Secondary research looks at other people's insights (and products), history, and culture. Primary research can take the form of interviews, focus groups, or intercepts. Primary research can include interviews with experts in the field that you've uncovered in your secondary research. Primary research is generally trickier than secondary, but it's the most valuable way of gaining insight into your potential audience.

Finding the right questions to ask is crucial. Asking people directly what kind of application or game they would like will not get you far. As I am fond of telling my students, if you had asked a group of kids and teens in 1957 what kind of toy they would like, no one would have said they wanted a plastic hoop they could rotate around their hips, but that's when Richard Knerr and Arthur Melin developed the contemporary hula hoop for Wham-O toys. In a way, the hula hoop was an extension of rhythmic play such as jump rope and clapping games. It arose in the context of popular dance styles, in which Bop was replacing Swing as the dance of choice for teens (the Twist would come later, and it may have had something to do with the hula hoop).

The first step is to develop a screener—a document that details the kind of people you want to reach out to. For a good example, see Portigal (2013), p. 38. Portigal's book *Interviewing Users: How to Uncover Compelling Insights* is a great guide to interviewing, especially if you are not experienced with it.

Basically, you want to find out what people in your proposed audience are like; what do they do for fun, work, or relaxation? What colors and visual styles appeal to them? Who are their heroes? What are their strongest values? What's their favorite music? What brands are in their refrigerator? This latter question can best be answered through home visits. If you can manage to visit people in their homes, you will find out *much* more about them by just looking around, and you're likelier to gain insights by finding things you didn't even know you were looking for.

If you don't have the luxury of home visits, interviews are the next best thing, in my experience. And not just one-on-one. I've had the best success with dyad interviews. That means inviting one interview subject (who meets the criteria on your screener) and asking them to bring their best friend. The dyad interview keeps people honest. When a person gives a false or incomplete answer to a question, their friend will likely call them on it. Your subjects may strike up conversations on their own during the interview that will reveal more about them.

Although consumer companies love them, I have found the focus group to be the weakest form of interviewing, especially with young people. Regardless of age, most people in a focus group consciously or unconsciously discover the most eloquent or aspirational person in the group and align themselves in some way with that person. What you get may be more like a portrait of a social dynamic than good answers to your questions. If you want to delve more deeply into various forms of design research, I recommend my book *Design Research: Methods and Perspectives* (2004).

Finally, it must be said that many artists and designers are wary of design research, primarily because they are concerned that they will lose their power to their findings. This is not the case. Design research *informs* the design, but does not *dictate* it. When you have your findings in front of you, translate them into design heuristics for yourself. As you do that, add your own values and voice back into the equation. You'll be a smarter designer for it.

Once Upon a Time, I Was a Little Girl

I was born in 1950, and I was a little girl until about 1962. By the time we were doing Purple Moon, I had three young daughters. I thought I knew everything about being a little girl.

When we began to design the PM game series, we decided to do two series of games with the same characters but from different perspectives—"social life" and "inner life." The *Secret Paths* series was all about inner lives and fantasies.

Our first *Secret Paths* title was *Secret Paths in the Forest*. I knew this forest, and I knew exactly what I wanted to do. I had read *The Secret Garden* over and over as a little girl. I had all those feelings for nurturing of plants and animals, just as the stereotype would have predicted. I even took care of snakes, much to my mother's chagrin. Sometimes I took care of the Faeries, too.

One of our research activities involved sending slightly ambiguous cutouts to our research subjects with a request to prepare a story with them that they could tell us at their interviews. The cutouts for *Secret Paths* were things such as trees, flowers, Faeries, birds, a lion, or a unicorn. At our first storytelling interview, I sensed that I had missed something. The girls were reluctant to go into the forest together; they wanted to go alone. And the story was one of being taken care of by the plants, animals, and Faeries. This pattern showed up again and again in our research. "I want to go there to be myself, to dream, to be taken care of." When asked if they would like to be able to share their forest with friends, the answer was usually ambivalent. "Well, *maybe*. If it's a really *good* friend. And only when I say."

That's how I really learned the lesson that even if you think you *are* or *were* your audience, you need to check your understanding. Be prepared for surprises.

Me and one of my snakes, 1958

DESIGN HEURISTIC

Learn about your audience to gain insights that will help guide you in design.

This chapter has presented several rules of thumb pertaining to the design of the various elements in a dramatic representation. Some of those principles have appeared in different forms in the literature of human factors and interface design, and some are simply intuitive. By contextualizing them within the overarching notion of interactive representation, we have attempted to deepen our understanding of the derivation of such rules and the relationships among them.

6

New Terrain in Interaction Design

IN THE FIRST EDITION OF THIS BOOK, I wrote about some of the up-and-coming things I could see on the horizon in human-computer interaction: new environments for writing, smart houses, multimedia, and virtual reality. These things and many more have since entered our world. Smart houses are still not so smart, but I think we have trouble handing over too much agency to the architecture. Instead, houses have become "smarter" by incorporating technologies that reduce their footprint in the world, from new materials to solar panels and graywater gardens. Multimedia in its most general sense is so pervasive as to be unremarkable except as a historically situated bridge that people thought of as a media type (usually employing videodisc technology). I wrote more about virtual reality in the paperbound version of the first edition, and I will include some of that writing here.

In the first section of this chapter, we will look at some of the methods and "media" that have been developed in the last two decades. In the second section, we'll explore how some of these methods—along with new insights and purposes—have extended the geometry of dramatic interaction. Third, we will take a few lessons from biology to talk about design for emergence. Finally, I'll offer some musings about design for the Good.

Methods and Media

If we assert that the computer itself is a medium, how can we talk about different instances of a computational platform as media in themselves? I choose the term somewhat reluctantly in an attempt to call out the relationship between computational platforms of various sorts with the kinds of content they may deliver and how they enable us to experience and interact with it. While some methods are common across computational systems (e.g., programming), others seem specific to particular types. Media and methods are often coupled because of the affordances of the particular computational platform; others are coupled more subtly by the normative uses of a platform. I'm going to walk through these methods and media, then spend some time thinking about how we might use them for dramatic interaction. The first "method" I'll discuss is one you all know very well.

A Note on Advertising

Product placement in computer/video games can be traced back to 1984, when KP Snacks made an appearance in a C-064 game called *Action Biker*, according to the MirriAd blog (www.mirriad.com/blog/), a site aimed at advertisers. Advertising on the Web began in 1993. The first instances were called "banner ads," in that they appeared as banners that went across the entire screen, usually at the bottom of the first screen of readable text (above the "scroll line").[1] Since then, we've been treated to the pop-up ad, the hover ad, and many more permutations. I don't find advertising in and of itself to be particularly annoying. I find product placement to be the most palatable form, as when one produces a game or film set in particular milieu, one may indeed find the "placed" products to enhance or at least belong in the scene. The sort of advertising that is of greater concern is the placement of ads, particularly in social networks, that force interactors to lose the "flow" of the activity. Most people object to obstructionist placing of ads in this context.[2] Auto-roll video ads—particularly with audio—are today's worst disruptors of flow.

Fundamentally, a major challenge for the designers of games, social networks, and web applications is to concentrate on finding an alternative to ad placement as a business model. We have struggled with this problem

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1. I vividly remember the day the marketing team at Purple Moon reluctantly showed me the first banner ad on our site. I had always maintained a "no advertising" stance. But there it was—a *Barbie* ad. I left the office and went to a movie with some explosions in it.

2. Early television often incorporated ads into the dramatic action—for instance, for those of you old enough to remember, the drop-in appearances of the Carnation man in the *George Burns and Gracie Allen show* (CBS 1950-1958). Even I don't remember it too well, but I recommend that anyone interested in advertising have a look at some of the early episodes.

The Challenge of Successful Online Advertising

Historically, advertising is a mode of communication that has been a one-way channel with a narrow agenda: show and sell. In traditional media, the success of an advertising campaign was attributed to the assumption that people will change an existing behavior if skillfully but simply encouraged and manipulated to do so. The most effective way to do this was to divide and conquer by segmenting an audience into broad target demographics. You're between the ages of 25–35, single, and female; you'll LOVE this!

So why doesn't this work for online marketing? The reason: Consumer metrics have evolved to a psychographic level. Turning the tables for a moment, as a *user*, I believe it's not enough to be targeted on a demographic level; I expect to be targeted on a psychographic level. When I'm just a demographic, it doesn't work. I'm not *just* 25–35, single, and female; I enjoy hiking, going out to local restaurants, and sharing cat videos with my friends. Ads that are unrelated—or worse, ads that offend my beliefs and values—can feel alarmingly intrusive.

Designing a successful advertising campaign in the new online consumer culture requires elements of precise, behavioral targeting. The Legacy Media assumption must be adjusted to reflect varying reactions to advertising. Rather than attempting to change an existing behavior, the goal of the advertiser should be to build upon known preferences and attitudes. What one person might find offensive, another might not even notice. Personal choice, from an opt-in/opt-out perspective, has proven to be a successful marketing adaptation. This method addresses the demands of the audience, creates potential to enhance conversion rates, and introduces an additional revenue source (on the product side by shifting to a subscription model in an opt-out event).

Kaze wants Rob to be quiet; the plot unfolds

If I as a *user* come to the realization that I will inevitably be exposed to advertisements, I want advertisers to give me the option to pick and choose what I am shown. Simply put, don't show me what *you* think I would like—show me more ads with cat videos!

—Suzanne E. Tow, Advertising Media Buyer in television for decades. The ability to pay a small amount for a television show without ads has changed the landscape of television advertising. Advertisers and legacy networks alike are emitting cries of desperation. The advertising model of revenue in the "consumer" software industry is unlikely to survive over the long term. To the extent that apps, like music and movies, may be purchased for relatively low fees, we can see the beginnings of an economy that is pay for value. I see this as a *business design problem* that we in the industry have to face.

Transmedia Design

When was the last time you saw a contemporary movie that didn't have an associated Web site? When is the last time you saw an animated movie that didn't have an associated game? A social network without pictures and video? A Grateful Dead show (age check) without an associated t-shirt? Transmedia design is not new, but doing it well is a relatively new design arena.

At Purple Moon, we worked to extend the world of the games through transmedia design, with a rich Web site, secret stones in their purple pouches (drawn from the content of the *Secret Paths* games), and "bendee" versions of the characters. Scholastic published books about the characters with incidents that weren't in the games. That, I think, was good transmedia design. We also put out a bunch of stuff that was just about marketing and branding—a Purple Moon backpack, Purple Moon Keds, a Purple Moon key ring with a purple soccer ball. This last batch served no real purpose in the "transmedia story." About four years ago, I saw a homeless guy wearing a Purple Moon backpack in San Francisco, so I guess it was good for something. My point is that marketing collateral alone does not a transmedia property make.

In his book *Convergence Culture* (2006), Henry Jenkins provides this definition of "transmedia storytelling":

> A transmedia story unfolds across multiple media platforms, with each new text making a distinctive and valuable contribution to the whole. In the ideal form of transmedia storytelling, each medium does what it does best—so that a story might be introduced in a film, expanded through television, novels, and comics; its world might be explored through gameplay or experienced as an amusement park attraction. Each

> franchise entry needs to be self-contained so you don't need to have seen the film to enjoy the game, and vice versa. Any given product is a point of entry into the franchise as a whole. Reading across the media sustains a depth of experience that motivates more consumption. Redundancy burns up fan interest and causes franchises to fail. Offering new levels of insight and experience refreshes the franchise and sustains consumer loyalty (97–98).

Jenkins provides a detailed analysis of *The Matrix* as a transmedia story, pointing out the strengths and weaknesses of every "text" or media type that is woven into the *Matrix* world.

I want to step back a ways so that we can ground ourselves in some early examples of transmedia design in popular culture. My first memory of it was the toys that came in Cracker-Jack boxes. The brand was introduced in 1908, and the "prize in every box" practice began in 1912. The toys in the box had nothing to do with the product, but the medium of a toy embedded in what may be the world's first junk food does actually bring two media together to make a brand story—one that lives to this day.

Most of us probably remember (or still see) costumes, toys, and other merchandise related to Disney movies. Disney's first videogame, *Mickey Mouse*, was released for the Nintendo RD1 in 1981, followed closely by *The Adventures of Tron* for the Atari 2600 in 1982. Disney has produced over 180 games based on Mickey, Donald, various feature films, and amusement park attractions. Soundtrack records have also been a part of Disney's transmedia business. Books, radio, television, and Web sites are also part of the Disney transmedia portfolio.

One way that a transmedia designer can blow it is by tipping his or her hand with the initial property. For example, in the second trilogy of *Star Wars* movies, the viewer can immediately identify the sequences that will or have become part of a videogame. There's nothing wrong with designing a film with games in mind, but one runs the risk of creating the kind of redundancy that Jenkins describes as a fan killer. Many of the chase sequences in particular are on the movie screen too long or are too monolithic for the film medium. The animated assets can be dropped right into a game, making the temptation even stronger to design the film *for* the game.[3]

3. J. J. is in the process of destroying this property anyhow.

Laura Crawford's ONE DOG

Over the course of the six years I taught in the Grad Media Design Program at Art Center College of Design, a program I designed to teach and support the creation of transmedia systems, I had dozens of truly amazing students. This is the story of one of the most talented: Laura Crawford. Laura graduated in the class of 2005.

Most graduate students have trouble figuring out what their thesis project should be. Ms. Crawford had more trouble than most arriving at a topic. One day while we were meeting, I asked her what she was most passionate about. Her answer came quickly: DOGS. She went on to design one of the most thorough and effective transmedia systems I've ever encountered. It was called simply ONE DOG.

Here is how it worked. Beginning with the ONE DOG Web site (offered through a kiosk in a pet store or accessible from home), a person looking for a dog could find the very best dog for her. First, she entered information about house and yard space, lifestyle, breed and size preferences, and personality attributes desired in the dog. The ONE DOG system made recommendations based on those constraints.

The system was affiliated with dog shelters all over the area. By networking with the shelters, several candidate dogs were found. From the kiosk in the pet store, you could play with the dogs in the shelter via telepresence. You could pull a rope at your end and your movements and tension were reflected on the other end. Once you found the dog of your dreams, you brought him home.

ONE DOG supported you as a dog owner as well. By attaching a small camera to the dog's collar, you could see a "dog blog" of your doggie's day from his perspective. ONE DOG offered a Bluetooth collar that would help you find the kinds of products that were right for your dog when you went to the pet store. Your dog could get references written by friends and landlords in case you wanted to persuade a landlord that your dog was good as gold. ONE DOG kept your dog's medical records online and reminded you when vet visits and vaccinations were due. And the ONE DOG community was accessible online for sharing and support.

Laura Crawford's only fear was that she would be pigeonholed as the "dog lady" as she entered her professional life, but that was not the case. Instead, she was identified as a brilliant systems thinker and a great designer of transmedia systems. Today, she works as Director of Advertising and Media for Edmunds.com, a company devoted to helping people find and maintain automobiles that are right for them. She loves her job. "I'm not the dog lady, but learning transmedia design informs everything I do," she says. "Switch out dogs for cars and there you are, creating an ecosystem to support relationships."

A dog lover plays remotely with a shelter dog. (Photo courtesy of Laura Crawford.)

Part of the motivation for transmedia design is, as Henry Jenkins says, to motivate more consumption. I think that's a lousy motivation. Another motivation is to extend fandom by offering a variety of media choices, but if the various media types are not orchestrated well or engage in too much "redundancy," the project will likely fail. The best motivation of all is to extend the world of a story into a variety of media types to provide greater pleasure, excitement, and depth for fans. Each element has its own magnitude and perhaps its own story arc. Fans will weave these elements together in a rich journey. Jenkins' caution against redundancy points to the fact that a transmedia "story," like a good drama, is an organic whole and uses the same selection criteria that Aristotle recommended in deciding whether a particular incident or scene should be part of that whole.

Virtual Reality

Virtual Reality (VR) is a medium in which the human sensorium is surrounded by (or immersed in) stimuli that are partially or wholly generated or represented by artificial means and in which all imagery is displayed from the point of view of an individual participant, even as he or she moves around. The effect is to give an interactor the sense of being present in a place where their body is not currently located. In the early 1990s, the typical interface technology involved a head-mounted display to produce stereoscopic video, some means of tracking the participant's head and body (in order to generate viewpoint-dependent images correctly and to determine direction of gaze and movement), a means of tracking manual gestures (typically an instrumented glove), and a means of representing a three-dimensional audio environment (typically achieved with spatialized sound presented through headphones).

VR is utterly a first-person point-of-view medium. The notion of point of view in VR is the manifestation of one's relationship to the representational world. Somehow in the world of computing as well as in film, the "screen" has become utterly conventional. VR shows no prejudice in its challenging of conventions; it questions film as rigorously as interactive computing. If one is to get the feel of a place, one must walk around it, listen to it, pick things up, and feel the presence of other beings with all the senses.

In 1990, when I was finishing up the first edition of this book, the VR phenomenon was approaching the elbow in its pop-culture curve. It was about to become one of those terms like "turbo" that was rendered meaningless by overuse—the term "virtual reality" had begun to spread like an oil slick over anything new and sexy in the world of interactive entertainment (e.g., "desktop VR"). By the end of 1991, movie producers, cable TV executives, and theme-park entrepreneurs had started talking about "passive VR" (an oxymoron if there ever was one). Meanwhile, hip young Northern Californians, initially at the forefront of VR enthusiasm, began to make dark jokes about "face-sucking goggles." As the first mainstream books, movies, and TV shows picked up on the hype, the younger and more creative contributors to the VR community began quietly mutating. In late 1992, VPL Research—pioneers in the development of enabling VR technology and wellspring of the pop-culture phenomenon—effectively ceased operation.

As the VR meme started to flame out in Northern California, many of us began scrambling to change the words on our shingles from "virtual reality" to something roughly synonymous, but less tainted—telepresence, augmented reality, immersion technology. Anything to get some distance from the all-too-vivid spectacle of the hype-fueled VR road-and-media show that rocketed VR pundits to the pinnacle of pop culture and then sent us burning back into the atmosphere, noticing too late that we were in the decaying orbit of what just might be a fad.

"Hey guys," little voices shout from the capsule as it begins to glow, "we weren't done yet . . . we were just beginning . . ."

What went away when the hype died? The hype positioned VR as a technology with the potential for creating a radically new entertainment medium almost instantaneously. It promised that entertainment and technology companies would emit hi-res, hi-touch consumer VR products in the near term. It provided the palpable icons of head-mounted displays and datagloves—encrustations on our bodies that we would be willing to put up with for the enormous rush they would enable. Many people hypothesized that this new form of entertainment would replace both videogames and TV. The more hopeful among us declared that it would transform the very nature of human communication.

But it quickly became apparent that VR as entertainment was going to be extremely difficult to "monetize." There was one really gnarly problem with VR as location-based entertainment, what amusement-park people would call "throughput." To get anything out of a VR experience, a person reasonably needs five minutes—probably longer—even to get a taste of the world, never mind having a dramatic experience in it. This problem remains. Less gnarly but equally important was the problem of hygiene. In Japan, for example, we observed a great deal of reticence to use a piece of equipment that had been on someone else's face, and cleaning it would be delicate and time-consuming. Note how that problem has been solved for 3D glasses in movie theatres; they are washed and wrapped in plastic film for your protection, and there are no electronics to spoil.

Where did VR go in those missing years? Primarily, it went into universities: University of Michigan, University of Buffalo, University of Washington, Iowa State, Duke—the list continues. Important advances in such technical areas as tactile interfaces and motion tracking have come from university work. Applications explored in universities include treatment for PTSD, phobias and addiction, pain reduction for burn victims, and archaeological reconstruction, as well as architectural and urban design. Many, if not most, of these applications are supported by grants from NSF and other foundations. They are exploring applications that can be "monetized"—that is, where the cost of the application is acceptable relative to its value to the customer. They are "productivity" or "research" applications writ large, relying on sensory immersion to make representations and experiences extremely powerful sources of discovery, learning, and invention with real-world value.

The Stanford Virtual Human Interaction Lab is doing something a little different; it's exploring how humans interact in VR. From the program's mission statement (2013):

> The mission of the Virtual Human Interaction Lab is to understand the dynamics and implications of interactions among people in immersive virtual reality simulations (VR), and other forms of human digital representations in media, communication systems, and games. Researchers in the lab are most concerned with understanding the social interaction that occurs within the confines of VR, and the majority of our work is centered on using empirical, behavioral science methodologies to explore people as they interact in these digital worlds.

They list as a special interest the exploration of "face-to-face" communication in such worlds.

Although many projects since the early 1990s have been described as "virtual reality art," few actually meet the criteria for the medium (the "turbo" problem again). Searching for images of virtual reality art yields more images of art *about* virtual reality than art that *is* virtual reality. The words have been used to describe everything from motion capture in animation to work with LEDs to time-lapse photography to "immersive" MMORGs. There are a few notable exceptions such as *World Skin: A Photo Safari in the Land of War* (an immersive installation created in 1997 by Maurice Benayoun and Jean-Baptiste Barrière). For my money, the most powerful VR art is still Char Davies' work back in the mid-90s. The problems are cost and logistics. Dramatically less expensive hardware has recently been introduced, including the Canvas portable CAVE (Cave Automated Virtual Environment) from the University of Illinois at Urbana-Champaign, with software free of charge (Rush 2006). A VR 3D viewer introduced in 2013 retails for \$300 (the high-end ones cost upwards of \$45,000). The CAVE environment, especially in a low-end implementation, is likely still to have difficulties representing more than one interactor's POV well, and there are difficulties with motion parallax. But we have seen that CAVE-based work can still deliver most of the qualities of immersive VR. I hope to see a new efflorescence in VR as new tools become available to more artists and designers.

Mobile Devices

When I first wrote this book, I could not have imagined the smartphone technology and culture we have today. Mobile devices invert the spatial relationship between people and computers. Even in the world of laptops, the position of the body was dictated by the device (VR is, of course, a great exception). Game controllers like Wiimotes, the Kinect, or dance mats also changed our physical relationships to devices, but not quite in the same way. Yes, we can use our bodies to make input in games and software that use such controllers, but we can't take them with us. Smartphones have created stunning new possibilities for interaction design.

Looking at the technology gives us a sense of the complex array of capabilities in our hands. The typical smartphone incorporates a bunch of different kinds of radios. The primary radio is used for voice and data transmission (3G, 5G, etc.). GPS (Global Positioning System) is a receive-only radio that looks for data from at least four satellites to compute the location of the receiver. Bluetooth radio transmits and receives information within a short range (approximately 100 feet). NFC (Near Field Communication) radio works in a range between 18 inches and 3 feet and is used primarily (today) for digital transactions.

Sensors within the smartphone include an accelerometer that senses movement and gravity, from which tilt can also be computed. The accelerometer means that the phone itself can also be used as its own "controller" (see, for example, *Starwalk*). Add-on sensors can measure things like temperature, humidity, and air quality. Probably the most important sensor in a smartphone is the camera. Besides enabling people to shoot and share photos and video, the camera opens the way to the use of things like image recognition software. That capability, in turn, is essential in building Augmented Reality applications.

We have notions that we call "citizen scientist" or "citizen journalist" that describe people who capture important stuff by smartphone in real time that might make a real difference. Yet these folks are marginalized, despite the hype. "We cannot confirm the video." "We cannot verify the photograph." Well, probably, yes you can, if you want to use the same standard of cellphone tower triangulation as a location identifier. And, maybe, yes you can, if you analyze the video and see it hasn't been fiddled with. This is not rocket science. The emanations of folks using our amazing technology are celebrated when we see it as the "Arab Awakening," and denigrated

Sharing is Caring: From Early Photography to Cameras in Mobile Phones

When photography was first developed in the 19th century (with the possible exception of the Shroud of Turin) photographs were unique objects that could be *owned* but not *shared*. This changed once the technology evolved into a copyable form (e.g., a negative used to make multiple prints). Sharing was now possible, through the agency of the photographer (in the 19th century there were traveling photographers in wagons who would set up local shop to make portraits).

An industrial form of the sharing of photographic images occurred with the invention of halftoning, which extended the previous technology of woodcuts, steel engravings, and other picture techniques used in books, pamphlets, and newspapers to make inexpensive replicas on paper. Still, the original photographs had to be physically transported from one place to another, so that a newspaper on the West Coast could not have a picture of a New York event until a train carried the photo from the East Coast.

In 1895 this changed, when Ernest A. Hummel electrically transmitted scanned shellac on metal foil pictures over dedicated circuits between the New York Herald and four other newspapers. This developed in an experimental way for several decades until in 1929 Vladimir Zworykin, the pivotal television system inventor, came up with a system that could scan and transmit in under a minute, enabling widespread adoption within the newspaper industry—which repurposed the already robust voice telephone system to carry the new "Wirephoto" data.

The technology remained expensive and in the realm of corporations. Ordinary people did not reproduce pictures to share without taking negatives to a photofinisher (often a service at a local drugstore).

The technology started to change in the late 1980s and early 1990s. In the mid-80s I worked at a research lab in Silicon Valley on inkjet printing; we could not afford a color digital scanner, and purchased a number of "standard" images on great reels of magnetic tape. By 1991, this had changed enough that I was able to personally purchase a 24-bit flatbed scanner for $1,200 that would make three passes over about five minutes and produce a "high resolution" 300dpi color scan that I could see and manipulate on my Macintosh IIc personal computer. I could even (painfully) email these scans to friends, assuming they had a color display. But I still used film in a 35mm camera to take pictures.

> Digital cameras started to make an appearance in the early 1990s (I remember the Sony Mavica I used at PARC; it recorded on floppy discs). But they still required using a PC to share images.
>
> Several digital cameras with cellular phone transmission capabilities were demoed as research projects in the early 1990s by Kodak, Olympus, and Canon. But everything changed in 1997 when Philippe Kahn and his wife had a baby. He impulsively wired together a digital camera and his digital cell phone and recorded the birth—and wirelessly transmitted the pictures to more than 2,000 family members, friends, and business acquaintances across the globe. Following this, he worked with Sharp to build a cell phone with an integrated camera that worked with an email system Kahn developed.
>
> The following explosion of popularity of photo sharing in the first decade of the 21st century was immense. It depended on repurposing infrastructure developed for other purposes: the digital cellular network (built for voice and messaging), email and the general Internet, and the World Wide Web. It continues today with the collapse of traditional film (Kodak in bankruptcy), the disappearance of pocket digital cameras from drugstores (your phone is as good as or better than a camera), and the rise of online social sharing of images and video . . .
>
> . . . and the collapse of several governments as citizens record and share actions in the polis.
>
> —Rob Tow

when we see it as "the war in Syria." Fill in your own timeline, and you will see the correlations.

Augmented Reality

The *Oxford English Dictionary* (2013) defines *augmented reality* as "a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view." The idea has been around in various forms for a long time. Mort Heilig had a notion of it when he designed *Sensorama*, even though his installation (1962) had no computational parts. There has been abiding interest and research in military applications for at least twenty years. Myron Krueger's *Videoplace* project (1975–1984; see Krueger 1990) presaged AR in some interesting ways. Krueger developed the capability to project the silhouette of an interactor into a world of computationally interactive objects and environments. For the interactor, it was like looking in a magical mirror. Krueger called this approach "artificial reality" and set it apart from what would later be called "virtual reality." Krueger's work was actually an inverse of AR in that the person's image was projected over (and interactively "into") a computationally generated scene.

Folks have been working on AR for a long time. Ivan Sutherland's early work in 1968 is often cited as the beginning of AR, although Sutherland's work eventually led to the development of VR. The term was coined by Tom Caudell and Divid Mizell (1992) to describe systems that involve an overlay of computer-generated material on real-world scenes. Important work has also been done by Paul Milgram and Fumio Kishino at the University of Toronto (1994) in which they produced a matrix defining AR on a continuum they called "mixed reality." From 1997, several groups explored AR as a wearable computer system that was often bulky, but did the job (see, for example, Feiner et al. 1997, Thomas et al. 1998). Between 2004 and 2008, dedicated handheld systems were developed by several labs. The first AR example on a mobile phone was probably Anders Henrysson's *AR-Tennis* game in 2005. AR applications for mobile phones began to be released commercially around 2007.

While I was working as chair and professor for an amazing group of students at Art Center College of Design, I came across two students in particular who did thesis work related to augmented reality that I must mention here for their prescience and imagination, and also to describe the kind of visionary work that informed the development of AR. Scott Nazarian (MFA class of 2004) is one of the big shots in AR. After he graduated, I had the good fortune to work with him at Sun Labs and again at California College of the Arts, where he taught a course in Futurism in the Grad Design Program. He has been at Frog Design since 2009, currently working as a creative director.

One day, I walked into the studio to see an installation project Nazarian had built to emulate what AR might look like. He built a curved semi-round of scrim that people could walk around inside of. As the participant turned, light fell on the objects set outside the scrim, and projections appeared on the inside (so you could see both at once). The installation instructed the participant how to make a peanut butter sandwich (see Figure 6.1).[4]

4. Possibly not a well-known fact: The main benefit of teaching is learning from your students.

Nazarian was mocking up an AR experience. He understood them to be "screenless" (via glasses or contacts, perhaps) overlays on the physical world. He called this sort of overlay an "eidolon[5] interactive experience" (eidolon IE).

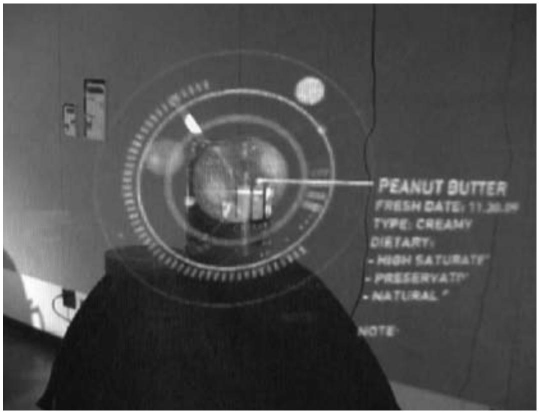

Figure 6.1. *Scott Nazarian's PBJ augmented reality experiment (Photo courtesy of D. Scott Nazarian © 2002–2005.)*

In his thesis project, *Strange Design* (2004), Nazarian designed an eidolon IE for use by a first assistant director (AD) in film production 30 years in the future (see Figure 6.2). Overlays of the AD's view identified people, their functions, and objects of importance in the scene. A major innovation was a "time-ahead" view of upcoming events that would require the AD's attention at some level. It would appear as an overlay of a translucent funnel that displayed upcoming events in a complex task space. It used depth of field (speed), color, and size as variables. The color palette of triage indicated level of urgency (triage was one of Scott's inspirations). Events/tasks/items appeared to move

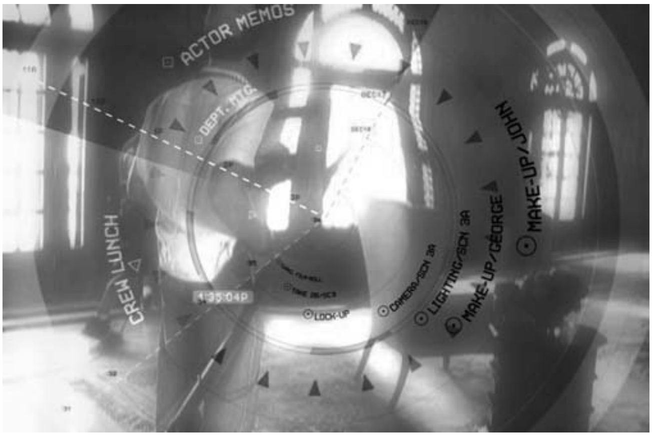

Figure 6.2. *Scott Nazarian's Eidolon time-ahead overlay (Photo courtesy of D. Scott Nazarian © 2002–2005.)*

5. From the Greek, a "phantom" or "apparition."

closer to the AD's eye as they approached in time. The speed with which an item apparently approached also reflected the priority of the item within its color group. Such a design could be used for a lot of things besides film production, including obvious applications in medicine (e.g., surgery). The AD could be toggled to other views: a continuity viewer, set and utilities viewer, and a location display that mapped cast and crew. It was remarkable. Scott could have just decided to be an oracle (obscure pun intended), but what fun would that have been? I hope that someday he returns to and implements an eidolon IE.

Another student whose speculative work illuminated the future of AR was Matthew McBride (MFA class of 2005). After graduating, he worked as Senior User Experience Designer at Schematic for four years, then became User Experience Director at Possible in 2009. He described his thesis project, *Telepath: Way-Finding in the New Urban Ecology* (2005), as seeking to "evolve the Human Computer Interface into a Human Environmental Interface, creating a more elegant relationship between the physical world and the invisible ecology of digital data co-present within it." Although early mobile mapping software probably appeared around 2007, McBride was thinking beyond it in 2005. His mock-up was a see-through display with mapping capabilities, tags, and affordances for social networking as well as way-finding (see Figure 6.3).

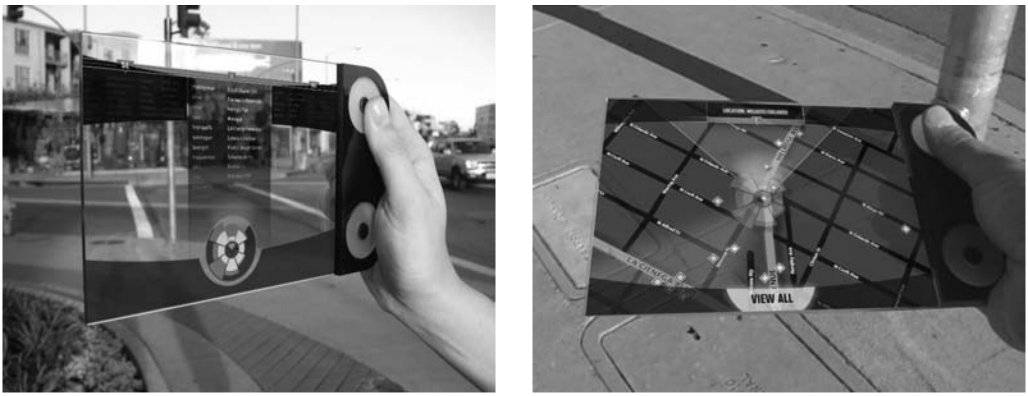

Figure 6.3. *McBride's Telepath proposed a tablet-like device that could be used for navigation, landmark recognition, comments, and sharing, with a gestural interface. (Photos courtesy of Matthew McBride.)*

The first AR apps for smartphones were launched in 2009. In the intervening years, we have seen a predictable trajectory. First comes consumerism. The earliest AR apps were likely to show you the names of restaurants and shops floating on the street ahead and maybe the associated customer ratings. The first AR ad was introduced in 2007. And there are games. Chase virtual ghosts, play virtual paintball, shoot at cars. Some go deeper, using the natural and architectural world as the skeleton for a global game of "king of the hill." Of course, navigation is a popular application type, spicing up travel with references from Wikipedia or giving the outdoor traveler look-ahead information about terrain.

Although the technical challenges are great, a lot of this is pretty trivial stuff in my opinion, at least until we get to nonconsumerist interactions with the natural and urban landscape.

One might say that a trajectory in media is that things move up the grade from triviality to genuine meaningfulness. It seems so, looking at AR applications. And yet, much is stalled by the smallness of vision; it's not about computing power. It's about marketing and the whole idea of an "app." I should apologize now to the many folks in architecture, geophysics, urban planning, wilderness protection, disease control and prevention, and other scientific fields who are actually doing meaningful things. There is a lot of wonderful stuff. Nazarian speaks about "the city" as something comprehensible at deep levels through AR. But these ideas are not yet making it into the smartphones of regular users, probably because the consumerist apparatus does not deem them important. The fertile ground in AR at this moment seems to be in automobiles, a worthy and productive use. But what of all the other possibilities?

Distributed and Participatory Sensing

Distributed sensing means populating a place with sensors that can transmit various kinds of data. It can also apply to sensors that are already in place in the world if we can get data from them; for example, excellent weather station data is available through Weather Underground (www.wunderground.com) and the National Oceanic and Atmospheric Organization (www.noaa.gov). Water and air pollution sensor data is harder to get to from already embedded sources, but there are movements afoot like Code for America (http://codeforamerica.org/) that seek to find ways to get governments and municipalities to "unlock" data that is siloed away

After Bhopal, the Stars

In 1985, I was working as a producer at Activision. Some very unique people brought me a very unique proposal for a product.

They were three middle-aged men who had worked for a long time at Union Carbide as engineers. The Bhopal Disaster and Union Carbide's role had sickened them, and they had begun to develop software instead. They had developed an astronomy program that would run on most of the contemporary platforms. You could scroll around a view of the sky from your own location. If you were looking at the sky at the same time, you could get the view to match up, then identify stars. The program contained data from an astronomical catalog. You could change your viewing position or the date of the view. It blew my mind.

This proposal came in before laptops were in common use. Management dismissed the proposal. "Nobody would take their computer outside to look at the sky."

It was hard to tell those fellows that the answer was "no." They were excellent engineers and had done an amazing thing. It was just too far ahead of its time.

A few years ago I fell in love with an iPhone app called *Starwalk* produced by Vito Technologies. The phone acts as a sort of magic lens on the stars. As you move your phone (and body) around, you see constellations fade in and out. You can identify stars and get high-resolution pictures of many of them. You can even see stars on the other side of the earth from where you are standing. And you can change the year/epoch of your view.

Those fellas who left Union Carbide would be happy that somebody has done this. It's a gift to all of us.

and provide access to active data sources that are currently unavailable to the public in digital form (or at all).

Computer scientist Sean White is one of the heroes of distributed sensing. During his PhD studies at Columbia, he worked on a system called the *Electronic Field Guide,* a large-scale collaboration between Columbia, the Smithsonian, and the University of Maryland. The vision for the project was to explore new forms of field guides that enhance cognition and memory. The project's explicit purpose was to serve botanists and other scientists in identifying plants and observing or visualizing some of the relationships at work in their ecosystems. Sean says, "If a botanist is studying a caterpillar, they may not be able to identify the species of plants that it eats. The system will help them create an ecological web of relationships and perhaps even help build a semantic web in the field for further eco-informatic study."[6] LeafView was a feature of the system that identified plant species visually in which the most effective identifiers were edges and veination (see Figure 6.4).

The LeafView project experimented with multiple cameras and sensors as inputs and with hardened tablets, augmented reality displays, and mobile phones as UI devices (see Figure 6.5). Sean observed an interesting difference between scientists using tablets and those using head-mounted AR displays. Those using tablets typically conceived of the process as data coming from a sensor near the plant and being transmitted to the computer, which represents it on the tablet display. Scientists using AR displays were more likely to construct the interaction as the *data coming from the plant*. In this case, the AR display (and its particular sensory qualities)

Figure 6.4. *Left: A scientist uses LeafView on a tablet PC. Right: Using LeafView with an AR visualization. (Photos courtesy of Sean White.)*

6. Sean White, Steven Feiner, and Jason Kopylec. "Virtual Vouchers: Prototyping a Mobile Augmented Reality User Interface for Botanical Species Identification." *Proceedings of 3DUI 2006* (IEEE Symp. on 3D User Interfaces), Alexandria, VA, March 25–26, 2006.

Figure 6.5. *Sean and his team also produced an iPhone version of LeafView. (Photo courtesy of Sean White.)*

effectively *collapsed the cognitive mediating distance* between the plant and the scientist. This effect was spectacular evidence that Sean was meeting his goal "to support being *in* the world and *part* of the world." Indeed, some scientists expressed a sense of being physically part of the environment, no longer bounded by their physical bodies.

Several organizations are doing work with sensors that can be attached to smartphones or developing other technologies for public use. For example, the Citizen Science research project supports citizen science by developing a host of sensors for atmospheric gases, temperature, and humidity (www.urban-atmospheres.net/Citizen-Science/). Eric Paulos at Carnegie Mellon University heads a group called the Living Environments Lab (www.livenv.net/). Among their many highly relevant and engaging projects is a participatory sensing effort called Community Sensing:

> . . . place-based sensing that invites non-experts to move and leave modular sensors in public spaces, allowing for a range of interactions from personal sensing to more public experiences. Our study of sensor appropriation, data sharing, and public authorship across four urban communities of bicyclists, students, parents, and homeless people reveals design opportunities for merging grassroots data collection with public expression and activism (Paulos 2011).

The Center for Embedded Network Sensing (CENS), a ten-year project at UCLA (2001–2011), did remarkable work in urban sensing and other human-centric civic and scientific projects. In collaboration with The Center for Research in Engineering, Media, and Performance (REMAP), CENS had a deep commitment to enhancing civic life. The CENS project suggests a model of participatory sensing in which individual "citizen scientists" contribute data to a larger view of a space in terms that deal with the quality

SiteLens: Seeing the Unseen

In 2008, Sean White, Steven Feiner, Sarah Williams, and Petia Morozov were working on a new tool for architects. White and Feiner explain (2009):

> *Urban planners, urban designers, and architects often visit a site prior to a design activity related to the site. These site visits are used for different purposes by different professionals, but the general goals are to get a sense for the physical site, find patterns, and discover and record new insights about the physical location and its characteristics.*

Later in their paper, they explain difficulties with the way things were traditionally done:

> *Several issues arise in the current process. First, there may be aspects of the site that are not visually apparent while visiting the site; for example, air quality and CO levels can be important when considering development, health and environmental justice issues, but cannot be seen with the naked eye. Second, the map data and the physical site are separate, imposing additional cognitive load on the user to place data in the scene or recall the scene when looking at a map offsite. Finally, still photos and video may not represent the dynamics of the physical site and environment when trying to understand correlations or associations between the data and the site.*

Their response to this problem—or opportunity—was an experimental AR application called *SiteLens*. The project was a situated visualization of air quality in Manhattanville, NYC using position- and orientation-tracked handheld augmented reality to visualize and compare both locally sensed geocoded carbon monoxide sensor readings and remote EPA readings used to represent the area. The resulting representations could provide not only the degree of deviation from the norm in such emissions, but also the direction from which they come. The form of the representations also lightens the cognitive load for the viewer. These data can influence building and development in terms of the health and wellbeing of those who will occupy potential new spaces as well as the likely consequences that new occupants might make to air quality in the area.

SiteLens compares locally sensed and EPA data for carbon monoxide at a local site. (Photo courtesy of Sean White.)

of urban life. Work in data science is necessary and challenging: how to aggregate, organize, visualize, and make sense of the large amount of data that can be collected. By energizing citizen scientists and gaining access to heretofore unavailable data from government sources, citizens and government can work together to make much more "sense" of the data we have and can collect.

How Do These Media and Methods Help Designers?

How might these various media and affordances help us to design dramatic interactions? Each opens up new opportunity spaces. The speed of technological development means that what we may envision as far in the future could be possible soon—or now. The near future may involve great new imaginings for applications and experiences, architectures, and affordance. It will certainly also be about discovering ways to use brilliant technological affordances to do a lot of imaginable things better.

In Chapter 1, I argued that "the representation is all there is." But in augmented and mixed reality, what do we make of the part of the real world on which things are overlaid? We can think of the actual world as forming part of the representation in that it becomes setting and environment. In combination with what we have designed, we impart new meaning to the actual world—meaning that works within the representational context. Just like real humans in interactive experiences, the real world becomes part of a larger representation that we are co-creating.

Looking back at some of the heuristics we defined in Chapter 5, we can see opportunities for enhancement with some of the media and methods we described earlier. One example is the idea of couching interaction in the context of the representation. Aspects of VR, AR, and sensor technologies can help us bring virtual objects and characters into physical and embodied contexts. I think of a game based on *Alice's Adventures in Wonderland* embedded in Huntington Gardens (a project I once proposed at Art Center). Would you follow the White Rabbit? (I did.) A combination of sensors, AR, and spatialized sound could bring the dramatic potential of the story to life.[7] Strategic and emotional analysis of the central actions of Alice's adventures would help us lay out pathways and cues to predispose action

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7. In the 1980s and 1990s, Antenna Theatre pioneered the use of audio in natural and built environments to embed plots and stories into an interactor's experience of a place.

toward dramatic shapes in a variety of traversals through the physical (and dramatic) space.

Too cute for you? We might use the very same technological affordances to turn the space into a journey through geographical or evolutionary biology, the experience of nested ecosystems, or the mathematics of increasingly complex natural shapes. We might explore how the gardens came to be and how they have changed. I'm not talking about a virtual tour guide. I'm talking about *mixed reality technologies working in concert to transform the experience of a place, including the actions one may take in it.* These are not new ideas so much as more realizable ideas with the panoply of affordances we have today.

Another heuristic suggests that we consider groups of interactors with common goals as collective characters for which group dynamics serve as traits. In citizen science and participatory computing we have seen just such collective characters forming up. Putting aside for a moment the very real work that must be done in data science to realize such projects at scale, we can almost see citizen scientists as characters without a plot. What is the central action? How can we predispose it to take on a dramatic shape? It may not merely be to collect or even to connect, but rather to *see in ways that make action clear*.

With the unfolding of dramatic interaction over both time and space, we see our little Freytag triangle casting some new shadows.

Extending the Geometry of Dramatic Interaction

The original version of this book focused on a two-dimensional notion of dramatic action: the Freytag triangle and subsequent elaborations (see Figures 3.3 and 3.7). In Chapter 4, we examined the ways in which the final plot of a dramatic interaction is a mediated collaboration between designer(s) and interactor(s). We focused on techniques for shaping the plot so that the interactor is predisposed to complete an action that is, in retrospect, dramatic in nature, knowing that we cannot control outcomes precisely. We know that the ways we design the experience include the degree of constraint on the final outcome for the interactor. So, for example, in the form of computer games, the old branching tree structures used by early games required the designer to define the contents of each node. Each possible consequence for an interactor's choice was highly constrained, resulting in greater formal control for the designer. Other architectures, represented by games like *World of Warcraft* or *Lord of the Rings Online*, provide constraints through theme, style, and environments and the nature of possible actions (quests, battles, etc.), as well as authoring affordances and constraints for creating characters. Such an architecture affords the interactor a greater degree of freedom in the construction of the whole action, moving the balance of power between the two classes of authors more toward the interactor and forcing the designer to rely more on the force of material causality. The fractal nature of dramatic interaction (see Figure 3.8) appears as an artifact of the nature of the interactive environment—generally speaking, what is possible within it. The characteristics of the environment influence the construction of plots inductively (see Figure 6.6).

From Lines to Fields: Clues from the Medieval Theatre

To begin, let's look back at some theatre history. Staging techniques from Medieval Theatre suggest interesting dramatic architectures. The vast majority of early Medieval plays (10th to 13th centuries) were liturgical in nature and performed within the church. The *platea*, or place, served as a generalized acting area. Around the *platea* were arranged several *mansions* (also called *sedes* or *loci*) that represented locations for scenes, foreshadowed by the stations of the cross. The actors moved from one mansion to another, using as much of the *platea* as necessary to perform the scene. Existing architectural features of the church lent themselves to particular mansions;

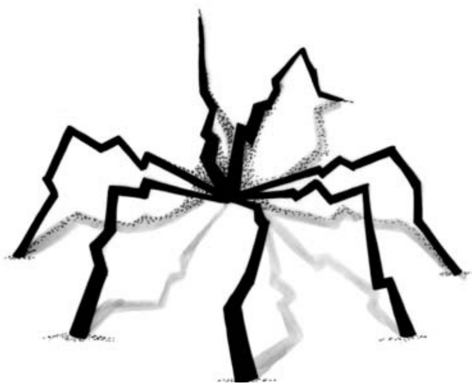


Figure 6.6. *Freytag's spider. If we think of dramatic interaction not in terms of two-dimensional Freytag, but as a work that holds the potential for many dramatic traversals through a space, we can see multiple Freytag-like shapes unfolding from the same beginning point.*

i.e., the choir was often used as "heaven" and the crypt as "hell." The plays performed in the church tended to treat biblical stories in a sequential way so that a "whole" emerged at the end of the year. The dramatic form came to be known as a *cycle*, containing several plays within the larger whole.

In the late 12th or early 13th century, plays began to be performed outside of the church. Although the messages of these plays remained more or less religious, a certain amount of comedy and even ridicule seeped into them (thanks, in part, to irreverent forebears such as the *Feast of Fools*, beginning around the 11th and continuing for several more centuries, performed around Christmastime in the church). The exterior architecture of towns came into play in terms of staging.

Once the plays moved out of the church, two sorts of staging techniques were adopted. Movable platforms, called *pageant wagons*, were developed primarily to stage *cycle* plays (see Figure 6.7). The pageant wagons carried each play in a particular cycle to several places throughout the town, and the wagons moved from one venue to another, presenting the plays in succession at a variety of places. The wagons carried mansions that continued to represent places or *loci* within the play. Actors often used the *platea* for performance space. You can think of this as a kind of spatial distribution system. *Fixed platforms* were the alternative form of staging, using existing architectures or built in public squares. The mansions might be scattered

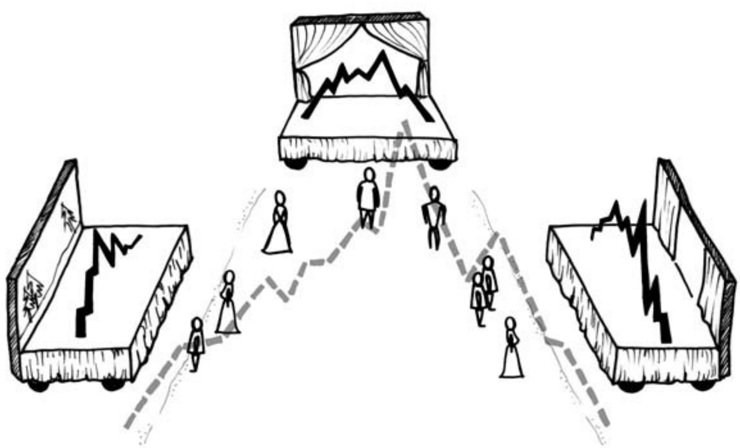


Figure 6.7. *The little play shown on each pageant wagon has its own plot. As the audience experiences all three (or more), a larger plot emerges so that we have nested dramatic shapes.*

out around the *platea* or in adjoining areas, causing the audience to move around to follow the action. The arrangement was presumably sequential to follow the sequence of the action.[8]

From Fields to Environments: The Renaissance Faire

We are now going to jump forward several centuries. The phenomenon of the Renaissance Faire in America seems to have originated in the early 1960s, corresponding with an uptick of popular interest in the Renaissance period, but Faires have been with us for a long time. In the Medieval period, they were typically temporary markets that included festivities. Renaissance Faires today are elaborately staged to create the sense of Renaissance times. They are typically built in woods or parks, with various venues for certain kinds of actions upon one or more "paths."

Contemporary Faires expand the action from the viewing of a play to include situated interactions within a defined and consistent environment. The consistency of the Faire—from the sensory surround, costuming conventions, and architecture to the characters constructed by Faire players and Faire goers—is the "glue" that holds the (historical) fantasy world together. The Faire is more than a field containing specific venues; it is an *environment* for interaction. The design of the Faire encourages encounters that are both spatially and temporally defined. A person can decide whether or not to engage with a particular tent or booth along the way, or they may head directly to a place they specifically want to go. A schedule of plays on the various stages and the timing of the jousts and parades may influence a participant's journey through temporal means. After you enter the front gate, a costume rental tent is in line of sight, offering the pleasure of costuming to those who have come without. Turn one way, and you will pass craftsmen and vendors, eventually ending up at the food court. Turn the other way to sample knife throwing and darts, grab a cider, and go to the joust, or turn right again to visit clothiers and jewelers and see a play on one of the stages (see Figure 6.8).

Crafters of many sorts show and sell their wares at the Faire, as long as their work is roughly situated within a Renaissance context. They may also be making some of their goods at the Faire, for example, yarn spinners,

8. See Brockett and Hildy 2007 for an excellent and comprehensive history of the theatre and Chambers, 1996 for a deep dive into the medieval theatre.

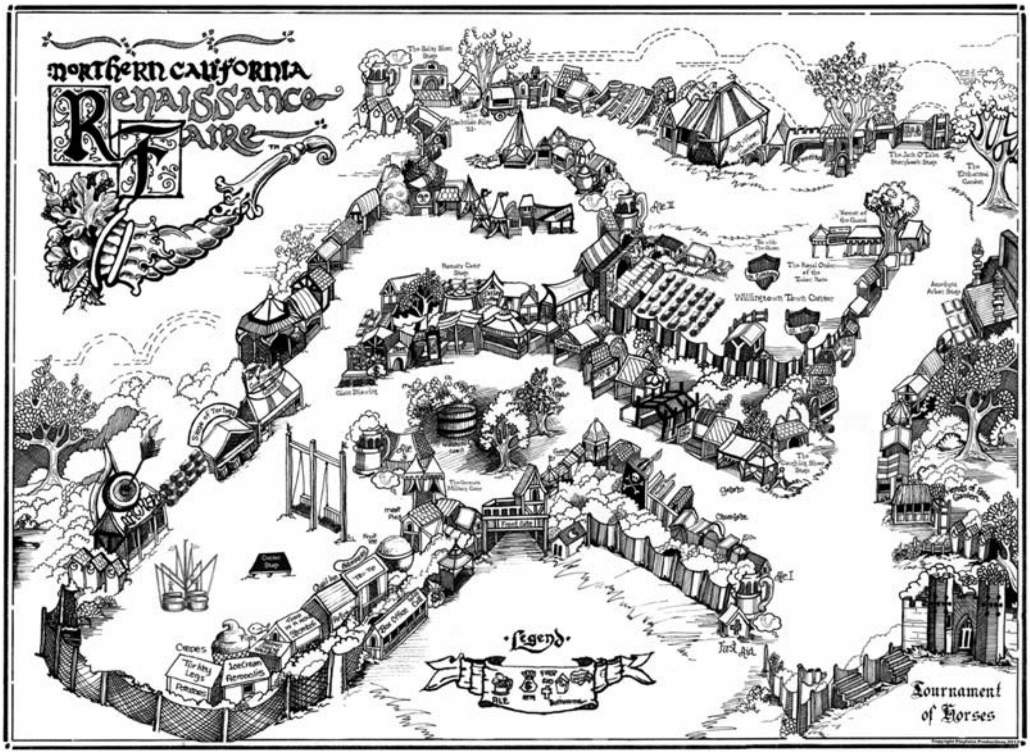


Figure 6.8. *Official Map of the 2012 Northern California Renaissance Faire, by Michelle Amsbury. Used with permission.*

metalworkers, and glassblowers. Other vendors include weavers, clothiers, cobblers, hatters, fabric artists, and potters. Drinking and eating are mainstays of any Faire, where ciders, wines, and beers are sold. A large fellow with a beard in period costume and a whole turkey leg in one hand and a flagon of wine in the other is a relatively common sight. Stages are spread out through the Faire arrangement on which different players can be seen. Musicians also perform (and sometimes sell their anachronistic CDs). The Faire also features "period" rides and games.

Various groups of players parade through the grounds at scheduled times: Queen Elizabeth I and The Royal Order of the Tudor Rose as well as other guilds including *La Danse Macabre*. A gaggle of bawdy washerwomen (also a guild) beat wet garments on rocks, splashing people and singing.

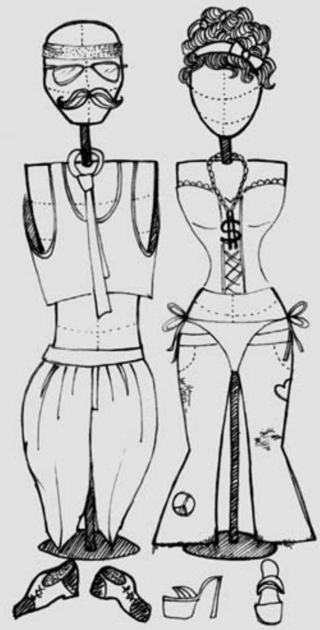
Majestic and comic jousts feature folks with incredibly heavy armor, great talent, and gorgeous horses who go at each other with poles among much cheering and cat-calling from the audience. Faire staff in all roles are trained in the proper etiquette, costume, diction, and accent typical of the Faire. These may be inauthentic, but they are consistent and coded.

Other performances pop up occasionally; we have seen for a few years a "Barbarian" and his young son dressed in furs and leather. For many years, there was a fantastic Ogre at the Norcal Faire, complete with tusks.

The 20th-Century Faire

Far from the purity envisioned by some of the early founders, the Renaissance Faire is full of anachronisms. I was once approached by a finely tuned Tudor lady who disapproved of my corset because it was clearly Victorian, lacing in the back. Under Elizabethan sumptuary laws, "common" women would not wear velvet or purple, but we see a lot of that among Faire goers. Medieval silhouettes are fairly common as well. Costume guides exist exclusively for Faire goers; they rely as much on the coded nature of Faire costuming as on the history of costume proper.

Rob and I wonder, what would a 20th-century Faire look like? I think of this as a particular sort of design challenge if you add yet another layer of fantasy; assume that you are living in the 23rd century. Thinking back to reconstruct the 20th, what would your sources be? What would you be likely to get wrong? Rob envisions men in spats with straight neckties and replicas of smartphones. I see a lot of women with bright red hair because of the few remaining images of Lucille Ball, but this is treated as a sign of high social status. Maternity clothing consists of large, boned balloons that completely obscure the body's shape. Many people wear only grayscale clothing. What would you imagine? Is there a game in this?



He hung in a rough rope net attached to the trees, sometimes descending to make strange objects, suddenly staring at you, sometimes dancing, always wild. In later years, he was joined by a female ogre with similar traits. As you can see, here we begin to diverge from the period into the fantasy roughly associated with it. The Furries wear fox tails in the anatomically appropriate areas. Recently the Norcal Faire has begun to "theme" several of its weekends for fantasy genres such as faeries and pirates. Another sort of morph is based on geographic differences. One may now see a full-up samurai, for example, or a Persian—from the same historical period, but from different places and cultures. The guilds of hardcore Elizabethan period re-enactors, who have special status among their kind, have often resisted such intrusions, but deviations continue to appear, either to fade or to be assimilated.

What doesn't work so well at the Faire is the attendance of folks we might call "tourists." They come to look at the people in weird costumes, ogle the ladies in corsets, buy a few things, maybe have a few beers. They don't costume. For those of us who are there for the fantasy, they are no fun. But since the Faire is owned by its tradesmen, tourists are a good source of revenue. Further, the Faire presents many tempting opportunities to rent or buy costumes and accessories, and it is prepopulated with role models (both staff and guests) that can often turn tourists into participants in the fantasy.

Long-time Faire-goers develop characters, acquire costumes and paraphernalia, and bond with each other in guilds or informal groups. If the community accepts a particular aberration or extension (the barbarian, for example), that group of characters may grow for future Faires. The point here is that the devoted individual interactor usually comes with a character attached. My off-kilter character is a defiant witch. I have not so far been set aflame.

Blossoming Geometries of Plot

The examples drawn from Medieval theatre lead us from a two-dimensional curve to a three-dimensional version of the modified Freytag triangle. In the 3D version, we can see that a field of possibility can be designed to create the probability of a satisfying plot for any unique interactor. The design of the field uses temporal as well as spatial arrangements to influence the shape of each unique plot.

Time Warp

One of the strongest flavors of fandom is what Henry Jenkins calls "cultural nomads" (Jenkins 1992). These are folks who participate intertextually with more than one fan universe. Jenkins dwells on a piece of fan art that is a mash-up between *Star Trek* and Arthurian Legend. Other fans may build fictional connections between TV shows or films based on an actor who appears in two or more of them, laboriously building the backstory that creates a connection via Patrick Stewart between *Star Trek: The Next Generation* and *X-Men*.

For many years, Rob and I and some other friends have harbored the fantasy of mashing up *Star Trek: TOS* with the Renaissance Faire. Here's the plan:

1. Wear your TOS uniform under your Renaissance garb, and secrete a tricorder somewhere on your person.
2. Enter the Faire and go to the privy.
3. Remove the Renaissance garb, and get out your tricorder.
4. Magically appear, point your tricorder at people and things, and have loud conversations about discovering a prewarp civilization.
5. See whether you get kicked out.

For cultural nomads, this sort of hack should be quite pleasurable, but you never know.

In both mansion staging and within the Faire, each venue has its own dramatic arc or Freytag triangle. In Medieval theatre, however, the series of plays in a cycle predisposes an interactor to see each mansion-based scene in sequence. At the Faire, an interactor has relatively greater freedom upon entering the gate to choose a direction or venue. Although that arrangement of stages and sellers predispose certain sequential traversals, it allows for greater variations in the interactor's path. The arc of the joust is punctuated with sharply rising and falling action in a cumulative series of encounters between knights and pages. The arc of the giant swing is shaped by how the swing moves higher and higher until the children squeal, and the operators of the swing then gently slow it down, punctuated by comments from the participants. Further, the arc within a particular venue like the maze will be different for each participant: horror to the lost little one, triumph to the brave venturer. Now we have two levels of arcs: that of the interactor's experience in each individual venue and that of each visitor's unique journey through the Faire. One might compare the overarching plot for an interactor as a line drawn along the curves of the venues visited as well as the chance encounters and conversations of the day. The environment of the Faire can be visualized with an overlay of a plethora of arcs blooming from the gate and stitching themselves through the arcs of various venues, activities, sights, and sounds. The same (but more) may be said of Burning Man, but that's another story.

Design for Emergence

There are approaches that we can take as designers of dramatic interaction that go in different directions than the notion of predisposing interactors to make certain kinds of choices or tilting the balance toward dramatic interaction through strategic design of gameplay as Clint Hocking and others have done. We can look for guidance to the observation of and theories around emergent behavior. A simple instance of emergence is when an interactor does something you did not foresee and for which you did not consciously design the potential. An example from science fiction is Kirk's triumph in the reputedly unbeatable Kobayashi Maru training scenario (Trek check). He did this, they say, by hacking the system, and it was always unclear whether this was a "legal" action. Noah Wardrip-Fruin tells an amusing tale of the "emergent" qualities of gameplay in the experimental game *Prom Week* in which he took actions that made every character

Sleep No More

The play *Sleep No More* is a theatrical example of what we've called "blossoming geometries of plot," but with different methods than those used by the Renaissance Faire. Punchdrunk Players staged the production in three abandoned warehouses in Manhattan. The production is wordless—performed through dance, gesture, and décor—and distributed through several floors and rooms of what is tricked out to be a 1930s hotel. Loosely based on the Scottish play, the action unfolds simultaneously in several spaces, and it is up to the audience member where to go and what to watch. A New York friend of Nazarian's from Frog Design calculates that there are at least 14 hours of experience-able content, but the audience's stay is limited to two and a half.

Like earlier site-based theatrical productions (e.g., *Tony and Tina's Wedding*), audience members follow characters through locations rather than being led by temporal sequence. But audience members for *Sleep No More* must wear white masks (reminiscent of neutral Venetian carnival masks), and they are warned not to say a word or touch a performer; they may, however touch set pieces, open drawers, etc. Says co-director and choreographer Maxine Doyle (Barrett and Doyle 2013), "The spaces are as autonomous and complex as the characters themselves, and each one operates as a distinct chapter in the overall work."

Doyle explains that the minor characters are fully developed so that we might "imagine the action that might have been happening off the page, what I call the unseen text." Each character has "a distinct arc, with a beginning, a middle and an end. Should an audience member wish to reconstruct the story afterwards, this will let them do that."

The performers act and dance out the themes and central actions of the original play as well as a great deal of "unseen text" in elaborately designed spaces. *The New Yorker* review (Als 2011) states that the music induces "a kind of emotional vertigo."

At the end of their time in the production, audience members end up in the cabaret-like lounge in which they began. When friends begin to discuss what they have just experienced, they are likely to express confusion and emotional fatigue. But here's the cool thing; they have all had what they would call a dramatic experience with a more-or-less dramatic shape. This is the secret sauce of Punchdrunk's genius. Interaction designers can learn from the authors' use of character arcs, the content matrix, and the autonomous use of spaces.

who had been "popular" at the beginning of the week to "unpopular" by the end.[9] The efflorescence of economies around games—legal and not so much—provides many examples of emergence.

As we saw in the example of the inclusion of cameras in smartphones, *infrastructures and logistics may be repurposed by users for emergent outcomes*. The Arab Awakening began in late 2010 with major unrest in Tunisia (with antecedent causes going back decades, if not centuries). The revolution in Tunisia can be seen as a regional tipping point. As of 2013, governments have been overthrown in Tunisia, Libya, Egypt, and Yemen, while a major civil war continues in Syria. Most people and governments did not foresee the repurposing of Twitter and Facebook as tools to support and document civil unrest and brutal violence. These media also played critical roles in the strategic and tactical unfolding of the uprisings. Targeted governments tried, mostly without success, to shut down public access to these tools in particular and to the Internet in general. A gentler example of repurposing infrastructure and logistics are systems and applications that can create 3D models of public spaces from large collections of photographs, as opposed to wire-framing or prescribed photographic or videographic methods for data capture.

For centuries, randomness has proven to be a great tool in the design of games. Rob reminds me of the use of octagonal dice to emulate a kind of "contained randomness" (see Figure 6.9) A trick here is to *design to the randomness*: that is, to create rules or consequences that emerge from any roll of the die. In this pocket universe of possibilities, consequences of randomness can be recombined for emergent outcomes within a rule-based system. This is not an unfamiliar method to most game designers—after all, it was used in Dungeons and Dragons with great success. One may also design to randomness in Nature,[10] for example, the outcomes of predator-prey relationships or the course of an invasive species as it travels through a forest or prairie. What might it change? What resistance might it meet?

Lessons from Biology

In this section we present three sets of ideas drawn from biology: symbiosis, symbiogenesis, and nested ecosystems. All suggest ways of thinking

9. Don't you wish you could have done that in high school?

10. I capitalize the word "Nature" in the tradition of natural philosophy and the tradition of the Royal Society including Newton, Locke, and Jefferson.

Figure 6.9. *Rob's collection of dice. The different shapes produce different probability functions.*

about dramatic interaction, and they also draw our attention to the natural world. In my analysis, the most significant turning points in interaction design thinking had some involvement with the natural world, either as inspiration or collaborator. For example, multisensory interfaces emerged from the characteristics of the human sensorium. Alan Kay's early ideas for the Dynabook envisioned its use as a field guide for kids out in the natural world. Distributed computing emerged from the need for more processing power to scan the skies for signs of extraterrestrial intelligence (SETI@home), moving on to complex scientific problems including protein folding and weather modeling. Distributed sensing as used by the Electronic Field Guide project was a way to learn about ecosystems. Each of these touch points with the natural world played a role in the emergence of new technologies and affordances.

SYMBIOSIS Symbiosis describes a relationship between two or more entities that provides mutual benefit, whether intended or not. In Nature we find symbiosis in unexpected places. For example, consider the relationship between oak forests and voles. *Science Daily* (2013) reports on research done at the University of Madrid (Perea et al. 2012). Beetles like to lay eggs in acorns. When the acorns mature and fall, the larvae drill their way out of the acorns and into the ground to become brand new beetles. Now, voles love to eat acorns. Strangely enough, the voles can tell which acorns they find still have larvae in them. They reject the empty-nest acorns and grab the ones with larvae, stashing them in the autumn as a food source for later. Voles like the beetle larvae and eat them up when they can, saving the acorn itself from lethal damage. The acorns which remain buried in the ground sprout new oak trees across the range of the voles. And that is how voles and oak trees and beetles all help themselves out by being in a symbiotic relationship.

A rather more complex example is the human body. One cell in ten in our bodies is actually human; the rest are microbes. Michael Pollan (2013) says:

> To the extent that we are bearers of genetic information, more than 99 percent of it is microbial. And it appears increasingly likely that this "second genome," as it is sometimes called, exerts an influence on our health as great and possibly even greater than the genes we inherit from our parents.

Pollan enumerates many of the services our "microbiome" provide for us. They occupy niches that might otherwise be claimed by pathogens. They also help with our bodies' abilities to make neurotransmitters, enzymes, certain vitamins and other nutrients, and "a suite of other signaling molecules that talk to, and influence, the immune and metabolic system." There is mounting evidence that we can have some influence on our microbiomes' health through diet. Taking a broad-spectrum antibiotic can create major disturbances by killing off some of the good guys as well as the targeted pathogens. Then microbes that are usually present in a balanced system can overrun things and create secondary nasty effects. Pass the probiotics.

This elegant and intricately complicated dance traces some interesting patterns for interaction designers. The notion of "invasive resistance" is one. The ability of microbes to evolve quickly under changing conditions is another. The "unintended consequences" of antibiotics present another interesting dynamic. I have a gut feeling that a cascade of new scientific information about our microbiome will present more intriguing patterns for interaction designers to consider.

SYMBIOGENESIS In 1998, scientist Lynn Margulis wrote an amazing and controversial book: *Symbiotic Planet: A New View of Evolution*. Margulis' view is that symbiosis forms the basis for much of evolutionary novelty. Beyond symbiotic relations between distinct individuals, some symbiotic individuals can combine into new organisms. She explains: "Symbiogenesis, an idea proposed by its Russian inventor Konstantin Merezhkovsky (1855–1921) refers to the formation of new organs and organisms through symbiotic mergers." Margulis presents persuasive scientific arguments for the origins of organelles in eukaryotic cells (e.g., chloroplasts and mitochondria) as the result of symbiogenic combinations of ancient bacteria. Mitochondria, once free-living organisms, were integrated into eukaryotic cells, where they generate chemical energy and perform other life-sustaining roles. She observes that when symbiotic organisms undergo symbiogenesis, some genes with redundant functions are dropped. With cells and bodies as symbiogenic partners, mitochondria retain only a handful of genes. In her subsequent book, *Acquiring Genomes* (Margulis and Sagan 2002), she argues that symbiogenesis is a prime force in evolution, placing cooperation (symbiosis) at least on the same level as competition (natural selection).

Digital photography exhibits a sort of technological symbiogenesis. As it moved from film to the digital sphere, photography "dropped" its darkroom genes and "took advantage of" existing digital infrastructures to form new storage and editing capabilities. This formulation is a simile, of course; photography is not an agent and has no "intent." We simply see a pattern we know from Nature recapitulated in technology. We as designers may choose to weave such patterns into new forms of technology and interaction.

NESTED ENTITIES AND ECOSYSTEMS Rob Tow says that the defining characteristic of an "entity" is that it demonstrates a "perception-representation-action" (PRA) loop in its behavior. It can perceive its environment, it can construct an internal representation of its perception, and it performs actions based upon that representation. Those actions are in turn perceived within its environment, forming the loop.

Consider a water strider as an entity. Water striders live in groups in slow-flowing streams and other bodies of fresh water, dining mostly on fallen insects and spiders. Water striders sense their distance from their fellows through the characteristic vibrations caused by their movements, distinguishing those particular sensations from other sources of vibration in the environment: perception. The perception of these vibrations is transduced into signals that activate the insect's muscles—representation—causing it to take action when necessary to maintain optimal dispersal over the surface of the water where the water striders are situated. Consciousness of what one perceives or conscious decision making to take action are not necessary elements of what Rob calls "representation"; this part of the loop requires only that perception be transformed into triggers for action. A water strider is an entity, and a particular group of water striders inhabiting a specific territory can be seen as an entity as well.[11] Contrariwise, a plastic bottle floating down the same stream does not qualify as an entity even though it can be made to perform actions, because it has no PRA loop.

Ecologists study the relations among heterogeneous entities (and non-entities) that constitute systems that are distinct and reliant on a particular set of dynamic relations among their elements. The overall pattern of these relations is what distinguishes a particular ecosystem. The more energy that moves through the system, the more niches there are. Energy-rich ecosystems typically exhibit greater biodiversity. While an ecosystem (such as a swamp) may survive without some of its usual constituents (e.g., frogs), there is a tipping point at which an ecosystem ceases to exist as an entity because a critical level of loss or change in energy flow is reached, destroying the pattern of relations that make up the dynamic whole. An ecosystem with energy roaring through it can effloresce. In terms of interactive systems, energy can be understood as processing and information, including human agency and—perhaps—flows from the natural world.

An understanding of nested entities and complex relations among them can help us cultivate what James Lovelock would call a "Gaian" perspective (Lovelock 1979). In that view, it's entities all the way down—and up. Even genomes have such entities in hierarchy—transposons, jumping genes, chromosomes, etc. We can understand the concept of Gaia (Earth Mother in Greek mythology) as the nested entities that make up the whole earth and its biome. In Gaia, there are systems within systems at work—both technological and human. Some are structurally constrained, some exhibit chaotic dynamics, and some produce *emergence*.

SIMPLE RULES, EMERGENT OUTCOMES I remember a day back in the early 1990s when I was at Esalen Institute with a gathering of VR types that had been arranged by Terence McKenna. I had known him for some

11. Consider how many words we have for such entities: schools, flocks, mobs, etc.

years by then and had deep respect for the maniacal depth of his knowledge in several domains. During one of the breaks in our deliberations, Terence went outside and climbed a tree. My videographer friend Rachel Strickland and I approached him for an ill-formed interview. I asked him about the first thing that came to mind. "What can you tell me about ants?" He replied, "Oh Brenda, you have no *idea*." He then talked nonstop for over two hours about the 20,000-plus species of ants, dwelling on those he knew best from his journeys in the Amazon and the Hawaiian islands. Ants do amazing work.

The behaviors of ants as they search for food have been modeled in computer algorithms to find good paths through graphs, which has become a way to work on more sophisticated problems. The combined behaviors of individuals in a colony act as a kind of superorganism. With ants and other creatures like bees, individual behaviors are governed by a fairly small number of rules that combine to create self-organizing group behaviors that are more powerful and successful than a single individual is equipped to produce. For example, ants searching for food leave pheremone trails. The more ants that follow a particular trail, the stronger the pheremone signal. But ants have a neat trick. The pheremone trails dissipate over time. That serves to discourage dead ends and confusing intersections. Ants also use pheremones to identify their "task groups" and to discover when it is time to raise a new queen for the colony.

In interaction design, we can learn from ants and other superorganisms that changing one of the few rules governing behavior can result in huge changes in the behavior of the colony as a whole. For example, in algorithms that have been developed to simulate ant behavior, the time scale of "pheremone" evaporation has large effects:

> The time scale must not be too large, otherwise suboptimal premature convergence behavior can occur. But it must not be too short either, otherwise no *cooperative behavior* can emerge. Cooperative behavior is the other important concept here: Ant colony algorithms make use of the simultaneous exploration of different solutions by a collection of identical ants. Ants that perform well at a given iteration influence the exploration of ants in future iterations. Because ants explore different solutions, the resulting pheremone trail is the consequence of different perspectives on the space of solutions. Even when only the best performing ant is allowed to reinforce its solution, there is a cooperative effect across time because ants in the next iteration use the pheremone trail to guide their exploration (Bonabeau, Dorigo, and Theraulaz 1999).

So in the case described previously, shortening the length of pheremone evaporation radically changes the ability of the superorganism to succeed.

If we are to take advantage of the idea of simple rule sets, we can experiment with changing one of the rules and see what happens. This mode of development involves *experimental design* as we search for rule shifts that are most likely to produce *emergent behavior that is interesting and generative*. Emergent behavior happens in interactive media, from games to social networks. When it happens, we do well to observe it carefully. An example is the affordance of the profile picture allowed for the emergence of a visual campaign in early 2013 on the day that the Supreme Court was to decide whether to hear two important cases involving same-sex marriage. People changed their profile pictures to red backgrounds with pink or white "=" signs in them to signify support for same-sex marriage. By the end of the day, Facebook was plastered with these signs, creating positive reinforcement by the group for a political stance with real-world implications. Two days later, this "pheremone" trail was fading, but the use of the profile picture for emergent collective behavior was established.

Design for the Good

As an actor, I had a personal ritual with Dionysian roots. Remembering that the actors of ancient Greece had a sacred and civic duty, I tried to frame my own work—comedy, tragedy, musical, or melodrama—in a similar way. Before I went onstage, I would say, may this work be for the Good. It didn't matter whether I was playing Lady Macbeth or Little Mary Sunshine. I had and have an ethical and spiritual relationship with the work.

One may glean from Aristotle's *Ethics* that happiness is virtue, and that virtue is doing what needs to be done as well as you can. This is quite different from the hedonistic view associating happiness with pleasure. Happiness in Aristotle's sense arises from the proper exercise of our best ethical natures. The condition of our lives (e.g., security versus fear and deprivation) can influence happiness, but it cannot eat away at the core of virtue.

In philosophy, another view holds sway with me as well. Rob Tow, summarizing a section of Foucault's *The Care of the Self* (Foucault 1986 154–155), points out a key difference between Epicurean and Stoic philosophies. It was held that Epicureans *might* marry, but that Stoics *must* marry, in order to be fully present in the world. The important distinction here, at least for me, is not about marriage, but about *being in the world*, present with all of life's delights and challenges.

We see our cultures morph and strain with change. Some who are distressed by the one-button, one-second lives that our technology allows us to have (if we choose) complain about technology in general and blame it for their own unhappiness. Folks, you know who you are. You have subscribed to the big-small-fast for too long. You could opt out without becoming Luddites. Even better, you could use your talents to design "slow interaction"—of sufficient magnitude to allow for dramatic engagement and of sufficient relevance to allow for happiness—to figure out how we find good balance in our lives.

We are surrounded by huge forces—Nature and technology—evoking both wonder and fear. How much easier it is to bury one's head in the sand and to blame technology for our unease (see Rushkoff 2013). And yet, technology is no more "other" than a hammer or an airplane or Thoreau's pencil. Technology is an extrusion of humanity; as such, it is not an "other" that can be blamed for things. It is part of us. The twin inventions of the telescope and microscope let us begin to see the world on its scale. Science has continued to allow us to discover more and more of the unseen entities and forces that make up our world. Part of our impetus for developing technology is to see the world at its own scale, and to know the entities invisible to the ordinary eye—not angels, but mitochondria.

In the 1960s, James Lovelock was a visiting scientist at Jet Propulsion Laboratories in Pasadena, California. He began work on what we now know as the Gaia theory to describe those characteristics of a planet as seen from space that might identify it as a system supporting life. In his book *Gaia: A New Look at Life on Earth*, published in 1979, Lovelock unfolds the Gaia hypothesis, arrived at through his collaborations with microbiologist Lynn Margulis and others.[12] Gaia, Lovelock (1979) says, is "a complex entity involving the Earth's biosphere, atmosphere, oceans, and soil; the totality constituting a feedback or cybernetic system which seeks an optimal physical and chemical environment for life on this planet." In her book *Symbiotic Planet*, Margulis (1998) explained that Gaia is "an emergent property of interactions among organisms, the spherical planet on which they reside, and an energy source, the sun." In the years since its initial publication, the Gaia hypothesis has been tested through such a variety of scientific means that it is now widely accepted among the scientific community.

12. See Vladimir I. Vernadsky, *The Biosphere*. In the preface to *Gaia* (1979), Lovelock referred to the failure of most in the West to recognize Vernadsky's contribution as "egregious."

Lovelock remarks: ". . . I find that country people still living close to the earth often seem puzzled that anyone should need to make a formal proposition of anything as obvious as the Gaia hypothesis. For them it is true and always has been." That does not negate the notion that a human being is an entity, but it does suggest that humans relate to Gaia in much the same way that the trillions of microorganisms in our bodies relate to us. A tree also has relatedness to Gaia, but offers different services, if you will, to the larger whole.

Humans offer particular intelligences: the ability to evince detailed and complex self-awareness, the power to extend our agency beyond our bodies through technology, and both consciousness of and curiosity about the larger contexts in which we live–cultures, civilizations, Earth, and the cosmos. These are unique talents. They enable us to have such a large influence over the Gaian whole as to cause highly consequential effects, including palpable harm. The prime characteristic of a Gaian perspective consists of awareness of our relatedness to the whole Gaian entity. We are not alone.

Looking down at the big blue ball as astronauts did in 1968, one can see that nothing on it is non-Gaian; even the asteroids that have embedded deposits of nickel deep into Earth's crust are now part of the grand ecosystem. Technology has been invented by entities as diverse as crows, raccoons, and marine mammals. Like Vernadsky's and Teilhard de Chardin's "noösphere,"[13] our technologies are extrusions of ourselves, and so, of Gaia. Joseph Campbell described our first view of the earth from space as "the first time the Earth was able to look back on itself through the eyes it had grown in human beings."[14]

Rob and I often speak of "Gaian Gardening." This is not the conquering of Nature as the Old Testament would have it; rather, this is mindfulness and behavior intended to serve balance and health of the Gaian whole. This is not "restoration" in the sense that one may never return to the *status quo ante* in Nature, but may instead nurture what is coming into being in a way that respects Gaian relations. This does not speak only to plants and wilderness and animals; it also speaks to how we frame the powers of the technologies we bring into being.

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13. Both Vernadsky and Teilhard de Chardin used the term "noösphere." De Chardin's is evidently the first published use in a 1922 paper entitled "Cosmogenesis."

14. This was part of a conversation published as an article by Johnson in 1997.

Our tools can be directed at Gaian Gardening, like the *Electronic Field Guide*. They can be directed toward extending pleasure, wonder, and knowledge, like *Starwalk*. We can use our tools (or invent new ones) to extend our ability to see the unseen, or to take action in the polis. We can use our technology in ways that support being in *right relationship* with Gaia. For 18th-century Quaker John Woolman, "right relationship" meant eschewing evils like materialism and greed, warning that these qualities would injure future generations. The Iroquois Nation's understanding of right relationship focuses on reciprocity; the Q'ero of Peru speak of reciprocity, harmony, and balance.

The writer Barry Lopez has been a constant source of inspiration to me over the years. In his essay "Landscape and Narrative" (1968), Lopez describes what we have been calling "right relationship" in a slightly different way. He observes that most indigenous peoples perceive a sacred order in the land, where both material and philosophical aspects of their cultures derive from "observations and meditations on the exterior landscape." He continues: "Each individual, further, undertakes to order his interior landscape according to the exterior landscape. To succeed in this means to achieve a balanced state of mental health." He advocates for "continuous attentiveness to both the obvious (scientific) and ineffable (artistic) orders of the local landscape."

I think of the term as embracing our Gaian belonging with virtue in Aristotle's sense, which leads to happiness and balance. In our consumerist world, right relationship can seem like an impossible goal. How can we pull our heads and hearts out of a culture of short-sightedness and greed when it is the soup in which we swim? To achieve right relationship with one another and with Gaia, we must strive for radical change. Cultural intervention at a large scale is necessary and Good.

A typical response to this call from interaction designers is often one of dismissal or frustration. "I work for a giant game company. They would never approve a project that went against their winning strategies in the marketplace." Well, friends, we are living in an entrepreneurial time. Elon Musk (founder of Space-X and Tesla Motors) will go to Mars because he is making it so.[15] People with a lot less wealth than Musk have funded companies to do right-relationship building with investment by regular people through tools like Kickstarter and Indiegogo.

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15. At the conference South by Southwest in 2013, Musk remarked, "I'd like to die on Mars, just not on impact" (Terdiman 2013).

"Well, it's *hard*," designers tell me. It's hard to create a product or technology with the intention of cultural intervention, one that goes against the tropes of popular culture. To those I reply, people have done these things. I've described many of them in this book. It's hard because it requires not only entertaining people, but also changing their minds. It's hard because there are few existing market niches for such work. Yes, it's hard. Virtue is hard. Gaian citizenship is hard. So suck it up. Get to work.

We live today between anxiety, delight, and despair. Our lives are torn up by what we see looming in the future of Gaia. We succumb to the temptation to be always busy, to collaborate with our existing culture personally and professionally. Alternatives are difficult to imagine. And yet, we all know that we must not only imagine but *make* them. Moving forward with hope is better than moving forward with despair or indifference; this is the best working hypothesis.

Hope is an active verb.

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