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# The Language of New Media

*Lev Manovich*

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*To Norman Klein/Peter Lunenfeld/Vivian Sobchack*

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# Introduction

## A Personal Chronology

*Moscow, 1975.* Although my ambition is to become a painter, I enroll in the mathematical ("matematicheskaya") high school, which in addition to a regular curriculum has courses in calculus and computer programming. The programming course lasts two years, during which we never see a computer. Our teacher uses a blackboard to explain the concepts of computer programming. First we learn a computer language invented in the Soviet Union in the late 1950s. The language has a wonderful Cold War name: "Peace-1" ("MiR-1"). Later we learn a more standard high-level language: ALGOL-60. For two years, we write computer programs in our notebooks. Our teacher grades them and returns them with corrections: missed end of the loop statement, undeclared variable, forgotten semicolon. At the end of the two-year course, we are taken—just once—to a data-processing center, which normally requires clearance to enter. I enter my program into a computer, but it does not run: Because I had never seen a computer keyboard before, I used the letter *O* whenever I need to input zero.

Also in 1975, I start taking private lessons in classical drawing, lessons that also last two years. The Moscow Architectural Institute entrance exams include a test in which the applicants have to complete a drawing of an antique bust in eight hours. To get the top grade, one has to produce a drawing that not only looks like the cast and has perfect perspective, but also has perfect shading. This means that all shadows and surfaces are defined completely through shading, so all the lines originally used to define them disappear. Hundreds of hours spent in front of a drawing board pay off: I get an A on the exam, even though out of eight possible casts I am assigned the most difficult one: the head of Venera. It is more difficult because, in contrast to casts of male heads such as Socrates', it does not have well-defined facets; the surfaces join smoothly together as though constructed with a spline modeling program. Later I learn that, during the 1970s, computer scientists were working on the same problem, that is, how to produce smoothly shaded images of 3-D objects on a computer. The standard rendering algorithm still used today was invented at the University of Utah in 1975—the same year I started my drawing lessons.[1]

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[1] B. T. Phong, "Illumination for Computer Generated Pictures," *Communication of the ACM* 18, no. 6 (June 1975): 311–317.

*New York, 1985.* It is early morning, and I am sitting in front of a Tetronics terminal in midtown Manhattan. I have just finished my night shift at Digital Effects, one of the first companies in the world devoted to producing 3-D computer animation for film and television. (The company worked on *Tron* and produced computer animation for all of the major television networks.) My job is to operate the Harris-500 mainframe, used to compute animations, and also the PDP-11, which controls the Dicomed film recorder, used to output animation on 35mm film. After a few months I am able to figure out the company's proprietary computer-graphics software written in APL (a high level programming language), and begin work on my first images. I would like to produce a synthetic image of an antique bust, but the task turns out to be impossible. The software is able to create 3-D objects only out of primitive geometric forms such as cubes, cylinders, and spheres—so I am forced to settle for a composition made out of these primitive forms. Tetronics is a vector rather than raster terminal, which means that it does not update its screen in real time. Each time I make a change in my program or simply change a point of view, I hit the enter key and wait while the computer redraws the lines, one by one. I wonder why I had to spend years learning to draw images in perspective when a computer could do it in seconds. A few of the images I create are exhibited in shows of computer art in New York. But this is the heyday of postmodernism: The art market is hot, paintings by young New York artists are selling for tens of thousands of dollars, and the art world has little interest in computer art.

*Linz, Austria, 1995.* I am at Ars Electronica, the world's most prestigious annual computer-art festival. This year it drops the "computer graphics" category, replacing it with the new "net art" category, signaling a new stage in the evolution of modern culture and media. The computer, which since the early 1960s has been used as a production tool, has now become a universal media machine—a tool used not only for production, but also for storage and distribution. The World Wide Web crystallizes this new condition; on the level of language, this fact is recognized around 1990 when the term "digital media" comes to be used along with "computer graphics." At the same time, along with existing cultural forms, computers begin to host an array of new forms: Web sites and computer games, hypermedia CD-ROMs and interactive installations—in short, "new media." And if in 1985 I had to write a long computer program in a specialized computer language just to put a picture of a shaded cube on a computer screen, ten years later I can

choose from a number of inexpensive, menu-based 3-D software tools that run on ordinary PCs and come with numerous ready-made 3-D models, including detailed human figures and heads.

What else can be said about 1995? The Soviet Union, where I was born, no longer exists. With its demise, the tensions that for decades animated creative imaginations both in the East and the West—between freedom and confinement, interactivity and predetermination, consumerism in the West and "spirituality" in the East—disappear. What takes their place? A triumph of consumerism, commercial culture (based on stereotypes and limited clichés), megacorporations that lay claim to such basic categories as space, time, and the future ("Where Do You Want to Go Today?" ads by Microsoft; "Internet Time" by Swatch, which breaks twenty-four hours into 1,000 Swatch "beats"; "You will" ads by AT&T), and "globalization" (a term at least as elusive as "spirituality").

When I visit St. Petersburg in 1995 to participate in a small computer art festival called "In Search of a Third Reality," I see a curious performance, which may be a good parable of globalization. Like the rest of the festival, the performance takes place in the planetarium. Its Director, forced like everyone else to make his own living in the new Russian economic order (or lack thereof), had rented the planetarium to conference organizers. Under the black hemispherical ceiling with mandatory models of planets and stars, a young artist methodically paints an abstract painting. Probably trained in the same classical style as I had been, he is no Pollock; cautiously and systematically, he makes careful brushstrokes on the canvas in front of him. On his hand he wears a Nintendo Dataglove, which in 1995 is a common media object in the West but a rare sight in St. Petersburg. The Dataglove transmits the movements of his hand to a small electronic synthesizer, assembled in the laboratory of some Moscow institute. The music from the synthesizer serves as an accompaniment to two dancers, a male and a female. Dressed in Isadora Duncan–like clothing, they improvise a "modern dance" in front of an older and, apparently, completely puzzled audience. Classical art, abstraction, and a Nintendo Dataglove; electronic music and early twentieth-century modernism; discussions of virtual reality (VR) in the planetarium of a classical city that, like Venice, is obsessed with its past—what for me, coming from the West, are incompatible historical and conceptual layers are composited together, with the Nintendo Dataglove being just one layer in the mix.

What also arrives by 1995 is the Internet—the most material and visible sign of globalization. And by the end of the decade it will also become clear that the gradual computerization of culture will eventually transform all of it. So, invoking the old Marxist model of base and superstructure, we can say that if the economic base of modern society from the 1950s onward starts to shift toward a service and information economy, becoming by the 1970s a so-called post-industrial society (Daniel Bell), and then later a "network society" (Manual Castells), by the 1990s the superstructure starts to feel the full impact of this change.[2] If the postmodernism of the 1980s is the first sign of this shift still to come—still weak, still possible to ignore—the 1990s' rapid transformation of culture into e-culture, of computers into universal culture carriers, of media into new media, demands that we rethink our categories and models.

The year is 2005. . . .

## Theory of the Present

I wish that someone in 1895, 1897, or at least 1903, had realized the fundamental significance of the emergence of the new medium of cinema and produced a comprehensive record: interviews with audiences; a systematic account of narrative strategies, scenography, and camera positions as they developed year by year; an analysis of the connections between the emerging language of cinema and different forms of popular entertainment that coexisted with it. Unfortunately, such records do not exist. Instead we are left with newspaper reports, diaries of cinema's inventors, programs of film showings, and other bits and pieces—a set of random and unevenly distributed historical samples.

Today we are witnessing the emergence of a new medium—the metamedium of the digital computer. In contrast to a hundred years ago, when cinema was coming into being, we are fully aware of the significance of this new media revolution. Yet I am afraid that future theorists and historians of computer media will be left with not much more than the equivalents of the newspaper reports and film programs from cinema's first decades. They will find that analytical texts from our era recognize the significance of the computer's takeover of culture yet, by and large, contain speculations about the future rather than a record and theory of the present. Future researchers will wonder why the theoreticians, who had plenty of experience analyzing older cultural forms, did not try to describe computer media's semiotic codes, modes of address, and audience reception patterns. Having painstakingly reconstructed how cinema emerged out of preceding cultural forms (panorama, optical toys, peep shows), one might ask why they didn't attempt to construct a similar genealogy for the language of computer media at the moment when it was just coming into being, that is, when the elements of previous cultural forms shaping it were still clearly visible and recognizable, before melting into a coherent language? Where were the theoreticians at the moment when the icons and buttons of multimedia interfaces were like wet paint on a just-completed painting, before they became universal conventions and thus slipped into invisibility? Where were they at the moment when the designers of *Myst* were debugging their code, converting graphics to 8-bit, and massaging QuickTime clips? Or at the historical moment when a twenty-something programmer at Netscape took the chewing gum out of his mouth, sipped warm Coke out of the can—he had been at a computer for sixteen hours straight, trying to meet a marketing deadline—and, finally satisfied with its small file size, saved a short animation of stars moving across the night sky? This animation would appear in the upper right corner of Netscape Navigator, and become the most widely seen moving image sequence ever—until the next release of the software.

What follows is an attempt at both a record and a theory of the present. Just as film historians traced the development of film language during cinema's first decades, I aim to describe and understand the logic driving the development of the language of new media. (I am not claiming that there is a single language of new media. I use "language" as an umbrella term to refer to a number of various conventions used by designers of new media objects to organize data and structure the user's experience.) It is tempting to extend this parallel a little further and speculate whether this new language is already drawing closer to acquiring its final and stable form, just as film language acquired its "classical" form during the 1910s. Or it may be that the 1990s are more like the 1890s, in the sense that the computer-media language of the future will be entirely different from the one used today.

Does it make sense to theorize the present when it seems to be changing so fast? It is a hedged bet. If subsequent developments prove my theoretical projections correct, I win. But even if the language of computer media develops in a different direction than the one suggested by the present analysis, this book will become a record of possibilities heretofore unrealized, of a horizon visible to us today but later unimaginable.

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[2] Daniel Bell, *The Coming of Post-industrial Society* (New York: Basic Books, 1973); Manuel Castells, *The Rise of the Network Society* (Cambridge, Mass.: Blackwell Publishers, 1996).

We no longer think of the history of cinema as a linear march toward a single possible language, or as a progression toward perfect verisimilitude. On the contrary, we have come to see its history as a succession of distinct and equally expressive languages, each with its own aesthetic variables, and each closing off some of the possibilities of its predecessor (a cultural logic not dissimilar to Thomas Kuhn's analysis of scientific paradigms.)[3] Similarly, every stage in the history of computer media offers its own aesthetic opportunities, as well as its own vision of the future: in short, its own "research paradigm." In this book I want to record the "research paradigm" of new media during its first decade, before it slips into invisibility.

## Mapping New Media: The Method

I analyze the language of new media by placing it within the history of modern visual and media cultures. What are the ways in which new media relies on older cultural forms and languages, and what are the ways in which it breaks with them? What is unique about how new media objects create the illusion of reality, address the viewer, and represent space and time? How do conventions and techniques of old media—such as the rectangular frame, mobile viewpoint, and montage—operate in new media? If we construct an archeology connecting new computer-based techniques of media creation with previous techniques of representation and simulation, where should we locate the essential historical breaks?

To answer these questions, I look at all areas of new media: Web sites, virtual worlds,[4] virtual reality (VR), multimedia, computer games, interactive installations, computer animation, digital video, cinema, and human-computer interfaces. Although the book's main emphasis is on theoretical and historical arguments, I also analyze many key new-media objects, from American commercial classics such as *Myst* and *Doom*, *Jurassic Park* and *Titanic*, to the work of international new media artists and collectives such as ART+COM, antirom, jodi.org, George Legrady, Olga Lialina, Jeffrey Shaw, and Tamas Waliczky.

The computerization of culture not only leads to the emergence of new cultural forms such as computer games and virtual worlds; it redefines existing ones such as photography and cinema. I therefore also investigate the effects of the computer revolution on visual culture at large. How does the shift to computer-based media redefine the nature of static and moving images? What is the effect of computerization on the visual languages used by our culture? What new aesthetic possibilities become available to us?

In answering these questions, I draw upon the histories of art, photography, video, telecommunication, design, and, last but not least, the key cultural form of the twentieth century—cinema. The theory and history of cinema serve as the key conceptual lens though which I look at new media. The book explores the following topics:

- the parallels between cinema history and the history of new media;
- the identity of digital cinema;
- the relations between the language of multimedia and nineteenth century pro-cinematic cultural forms;
- the functions of screen, mobile camera, and montage in new media as compared to cinema;
- the historical ties between new media and avant-garde film.

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[3] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2d ed. (Chicago: University of Chicago Press, 1970).

[4] By virtual worlds I mean 3-D computer-generated interactive environments. This definition fits a whole range of 3-D computer environments already in existence—high-end VR works that feature head-mounted displays and photo realistic graphics, arcade, CD-ROM and on-line multi-player computer games, QuickTime VR movies, VRML (Virtual Reality Modeling Language) scenes, and graphical chat environments such as The Palace and Active Worlds.

Virtual worlds represent an important trend across computer culture, consistently promising to become a new standard in human-computer interfaces and computer networks. (For a discussion of why this promise may never be fulfilled, see the "Navigable Space" section.) For example, Silicon Graphics developed a 3-D file system that was showcased in the movie *Jurassic Park*. Sony used a picture of a room as an interface in its MagicLink personal communicator. Apple's short-lived E-World greeted its users with a drawing of a city. Web designers often use pictures of buildings, aerial views of cities, and maps as interface metaphors. In the words of the scientists from Sony's The Virtual Society Project (www.csl.sony.co.jp/project/VS/), "It is our belief that future online systems will be characterized by a high degree of interaction, support for multi-media and most importantly the ability to support shared 3-D spaces. In our vision, users will not simply access textual based chat forums, but will enter into 3-D worlds where they will be able to interact with the world and with other users in that world."

Along with film theory, this book draws theoretical tools from both the humanities (art history, literary theory, media studies, social theory) and computer science. Its overall method could be called "digital materialism." Rather than imposing some a priori theory from above, I build a theory of new media from the ground up. I scrutinize the principles of computer hardware and software and the operations involved in creating cultural objects on a computer to uncover a new cultural logic at work.

Most writings on new media are full of speculation about the future. This book, in contrast, analyses new media as it has actually developed until the present moment, while pointing to directions for new media artists and designers that have yet to be explored. It is my hope that the theory of new media developed here can act not only as an aid to understanding the present, but also as a grid for practical experimentation. For example, the "Theory of Cultural Interfaces" section analyzes how the interfaces of new media objects are being shaped by three cultural traditions: print, cinema, and human-computer interface. By describing elements in these traditions that are already being used in new media, I point toward other elements and their combinations still awaiting experimentation. The "Compositing" section provides another set of directions for experiments by outlining a number of new types of montage. Yet another direction is discussed in "Database," where I suggest that new media narratives can explore the new compositional and aesthetic possibilities offered by a computer database.

Although this book does not speculate about the future, it does contain an implicit theory of how new media will develop. The advantage of placing new media within a larger historical perspective is that we begin to see the long trajectories that lead to new media in its present state, and we can extrapolate these trajectories into the future. The section "Principles of New Media" describes four key trends that, in my view, are shaping the development of new media over time: modularity, automation, variability, and transcoding.

Of course we don't have to accept these trends blindly. Understanding the logic that is shaping the evolution of new media language allows us to develop different alternatives. Just as avant-garde filmmakers have offered alternatives to cinema's particular narrative audio-visual regime throughout the medium's history, the task of avant-garde new media artists today is to offer alternatives to the existing language of computer media. This can be better accomplished if we have a theory of how "mainstream" language is now structured and how it might evolve over time.

## Mapping New Media: Organization

This book aims to contribute to the emerging field of new media studies (sometimes called "digital studies") by providing one potential map of what the field can be. Just as a literary theory textbook might feature chapters on narrative and voice, and a textbook of film studies might discuss cinematography and editing, this book calls for the definition and refinement of the new categories specific to new media theory.

I have divided the book into a number of chapters, each of which covers one key concept or problem. Concepts developed in earlier chapters become building blocks for analyses in later chapters. In determining the sequence of the chapters, I considered textbooks on various established fields relevant to new media, such as film studies, literary theory, and art history; much as a textbook on film may begin with film technology and end up with film genres, this book progresses from the material foundations of new media to its forms.

One could also draw an analogy between the "bottom-up" approach I use here and the organization of computer software. A computer program written by a programmer undergoes a series of translations: high-level computer language is compiled into executable code, which is then converted by an assembler into binary code. I follow this order in reverse, advancing from the level of binary code to the level of a computer program, and then move on to consider the logic of new media objects driven by these programs:

1. "What Is New Media?"—the digital medium itself, its material and logical organization.
2. "The Interface"—the human-computer interface; the operating system (OS).
3. "The Operations"—software applications that run on top of the OS, their interfaces, and typical operations.
4. "The Illusions"—appearance, and the new logic of digital images created using software applications.
5. "The Forms"—commonly used conventions for organizing a new media object as a whole.

The last chapter "What Is Cinema?" mirrors the book's beginning. Chapter 1 points out that many of the allegedly unique principles of new media can already be found in cinema. Subsequent chapters continue to employ film history and theory as a means of analyzing new media. Having discussed different levels of new media—interface, operations, illusion, and forms—I then reverse my conceptual lens to look at how computerization changes cinema. I analyze the identity of digital cinema by placing it within the history of the moving image and discuss how computerization offers new opportunities for developing the language of film.

At the same time, the last chapter continues the "bottom-up" trajectory of the book as a whole. If chapter 5 looks at the organization of new cultural objects, such as Web sites, hypermedia CD-ROMs, and virtual worlds, all "children" of the computer, chapter 6 considers the effects of computerization on an older cultural form that exists, so to speak, "outside" computer culture proper—cinema.

Each chapter begins with a short introduction that discusses a concept and summarizes the arguments developed in individual sections. For example, chapter 2, "The Interface," begins with a general discussion of the importance of the concept of the interface in new media. The two sections of chapter 2 then look at different aspects of new media interfaces: their reliance on the conventions of other media and the relationship between the body of the user and the interface.

## The Terms: Language, Object, Representation

In putting the word *language* into the title of the book, I do not want to suggest that we need to return to the structuralist phase of semiotics in understanding new media. However, given that most studies of new media and cyberculture focus on their sociological, economic, and political dimensions, it was important for me to use the word *language* to signal the different focus of this work: the emergent conventions, recurrent design patterns, and key forms of new media. I considered using the words *aesthetics* and *poetics* instead of *language*, eventually deciding against them. *Aesthetics* implies a set of oppositions that I would like to avoid—between art and mass culture, the beautiful and the ugly, the valuable and the unimportant. *Poetics* also bears undesirable connotations. Continuing the project of the Russian formalists of the 1910s, theoreticians in the 1960s defined *poetics* as the study of the specific properties of particular arts, such as narrative literature. In his *Introduction to Poetics* (1968), literary scholar Tzvetan Todorov, for instance, writes:

> In contradistinction to the interpretation of particular works, it [poetics] does seek to name meaning, but aims at a knowledge of the general laws that preside over the birth of each work. But in contradistinction to such sciences as psychology, sociology, etc., it seeks these laws within literature itself. Poetics is therefore an approach to literature at once 'abstract' and 'internal.'[5]

In contrast to such an "internal" approach, I neither claim that the conventions, elements, and forms of new media are unique, nor do I consider it useful to look at them in isolation. On the contrary, this book aims to situate new media in relation to a number of other areas of culture, both past and present:

- other arts and media traditions: their visual languages and their strategies for organizing information and structuring the viewer's experience;
- computer technology: the material properties of the computer, the ways in which it is used in modern society; the structure of its interface, and key software applications;
- contemporary *visual culture:* the internal organization, iconography, iconology, and viewer experience of various visual sites in our culture—fashion and advertising, supermarkets and fine art objects, television programs and publicity banners, offices and techno-clubs;
- contemporary *information culture.*

The concept "information culture," which is my term, can be thought of as a parallel to another, already familiar concept—visual culture. It includes the ways in which information is presented in different cultural sites and objects—road signs; displays in airports and train stations; television on-screen menus; graphic layouts of television news; the layouts of books, newspapers, and magazines; the interior designs of banks, hotels, and other commercial and leisure spaces; the interfaces of planes and cars; and, last but not least, the interfaces of computer operating systems (Windows, Mac OS, UNIX) and software applications (Word, Excel, PowerPoint, Eudora, Navigator, RealPlayer, Filemaker, Photoshop, etc.). Extending the parallels with visual culture, information culture also includes historical methods for organizing and retrieving information (analogs of iconography) as well as patterns of user interaction with information objects and displays.

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[5] Tzevan Todorov, *Introduction to Poetics*, trans. Richard Howard (Minneapolis: University of Minnesota Press, 1981), 6.

Another word deserving comment is *object*. Throughout the book, I use the term *new media object*, rather than *product*, *artwork*, *interactive media* or other possible terms. A new media object may be a digital still, digitally composited film, virtual 3-D environment, computer game, self-contained hypermedia DVD, hypermedia Web site, or the Web as a whole. The term thus fits with my aim of describing the general principles of new media that hold true across all media types, all forms of organization, and all scales. I also use *object* to emphasize that my concern is with the culture at large rather than with new media art alone. Moreover, *object* is a standard term in the computer science and computer industry, where it is used to emphasize the modular nature of object-oriented programming languages such as C++ and Java, object-oriented databases, and the Object Linking and Embedding (OLE) technology used in Microsoft Office products. Thus it also serves my purpose to adopt the terms and paradigms of computer science for a theory of computerized culture.

In addition, I hope to activate connotations that accompanied the use of the word *object* by the Russian avant-garde artists of the 1920s. Russian Constructivists and Productivists commonly referred to their creations as *objects* (*vesh*, *construktsia*, *predmet*) rather than works of art. Like their Bauhaus counterparts, they wanted to take on the roles of industrial designers, graphic designers, architects, and clothing designers, rather than remain fine artists producing one-of-a-kind works for museums or private collections. *Object* pointed toward the factory and industrial mass production rather than the traditional artist's studio, and it implied the ideals of rational organization of labor and engineering efficiency that artists wanted to bring into their own work.

In the case of new media objects, all these connotations are worth invoking. In the world of new media, the boundary between art and design is fuzzy at best. On the one hand, many artists make a living as commercial designers; on the other hand, professional designers are typically the ones who really push forward the language of new media by being engaged in systematic experimentation and also by creating new standards and conventions. The second connotation, that of industrial production, also holds true for new media. Many new media projects are put together by large teams (although, in contrast to the studio system of the classical Hollywood era, single producers or small teams are also common). Many new media objects, such as popular games or software applications, sell millions of copies. Yet another feature of the new media field that unites it with big industry is the strict adherence to various hardware and software standards.[6]

Finally, and most important, I use the word *object* to reactivate the concept of laboratory experimentation practiced by the avant-garde of the 1920s. Today, as more artists are turning to new media, few are willing to undertake systematic, laboratory-like research into its elements and basic compositional, expressive, and generative strategies. Yet this is exactly the kind of research undertaken by Russian and German avant-garde artists of the 1920s in places like Vkhutemas[7] and Bauhaus, as they explored the new media of their time: photography, film, new print technologies, telephony. Today, those few who are able to resist the immediate temptation to create an "interactive CD-ROM," or make a feature-length "digital film," and instead focus on determining the new-media equivalent of a shot, sentence, word, or even letter, are rewarded with amazing findings.

A third term that is used throughout the book and needs comment is *representation*. In using this term, I want to invoke the complex and nuanced understanding of the functioning of cultural objects as developed in the humanities over the last decades. New media objects are cultural objects; thus, any new media object—whether a Web site, computer game, or digital image—can be said to represent, as well as help construct, some outside referent: a physically existing object, historical information presented in other documents, a system of categories currently employed by culture as a whole or by particular social groups. As is the case with all cultural representations, new media representations are also inevitably biased. They represent/construct some features of physical reality at the expense of others, one worldview among many, one possible system of categories among numerous others. In this book I will take this argument one step further by suggesting that software interfaces—both those of operating systems and of software applications—also act as representations. That is, by organizing data in particular ways, they privilege particular models of the world and the human subject. For instance, the two key ways to organize computer data commonly used today—a hierarchical file system (Graphical User Interface from the 1984 Macintosh onward) and a "flat," nonhierarchical network of hyperlinks (1990s World Wide Web)—represent the world in two fundamentally different and in fact opposing ways. A hierarchical file system assumes that the world can be reduced to a logical and hierarchical order, where every object has a distinct and well-defined place. The World Wide Web model assumes that every object has the same importance as any other, and that everything is, or can be, connected to everything else. Interfaces also privilege particular modes of data access traditionally associated with particular arts and media technologies. For instance, the World Wide Web of the 1990s foregrounded the page as a basic unit of data organization (regardless of which media types it contained), while Acrobat software applied the metaphor of "video playback" to text-based documents. Thus interfaces act as "representations" of older cultural forms and media, privileging some at the expense of others.

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[6] Examples of software standards include operating systems such as UNIX, Windows, and MAC OS; file formats (JPEG, MPEG, DV, QuickTime, RTF, WAV); scripting languages (HTML, Javascript); programming languages (C++, Java); communication protocols (TCP-IP); the conventions of HCI (e.g., dialog boxes, copy and paste commands, the help pointer); and also unwritten conventions, such as the 640-by-480 pixel image size that was used for more than a decade. Hardware standards include storage media formats (ZIP, JAZ, CD-ROM, DVD), port types (serial, USB, Firewire), bus architectures (PCI), and RAM types.

[7] Vkhutemas was a Moscow art and design school in the 1920s that united most leftist avant-garde artists; it functioned as a counterpart of the Bauhaus in Germany.

In describing the language of new media, I have found it useful to use the term *representation* in opposition to other terms. Depending on which term it is opposed to, the meaning of *representation* changes. Since these oppositions are introduced in different sections of the book, I will summarize them here:

1. *Representation—simulation* ("Screen" section). Here, *representation* refers to various screen technologies such as post-Renaissance painting, film, radar, and television. I define *screen* as a rectangular surface that frames a virtual world and that exists within the physical world of a viewer without completely blocking her visual field. *Simulation* refers to technologies that aim to immerse the viewer completely within a virtual universe—Baroque Jesuit churches, nineteenth-century panorama, twentieth-century movie theaters.
2. *Representation—control* ("Cultural Interfaces" section). Here I oppose the image as a representation of an illusionary fictional universe and the image as a simulation of a control panel (for instance, GUI with its different icons and menus) that allows the user to control a computer. This new type of image can be called *image-interface*. The opposition representation—control corresponds to an opposition between depth and surface: a computer screen as window into illusionistic space versus computer screen as flat control panel.
3. *Representation—action* ("Teleaction" section). This is the opposition between technologies used to create illusions (fashion, realist paintings, dioramas, military decoys, film montage, digital compositing) and representational technologies used to enable action, that is, to allow the viewer to manipulate reality through representations (maps, architectural drawings, x-rays, telepresence). I refer to images produced by later technologies as *image-instruments*.
4. *Representation—communication* ("Teleaction" section). This is the opposition between representational technologies (film, audio, and video magnetic tape, digital storage formats) and real-time communication technologies, that is, everything that begins with *tele-* (telegraph, telephone, telex, television, telepresence). Representational technologies allow for the creation of traditional aesthetic objects, that is, objects that are fixed in space or time and refer to some referent(s) outside themselves. By foregrounding the importance of person-to-person telecommunication, and *telecultural* forms in general that do not produce any objects, new media force us to reconsider the traditional equation between culture and objects.
5. *Visual illusionism—simulation* (introduction to "Illusions" chapter). *Illusionism* here refers both to representation and simulation as these terms are used in the "Screen" section. Thus illusionism combines traditional techniques and technologies that aim to create a visual resemblance of reality—perspectival painting, cinema, panorama, etc. *Simulation* refers to various computer methods for modeling other aspects of reality beyond visual appearance—movement of physical objects, shape changes occurring over time in natural phenomena (water surface, smoke), motivations, behavior, speech and language comprehension in human beings.
6. *Representation—information* (introduction to "Forms" chapter). This opposition refers to two opposing goals of new media design: immersing users in an imaginary fictional universe similar to traditional fiction and giving users efficient access to a body of information (for instance, a search engine, Web site, or on-line encyclopedia).

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# What Is New Media?

What is new media? We may begin answering this question by listing the categories commonly discussed under this topic in the popular press: the Internet, Web sites, computer multimedia, computer games, CD-ROMs and DVD, virtual reality. Is this all there is to new media? What about television programs shot on digital video and edited on computer workstations? Or feature films that use 3-D animation and digital compositing? Shall we also count these as new media? What about images and text-image compositions—photographs, illustrations, layouts, ads—created on computers and then printed on paper? Where shall we stop?

As can be seen from these examples, the popular understanding of new media identifies it with the use of a computer for distribution and exhibition rather than production. Accordingly, texts distributed on a computer (Web sites and electronic books) are considered to be new media, whereas texts distributed on paper are not. Similarly, photographs that are put on a CD-ROM and require a computer to be viewed are considered new media; the same photographs printed in a book are not.

Shall we accept this definition? If we want to understand the effects of computerization on culture as a whole, I think it is too limiting. There is no reason to privilege the computer as a machine for the exhibition and distribution of media over the computer as a tool for media production or as a media storage device. All have the same potential to change existing cultural languages. And all have the same potential to leave culture as it is.

The last scenario is unlikely, however. What is more likely is that just as the printing press in the fourteenth century and photography in the nineteenth century had a revolutionary impact on the development of modern society and culture, today we are in the middle of a new media revolution—the shift of all culture to computer-mediated forms of production, distribution, and communication. This new revolution is arguably more profound than the previous ones, and we are just beginning to register its initial effects. Indeed, the introduction of the printing press affected only one stage of cultural communication—the distribution of media. Similarly, the introduction of photography affected only one type of cultural communication—still images. In contrast, the computer media revolution affects all stages of communication, including acquisition, manipulation, storage, and distribution; it also affects all types of media—texts, still images, moving images, sound, and spatial constructions.

How shall we begin to map out the effects of this fundamental shift? What are the ways in which the use of computers to record, store, create, and distribute media makes it "new"?

In the section "Media and Computation," I show that new media represents a convergence of two separate historical trajectories: computing and media technologies. Both begin in the 1830s with Babbage's Analytical Engine and Daguerre's daguerreotype. Eventually, in the middle of the twentieth century, a modern digital computer is developed to perform calculations on numerical data more efficiently; it takes over from numerous mechanical tabulators and calculators widely employed by companies and governments since the turn of the century. In a parallel movement, we witness the rise of modern media technologies that allow the storage of images, image sequences, sounds, and text using different material forms—photographic plates, film stocks, gramophone records, etc. The synthesis of these two histories? The translation of all existing media into numerical data accessible through computers. The result is new media—graphics, moving images, sounds, shapes, spaces, and texts that have become computable; that is, they comprise simply another set of computer data. In "Principles of New Media," I look at the key consequences of this new status of media. Rather than focusing on familiar categories such as interactivity or hypermedia, I suggest a different list. This list reduces all principles of new media to five—numerical representation, modularity, automation, variability, and cultural transcoding. In the last section, "What New Media Is Not," I address other principles that are often attributed to new media. I show that these principles can already be found at work in older cultural forms and media technologies such as cinema, and therefore in and of themselves are in sufficient to distinguish new media from old.

## How Media Became New

On August 19, 1839, the Palace of the Institute in Paris was filled with curious Parisians who had come to hear the formal description of the new reproduction process invented by Louis Daguerre. Daguerre, already well known for his Diorama, called the new process *daguerreotype*. According to a contemporary, "a few days later, opticians' shops were crowded with amateurs panting for daguerreotype apparatus, and everywhere cameras were trained on buildings. Everyone wanted to record the view from his window, and he was lucky who at first trial got a silhouette of roof tops against the sky."[1] The media frenzy had begun. Within five months more than thirty different descriptions of the technique had been published around the world—Barcelona, Edinburgh, Naples, Philadelphia, St. Petersburg, Stockholm. At first, daguerreotypes of architecture and landscapes dominated the public's imagination; two years later, after various technical improvements to the process had been made, portrait galleries had opened everywhere—and everyone rushed to have her picture taken by the new media machine.[2]

In 1833 Charles Babbage began designing a device he called "the Analytical Engine." The Engine contained most of the key features of the modern digital computer. Punch cards were used to enter both data and instructions. This information was stored in the Engine's memory. A processing unit, which Babbage referred to as a "mill," performed operations on the data and wrote the results to memory; final results were to be printed out on a printer. The Engine was designed to be capable of doing any mathematical operation; not only would it follow the program fed into it by cards, but it would also decide which instructions to execute next, based on intermediate results. However, in contrast to the daguerreotype, not a single copy of the Engine was completed. While the invention of the daguerreotype, a modern media tool for the reproduction of reality, impacted society immediately, the impact of the computer was yet to be seen.

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[1] Quoted in Beaumont Newhall, *The History of Photography from 1839 to the Present Day.* 4th ed. (New York: Museum of Modern Art, 1964), 18.

[2] Newhall, *The History of Photography,* 17–22.

Interestingly, Babbage borrowed the idea of using punch cards to store information from an earlier programmed machine. Around 1800, J. M. Jacquard invented a loom that was automatically controlled by punched paper cards. The loom was used to weave intricate figurative images, including Jacquard's portrait. This specialized graphics computer, so to speak, inspired Babbage in his work on the Analytical Engine, a general computer for numerical calculations. As Ada Augusta, Babbage's supporter and the first computer programmer, put it, "The Analytical Engine weaves algebraical patterns just as the Jacquard loom weaves flowers and leaves."[3] Thus a programmed machine was already synthesizing images even before it was put to processing numbers. The connection between the Jacquard loom and the Analytical Engine is not something historians of computers make much of, since for them computer image synthesis represents just one application of the modern digital computer among thousands of others, but for a historian of new media, it is full of significance.

We should not be surprised that both trajectories—the development of modern media and the development of computers—begin around the same time. Both media machines and computing machines were absolutely necessary for the functioning of modern mass societies. The ability to disseminate the same texts, images, and sounds to millions of citizens—thus assuring the same ideological beliefs—was as essential as the ability to keep track of their birth records, employment records, medical records, and police records. Photography, film, the offset printing press, radio, and television

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[3] Charles Eames, *A Computer Perspective: Background to the Computer Age* (Cambridge, Mass: Harvard University Press, 1990), 18.

made the former possible while computers made possible the latter. Mass media and data processing are complementary technologies; they appear together and develop side by side, making modern mass society possible.

For a long time the two trajectories ran in parallel without ever crossing paths. Throughout the nineteenth and the early twentieth centuries, numerous mechanical and electrical tabulators and calculators were developed; they gradually became faster and their use more widespread. In a parallel movement, we witness the rise of modern media that allow the storage of images, image sequences, sounds, and texts in different material forms—photographic plates, film stock, gramophone records, etc.

Let us continue tracing this joint history. In the 1890s modern media took another step forward as still photographs were put in motion. In January 1893, the first movie studio—Edison's "Black Maria"—started producing twenty-second shorts that were shown in special Kinetoscope parlors. Two years later the Lumière brothers showed their new Cinématographie camera/projection hybrid, first to a scientific audience and later, in December 1895, to the paying public. Within a year, audiences in Johannesburg, Bombay, Rio de Janeiro, Melbourne, Mexico City, and Osaka were subjected to the new media machine, and they found it irresistible.[4] Gradually scenes grew longer, the staging of reality before the camera and the subsequent editing of samples became more intricate, and copies multiplied. In Chicago and Calcutta, London and St. Petersburg, Tokyo and Berlin, and thousands of smaller places, film images would soothe movie audiences, who were facing an increasingly dense information environment outside the theater, an environment that no longer could be adequately handled by their own sampling and data processing systems (i.e., their brains). Periodic trips into the dark relaxation chambers of movie theaters became a routine survival technique for the subjects of modern society.

The 1890s was the crucial decade not only for the development of media, but also for computing. If individual brains were overwhelmed by the amount of information they had to process, the same was true of corporations and of governments. In 1887, the U.S. Census Bureau was still interpreting figures from the 1880 census. For the 1890 census, the Census Bureau adopted electric tabulating machines designed by Herman Hollerith. The data collected on every person was punched into cards; 46,804 enumerators completed forms for a total population of 62,979,766. The Hollerith tabulator opened the door for the adoption of calculating machines by business; during the next decade electric tabulators became standard equipment in insurance companies, public utility companies, railroad offices, and accounting departments. In 1911, Hollerith's Tabulating Machine Company was merged with three other companies to form the Computing-Tabulating-Recording Company; in 1914, Thomas J. Watson was chosen as its head. Ten years later its business tripled, and Watson renamed the company the "International Business Machines Corporation," or IBM.[5]

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[4] David Bordwell and Kristin Thompson, *Film Art: An Introduction*, 5th ed. (New York: McGraw-Hill), 15.

Moving into the twentieth century, the key year for the history of media and computing is 1936. British mathematician Alan Turing wrote a seminal paper entitled "On Computable Numbers." In it he provided a theoretical description of a general-purpose computer later named after its inventor: "the Universal Turing Machine." Even though it was capable of only four operations, the machine could perform any calculation that could be done by a human and could also imitate any other computing machine. The machine operated by reading and writing numbers on an endless tape. At every step the tape would be advanced to retrieve the next command, read the data, or write the result. Its diagram looks suspiciously like a film projector. Is this a coincidence?

If we believe the word *cinematograph,* which means "writing movement," the essence of cinema is recording and storing visible data in a material form. A film camera records data on film; a film projector reads it off. This cinematic apparatus is similar to a computer in one key respect: A computer's program and data also have to be stored in some medium. This is why the Universal Turing Machine looks like a film projector. It is a kind of film camera and film projector at once, reading instructions and data stored on endless tape and writing them in other locations on this tape. In fact, the development of a suitable storage medium and a method for coding data represent important parts of the prehistory of both cinema and the computer. As we know, the inventors of cinema eventually settled on using discrete images recorded on a strip of celluloid; the inventors of the computer—which needed much greater speed of access as well as the ability to quickly read and write data—eventually decided to store it electronically in a binary code.

The histories of media and computing became further entwined when German engineer Konrad Zuse began building a computer in the living room of his parents' apartment in Berlin—the same year that Turing wrote his seminal paper. Zuse's computer was the first working digital computer. One of his innovations was using punched tape to control computer programs. The tape Zuse used was actually discarded 35mm movie film.[6]

One of the surviving pieces of this film shows binary code punched over the original frames of an interior shot. A typical movie scene—two people in a room involved in some action—becomes a support for a set of computer commands. Whatever meaning and emotion was contained in this movie scene has been wiped out by its new function as data carrier. The pretense of modern media to create simulations of sensible reality is similarly canceled; media are reduced to their original condition as information carrier, nothing less, nothing more. In a technological remake of the Oedipal complex, a son murders his father. The iconic code of cinema is discarded in favor of the more efficient binary one. Cinema becomes a slave to the computer.

But this is not yet the end of the story. Our story has a new twist—a happy one. Zuse's film, with its strange superimposition of binary over iconic code, anticipates the convergence that will follow half a century later. The two separate historical trajectories finally meet. Media and computer—Daguerre's daguerreotype and Babbage's Analytical Engine, the Lumière Cinématographie and Hollerith's tabulator—merge into one. All existing media are translated into numerical data accessible for the computer. The result: graphics, moving images, sounds, shapes, spaces, and texts become computable, that is, simply sets of computer data. In short, media become new media.

This meeting changes the identity of both media and the computer itself. No longer just a calculator, control mechanism, or communication device, the computer becomes a media processor. Before, the computer could read a row of numbers, outputting a statistical result or a gun trajectory. Now it can read pixel values, blurring the image, adjusting its contrast, or checking whether it contains an outline of an object. Building on these lower-level operations, it can also perform more ambitious ones—searching image databases for images similar in composition or content to an input image, detecting shot changes in a movie, or synthesizing the movie shot itself, complete with setting and actors. In a historical loop, the computer has returned to its origins. No longer just an Analytical Engine, suitable only for crunching numbers, it has become Jacquard's loom—a media synthesizer and manipulator.

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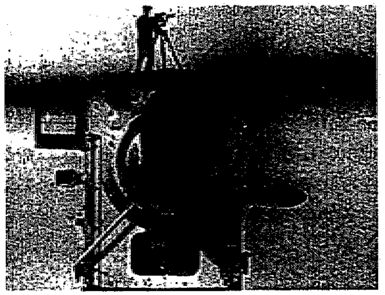
[5] Eames, *A Computer Perspective,* 22–27, 46–51, 90–91.

[6] Ibid., 120.

## Principles of New Media



The identity of media has changed even more dramatically than that of the computer. Below I summarize some of the key differences between old and new media. In compiling this list of differences, I tried to arrange them in a logical order. That is, the last three principles are dependent on the first two. This is not dissimilar to axiomatic logic, in which certain axioms are taken as starting points and further theorems are proved on their basis.

Not every new media object obeys these principles. They should be considered not as absolute laws but rather as general tendencies of a culture undergoing computerization. As computerization affects deeper and deeper layers of culture, these tendencies will increasingly manifest themselves.

### 1. Numerical Representation

All new media objects, whether created from scratch on computers or converted from analog media sources, are composed of digital code; they are numerical representations. This fact has two key consequences:

1. A new media object can be described formally (mathematically). For instance, an image or a shape can be described using a mathematical function.
2. A new media object is subject to algorithmic manipulation. For instance, by applying appropriate algorithms, we can automatically remove "noise" from a photograph, improve its contrast, locate the edges of the shapes, or change its proportions. In short, *media becomes programmable.*

When new media objects are created on computers, they originate in numerical form. But many new media objects are converted from various forms of old media. Although most readers understand the difference between analog and digital media, a few notes should be added on the terminology and the conversion process itself. This process assumes that data is originally *continuous,* that is, "the axis or dimension that is measured has no apparent indivisible unit from which it is composed."[7] Converting continuous data into a numerical representation is called *digitization.* Digitization consists of two steps: sampling and quantization. First, data is *sampled,* most often at regular intervals, such as the grid of pixels used to represent a digital image. The frequency of sampling is referred to as *resolution.* Sampling turns continuous data into *discrete* data, that is, data occurring in distinct units: people, the pages of a book, pixels. Second, each sample is *quantified,* that is, it is assigned a numerical value drawn from a defined range (such as 0–255 in the case of an 8-bit greyscale image).[8]

While some old media such as photography and sculpture are truly continuous, most involve the combination of continuous and discrete coding. One example is motion picture film: each frame is a continuous photograph, but time is broken into a number of samples (frames). Video goes one step further by sampling the frame along the vertical dimension (scan lines). Similarly, a photograph printed using a halftone process combines discrete and continuous representations. Such a photograph consists of a number of orderly dots (i.e., samples), although the diameters and areas of dots vary continuously.

As the last example demonstrates, while modern media contain levels of discrete representation, the samples are never quantified. This quantification of samples is the crucial step accomplished by digitization. But why, we may ask, are modern media technologies often in part discrete? The key assumption of modern semiotics is that communication requires discrete units. Without discrete units, there is no language. As Roland Barthes put it, "Language is, as it were, that which divides reality (for instance, the continuous spectrum of the colors is verbally reduced to a series of discontinuous terms)."[9] In assuming that any form of communication requires a discrete representation, semioticians took human language as the prototypical example of a communication system. A human language is discrete on most scales: We speak in sentences; a sentence is made from words; a word consists of morphemes, and so on. If we follow this assumption, we may expect that media used in cultural communication will have discrete levels. At first this theory seems to work. Indeed, a film samples the continuous time of human existence into discrete frames; a drawing samples visible reality into discrete lines; and a printed photograph samples it into discrete dots. This assumption does not universally work, however: Photographs, for instance, do not have any apparent units. (Indeed, in the 1970s semiotics was criticized for its linguistic bias, and most semioticians came to recognize that a language-based model of distinct units of meaning cannot be applied to many kinds of cultural communication.) More important, the discrete units of modern media are usually not units of meanings in the way morphemes are. Neither film frames nor halftone dots have any relation to how a film or photograph affects the viewer (except in modern art and avant-garde film—think of paintings by Roy Lichtenstein and films of Paul Sharits—which often make the "material" units of media into units of meaning).

The most likely reason modern media has discrete levels is because it emerged during the Industrial Revolution. In the nineteenth century, a new organization of production known as the factory system gradually replaced artisan labor. It reached its classical form when Henry Ford installed the first assembly line in his factory in 1913. The assembly line relied on two principles. The first was standardization of parts, already employed in the production of military uniforms in the nineteenth century. The second, newer principle was the separation of the production process into a set of simple, repetitive, and sequential activities that could be executed by workers who did not have to master the entire process and could be easily replaced.

Not surprisingly, modern media follows the logic of the factory, not only in terms of division of labor as witnessed in Hollywood film studios, animation studios, and television production, but also on the level of material organization. The invention of typesetting machines in the 1880s industrialized publishing while leading to a standardization of both type design and fonts (number and types). In the 1890s cinema combined automatically produced images (via photography) with a mechanical projector. This required standardization of both image dimensions (size, frame ratio, contrast) and temporal sampling rate. Even earlier, in the 1880s, the first television systems already involved standardization of sampling both in time and space. These modern media systems also followed factory logic in that, once a new "model" (a film, a photograph, an audio recording) was introduced, numerous identical media copies would be produced from this master. As I will show, new media follows, or actually runs ahead of, a quite different logic of post-industrial society—that of individual customization, rather than mass standardization.

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[7] Isaac Victor Kerlov and Judson Rosebush, *Computer Graphics for Designers and Artists* (New York: Van Nostrand Reinhold, 1986), 14.

[8] Ibid., 21.

[9] Roland Barthes, *Elements of Semiology,* trans. Annette Lavers and Colin Smith (New York: Hill and Wang, 1968), 64.

### 2. Modularity

This principle can be called the "fractal structure of new media." Just as a fractal has the same structure on different scales, a new media object has the same modular structure throughout. Media elements, be they images, sounds, shapes, or behaviors, are represented as collections of discrete samples (pixels, polygons, voxels, characters, scripts). These elements are assembled into larger-scale objects but continue to maintain their separate identities. The objects themselves can be combined into even larger objects—again, without losing their independence. For example, a multimedia "movie" authored in popular Macromedia Director software may consist of hundreds of still images, QuickTime movies, and sounds that are stored separately and loaded at run time. Because all elements are stored independently, they can be modified at any time without having to change the Director "movie" itself. These "movies" can be assembled into a larger "movie," and so on. Another example of modularity is the concept of "object" used in Microsoft Office applications. When an "object" is inserted into a document (for instance, a media clip inserted into a Word document), it continues to maintain its independence and can always be edited with the program originally used to create it. Yet another example of modularity is the structure of an HTML document: With the exemption of text, it consists of a number of separate objects—GIF and JPEG images, media clips, Virtual Reality Modeling Language (VRML) scenes, Shockwave and Flash movies—which are all stored independently, locally, and/or on a network. In short, a new media object consists of independent parts, each of which consists of smaller independent parts, and so on, down to the level of the smallest "atoms"—pixels, 3-D points, or text characters.

The World Wide Web as a whole is also completely modular. It consists of numerous Web pages, each in its turn consisting of separate media elements. Every element can always be accessed on its own. Normally we think of elements as belonging to their corresponding Web sites, but this is just a convention, reinforced by commercial Web browsers. The Netomat browser by artist Maciej Wisnewski, which extracts elements of a particular media type from different Web pages (for instance, images only) and displays them together without identifying the Web sites from which they are drawn, highlights for us this fundamentally discrete and nonhierarchical organization of the Web.

In addition to using the metaphor of a fractal, we can also make an analogy between the modularity of new media and structured computer programming. Structural computer programming, which became standard in the 1970s, involves writing small and self-sufficient modules (called in different computer languages *subroutines, functions, procedures, scripts*), which are then assembled into larger programs. Many new media objects are in fact computer programs that follow structural programming style. For example, most interactive multimedia applications are written in Macromedia Director's Lingo. A Lingo program defines scripts that control various repeated actions, such as clicking on a button; these scripts are assembled into larger scripts. In the case of new media objects that are not computer programs, an analogy with structural programming still can be made because their parts can be accessed, modified, or substituted without affecting the overall structure of an object. This analogy, however, has its limits. If a particular module of a computer program is deleted, the program will not run. In contrast, as with traditional media, deleting parts of a new media object does not render it meaningless. In fact, the modular structure of new media makes such deletion and substitution of parts particularly easy. For example, since an HTML document consists of a number of separate objects each represented by a line of HTML code, it is very easy to delete, substitute, or add new objects. Similarly, since in Photoshop the parts of a digital image usually kept placed on separate layers, these parts can be deleted and substituted with a click of a button.

### 3. Automation

The numerical coding of media (principle 1) and the modular structure of a media object (principle 2) allow for the automation of many operations involved in media creation, manipulation, and access. Thus human intentionality can be removed from the creative process, at least in part.[10]

Following are some examples of what can be called "low-level" automation of media creation, in which the computer user modifies or creates from scratch a media object using templates or simple algorithms. These techniques are robust enough so that they are included in most commercial software for image editing, 3-D graphics, word processing, graphics layout, and so forth. Image-editing programs such as Photoshop can automatically correct scanned images, improving contrast range and removing noise. They also come with filters that can automatically modify an image, from creating simple variations of color to changing the whole image as though it were painted by Van Gogh, Seurat, or another brand-name artist. Other computer programs can automatically generate 3-D objects such as trees, landscapes, and human figures as well as detailed ready-to-use animations of complex natural phenomena such as fire and waterfalls. In Hollywood films, flocks of birds, ant colonies, and crowds of people are automatically created by AL (artificial life) software. Word processing, page layout, presentation, and Web creation programs come with "agents" that can automatically create the layout of a document. Writing software helps the user to create literary narratives using highly formalized genre conventions. Finally, in what may be the most familiar experience of automated media generation, many Web sites automatically generate Web pages on the fly when the user reaches the site. They assemble the information from databases and format it using generic templates and scripts.

Researchers are also working on what can be called "high-level" automation of media creation, which requires a computer to understand, to a certain degree, the meanings embedded in the objects being generated, that is, their semantics. This research can be seen as part of a larger project of artificial intelligence (AI). As is well known, the AI project has achieved only limited success since its beginnings in the 1950s. Correspondingly, work on media generation that requires an understanding of semantics is also in the research stage and is rarely included in commercial software. Beginning in the 1970s, computers were often used to generate poetry and fiction. In the 1990s, frequenters of Internet chat rooms became familiar with "bots"—computer programs that simulate human conversation. Researchers at New York University designed a "virtual theater" composed of a few "virtual actors" who adjusted their behavior in real-time in response to a user's actions.[11] The MIT Media Lab developed a number of different projects devoted to "high-level" automation of media creation and use: a "smart camera" that, when given a script, automatically follows the action and frames the shots;[12] ALIVE, a virtual environment where the user interacts with animated characters;[13] and a new kind of human-computer interface where the computer presents itself to a user as an animated talking character. The character, generated by a computer in real-time, communicates with the through user natural language; it also tries to guess the user's emotional state and to adjust the style of interaction accordingly.[14]

The area of new media where the average computer user encountered AI in the 1990s was not, however, the human-computer interface, but computer games. Almost every commercial game included a component called an "AI engine," which stands for the part of the game's computer code that controls its characters—car drivers in a car race simulation, enemy forces in a strategy game such as *Command and Conquer,* single attackers in first-person shooters such as *Quake.* AI engines use a variety of approaches to simulate human intelligence, from rule-based systems to neural networks. Like AI expert systems, the characters in computer games have expertise in some well-defined but narrow area such as attacking the user. But because computer games are highly codified and rule-based, these characters function very effectively; that is, they effectively respond to the few things the user is allowed to ask them to do: run forward, shoot, pick up an object. They cannot do anything else, but then the game does not provide the opportunity for the user to test this. For instance, in a martial arts fighting game, I can't ask questions of my opponent, nor do I expect him or her to start a conversation with me. All I can do is "attack" my opponent by pressing a few buttons, and within this highly codified situation the computer can "fight" me back very effectively. In short, computer characters can display intelligence and skills only because programs place severe limits on our possible interactions with them. Put differently, computers can pretend to be intelligent only by tricking us into using a very small part of who we are when we communicate with them. At the 1997 SIGGRAPH (Special Interest Group on Computer Graphics of the Association for Computing Machinery) convention, for example, I played against both human and computer-controlled characters in a VR simulation of a nonexistent sports game. All my opponents appeared as simple blobs covering a few pixels of my VR display; at this resolution, it made absolutely no difference who was human and who was not.

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[10] I discuss particular cases of computer automation of visual communication in more detail in "Automation of Sight from Photography to Computer Vision," *Electronic Culture: Technology and Visual Representation,* ed. by Timothy Druckrey and Michael Sand (New York: Aperture, 1996), 229–239; and in "Mapping Space: Perspective, Radar, and Computer Graphics," *SIGGRAPH '93 Visual Proceedings,* ed. by Thomas Linehan (New York: ACM, 1993), 142–147.

[11] http://www.mrl.nyu.edu/improv/.

[12] http://www-white.media.mit.edu/vismod/demos/smartcam/.

[13] http://pattie.www.media.mit.edu/people/pattie/CACM-95/alife-cacm95.html.

[14] This research was pursued at different groups at the MIT lab. See, for instance, the home page of the Gesture and Narrative Language Group, http://gn.www.media.mit.edu/groups/gn/.

Along with "low-level" and "high-level" automation of media creation, another area of media use subjected to increasing automation is media access. The switch to computers as a means of storing and accessing enormous amounts of media material, exemplified by the "media assets" stored in the databases of stock agencies and global entertainment conglomerates, as well as public "media assets" distributed across numerous Web sites, created the need to find more efficient ways to classify and search media objects. Word processors and other text-management software has long provided the capacity to search for specific strings of text and automatically index documents. The UNIX operating system also included powerful commands to search and filter text files. In the 1990s software designers started to provide media users with similar abilities. Virage introduced Virage VIR Image Engine, which allows one to search for visually similar image content among millions of images as well as a set of video search tools to allow indexing and searching video files.[15] By the end of the 1990s, the key Web search engines already included the option to search the Internet by specific media such as images, video, and audio.

The Internet, which can be thought of as one huge distributed media database, also crystallized the basic condition of the new information society: overabundance of information of all kinds. One response was the popular idea of software "agents" designed to automate searching for relevant information. Some agents act as filters that deliver small amounts of information given the user's criteria. Others allow users to tap into the expertise of other users, following their selections and choices. For example, the MIT Software Agents Group developed such agents as BUZZwatch, which "distills and tracks trends, themes, and topics within collections of texts across time" such as Internet discussions and Web pages; Letizia, "a user interface agent that assists a user browsing the World Wide Web by . . . scouting ahead from the user's current position to find Web pages of possible interest"; and Footprints, which "uses information left by other people to help you find your way around."[16]

By the end of the twentieth century, the problem was no longer how to create a new media object such as an image; the new problem was how to find an object that already exists somewhere. If you want a particular image, chances are it already exists—but it may be easier to create one from scratch than to find an existing one. Beginning in the nineteenth century, modern society developed technologies that automated media creation—the photo camera, film camera, tape recorder, videorecorder, etc. These technologies allowed us, over the course of 150 years, to accumulate an unprecedented amount of media materials—photo archives, film libraries, audio archives. This led to the next stage in media evolution—the need for new technologies to store, organize, and efficiently access these materials. The new technologies are all computer-based—media databases; hypermedia and other ways of organizing media material such as the hierarchical file system itself; text management software; programs for content-based search and retrieval. Thus automation of media access became the next logical stage of the process that had been put into motion when the first photograph was taken. The emergence of new media coincides with this second stage of a media society, now concerned as much with accessing and reusing existing media objects as with creating new ones.[17]

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[15] See http://www.virage.com/products.

[16] http://agents.www.media.mit.edu/groups/agents/projects/.

### 4. Variability

A new media object is not something fixed once and for all, but something that can exist in different, potentially infinite versions. This is another consequence of the numerical coding of media (principle 1) and the modular structure of a media object (principle 2).

Old media involved a human creator who manually assembled textual, visual, and/or audio elements into a particular composition or sequence. This sequence was stored in some material, its order determined once and for all. Numerous copies could be run off from the master, and, in perfect correspondence with the logic of an industrial society, they were all identical. New media, in contrast, is characterized by variability. (Other terms that are often used in relation to new media and that might serve as appropriate synonyms of *variable* are *mutable* and *liquid*.) Instead of identical copies, a new media object typically gives rise to many different versions. And rather than being created completely by a human author, these versions are often in part automatically assembled by a computer. (The example of Web pages automatically generated from databases using templates created by Web designers can be invoked here as well.) Thus the principle of variability is closely connected to automation.

Variability would also not be possible without modularity. Stored digitally, rather than in a fixed medium, media elements maintain their separate identities and can be assembled into numerous sequences under program control. In addition, because the elements themselves are broken into discrete samples (for instance, an image is represented as an array of pixels), they can be created and customized on the fly.

The logic of new media thus corresponds to the postindustrial logic of "production on demand" and "just in time" delivery logics that were themselves made possible by the use of computers and computer networks at all stages of manufacturing and distribution. Here, the "culture industry" (a term coined by Theodor Adorno in the 1930s) is actually ahead of most other industries. The idea that a customer might determine the exact features of her desired car at the showroom, transmit the specs to the factory, and hours later receive the car, remains a dream, but in the case of computer media, such immediacy is reality. Because the same machine is used as both showroom and factory, that is, the same computer generates and displays media—and because the media exists not as a material object but as data that can be sent through wires at the speed of light, the customized version created in response to the user's input is delivered almost immediately. Thus, to continue with the same example, when you access a Web site, the server immediately assembles a customized Web page.

Here are some particular cases of the variability principle (most of them will be discussed in more detail in later chapters):

1. Media elements are stored in a *media database;* a variety of end-user objects, which vary in resolution and in form and content, can be generated, either beforehand or on demand, from this database. At first, we might think that this is simply a particular technological implementation of the variability principle, but, as I will show in the "Database" section, in a computer age the database comes to function as a cultural form in its own right. It offers a particular model of the world and of the human experience. It also affects how the user conceives the data it contains.
2. It becomes possible to separate the levels of "content" (data) and interface. *A number of different interfaces can be created from the same data.* A new media object can be defined as one or more interfaces to a multimedia database.[18]
3. *Information about the user can be used by a computer program to customize automatically the media composition as well as to create elements themselves.* Examples: Web sites use information about the type of hardware and browser or user's network address to customize automatically the site the user will see; interactive computer installations use information about the user's body movements to generate sounds, shapes, and images, or to control the behavior of artificial creatures.

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[17] See my "Avant-Garde as Software," in *Ostranenie,* ed. Stephen Kovats (Frankfurt and New York: Campus Verlag, 1999) (http://visarts.ucsd.edu/~manovich).

[18] For an experiment in creating different multimedia interfaces to the same text, see my *Freud-Lissitzky Navigator* (http://visarts.ucsd.edu/~manovich/FLN).

4. A particular case of this customization is *branching-type interactivity* (sometimes also called "*menu-based* interactivity"). The term refers to programs in which all the possible objects the user can visit form a branching tree structure. When the user reaches a particular object, the program presents her with choices and allows her to choose among them. Depending on the value chosen, the user advances along a particular branch of the tree. In this case the information used by a program is the output of the user's cognitive process, rather than the network address or body position.

5. *Hypermedia* is another popular new media structure, which is conceptually close to branching-type interactivity (because quite often the elements are connected using a branch tree structure). In hypermedia, the multimedia elements making a document are connected through hyperlinks. Thus the elements and the structure are independent of each other—rather than hard-wired together, as in traditional media. The World Wide Web is a particular implementation of hypermedia in which the elements are distributed throughout the network. Hypertext is a particular case of hypermedia that uses only one media type—text. How does the principle of variability work in this case? We can think of all possible paths through a hypermedia document as being different versions of it. By following the links, the user retrieves a particular version of a document.

6. Another way in which different versions of the same media objects are commonly generated in computer culture is through *periodic updates*. For instance, modern software applications can periodically check for updates on the Internet and then download and install these updates, sometimes without any action on the part of the user. Most Web sites are also periodically updated either manually or automatically, when the data in the databases that drive the sites changes. A particularly interesting case of this "updateability" feature is those sites that continuously update information such as stock prices or weather.

7. One of the most basic cases of the variability principle is *scalability*, in which different versions of the same media object can be generated at various sizes or levels of detail. The metaphor of a map is useful in thinking about the scalability principle. If we equate a new media object with a physical territory, different versions of this object are like maps of this territory generated at different scales. Depending on the scale chosen, a map provides more or less detail about the territory. Indeed, different versions of a new media object may vary strictly quantitatively, that is, in the amount of detail present: For instance, a full-size image and its icon, automatically generated by Photoshop; a full text and its shorter version, generated by the "Autosummarize" command in Microsoft Word; or the different versions that can be created using the "Outline" command in Word. Beginning with version 3 (1997), Apple's QuickTime format made it possible to embed a number of different versions that differ in size within a single QuickTime movie; when a Web user accesses the movie, a version is automatically selected depending on connection speed. A conceptually similar technique called "distancing" or "level of detail" is used in interactive virtual worlds such as VRML scenes. A designer creates a number of models of the same object, each with progressively less detail. When the virtual camera is close to the object, a highly detailed model is used; if the object is far away, a less detailed version is automatically substituted by a program to save unnecessary computation of detail that cannot be seen anyway.

New media also allow us to create versions of the same object that differ from each other in more substantial ways. Here the comparison with maps of different scales no longer works. Examples of commands in commonly used software packages that allow the creation of such qualitatively different versions are "Variations" and "Adjustment layers" in Photoshop 5 and the "writing style" option in Word's "Spelling and Grammar" command. More examples can be found on the Internet where, beginning in the mid-1990s, it become common to create a few different versions of a Web site. The user with a fast connection can choose a rich multimedia version, whereas the user with a slow connection can choose a more bare-bones version that loads faster.

Among new media artworks, David Blair's *Wax Web*, a Web site that is an "adaptation" of an hour-long video narrative, offers a more radical implementation of the scalability principle. While interacting with the narrative, the user can change the scale of representation at any point, going from an image-based outline of the movie to a complete script or a particular shot, or a VRML scene based on this shot, and so on.[19] Another example of how use of the scalability principle can create a dramatically new experience of an old media object is Stephen Mamber's database-driven representation of Hitchcock's *The Birds.* Mamber's software generates a still for every shot of the film; it then automatically combines all the stills into a rectangular matrix one shot per cell. As a result, time is spatialized, similar to the process in Edison's early Kinetoscope cylinders. Spatializing the film allows us to study its different temporal structures, which would be hard to observe otherwise. As in *WaxWeb,* the user can at any point change the scale of representation, going from a complete film to a particular shot.

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[19] http://jefferson.village.virginia.edu/wax/.

As can be seen, the principle of variability is useful in allowing us to connect many important characteristics of new media that on first sight may appear unrelated. In particular, such popular new media structures as branching (or menu) interactivity and hypermedia can be seen as particular instances of the variability principle. In the case of branching interactivity, the user plays an active role in determining the order in which already generated elements are accessed. This is the simplest kind of interactivity; more complex kinds are also possible in which both the elements and the structure of the whole object are either modified or generated on the fly in response to the user's interaction with a program. We can refer to such implementations as *open interactivity* to distinguish them from the *closed interactivity* that uses fixed elements arranged in a fixed branching structure. Open interactivity can be implemented using a variety of approaches, including procedural and object-oriented computer programming, AI, AL, and neural networks.

As long as there exists some kernel, some structure, some prototype that remains unchanged throughout the interaction, open interactivity can be thought of as a subset of the variability principle. Here a useful analogy can be made with Wittgenstein's theory of family resemblance, later developed into the theory of prototypes by cognitive psychologists. In a family, a number of relatives will share some features, although no single family member may possess all of the features. Similarly, according to the theory of prototypes, the meanings of many words in a natural language derive not through logical definition but through proximity to a certain prototype.

*Hypermedia,* the other popular structure of new media, can also be seen as a particular case of the more general principle of variability. According to the definition by Halasz and Schwartz, hypermedia systems "provide their users with the ability to create, manipulate and/or examine a network of information-containing nodes interconnected by relational links."[20] Because in new media individual media elements (images, pages of text, etc.) always retain their individual identity (the principle of modularity), they can be "wired" together into more than one object. Hyperlinking is a particular way of achieving this wiring. A hyperlink creates a connection between two elements, for example, between two words in two different pages or a sentence on one page and an image in another, or two different places within the same page. Elements connected through hyperlinks can exist on the same computer or on different computers connected on a network, as in the case of the World Wide Web.

If in old media elements are "hardwired" into a unique structure and no longer maintain their separate identity, in hypermedia elements and structure are separate from each other. The structure of hyperlinks—typically a branching tree—can be specified independently from the contents of a document. To make an analogy with the grammar of a natural language as described in Noam Chomsky's early linguistic theory,[21] we can compare a hypermedia structure that specifies connections between nodes with the deep structure of a sentence; a particular hypermedia text can then be compared with a particular sentence in a natural language. Another useful analogy is computer programming. In programming, there is clear separation between algorithms and data. An algorithm specifies the sequence of steps to be performed on any data, just as a hypermedia structure specifies a set of navigation paths (i.e., connections between nodes) that potentially can be applied to any set of media objects.

The principle of variability exemplifies how, historically, changes in media technologies are correlated with social change. If the logic of old media corresponded to the logic of industrial mass society, the logic of new media fits the logic of the postindustrial society, which values individuality over conformity. In industrial mass society everyone was supposed to enjoy the same goods—and to share the same beliefs. This was also the logic of media technology. A media object was assembled in a media factory (such as a Hollywood studio). Millions of identical copies were produced from a master and distributed to all the citizens. Broadcasting, cinema, and print media all followed this logic.

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[20] Frank Halasz and Mayer Schwartz, "The Dexter Hypertext Reference Model," *Communication of the ACM* (New York: ACM, 1994), 30.

[21] Noam Chomsky, *Syntactic Structures* (The Hague and Paris: Mouton, 1957).

In a postindustrial society, every citizen can construct her own custom lifestyle and "select" her ideology from a large (but not infinite) number of choices. Rather than pushing the same objects/information to a mass audience, marketing now tries to target each individual separately. The logic of new media technology reflects this new social logic. Every visitor to a Web site automatically gets her own custom version of the site created on the fly from a database. The language of the text, the contents, the ads displayed—all these can be customized. According to a report in *USA Today* (9 November 1999), "Unlike ads in magazines or other real-world publications, 'banner' ads on Web pages change with every page view. And most of the companies that place the ads on the Web site track your movements across the Net, 'remembering' which ads you've seen, exactly when you saw them, whether you clicked on them, where you were at the time, and the site you have visited just before."[22]

Every hypertext reader gets her own version of the complete text by selecting a particular path through it. Similarly, every user of an interactive installation gets her own version of the work. And so on. In this way new media technology acts as the most perfect realization of the utopia of an ideal society composed of unique individuals. New media objects assure users that their choices—and therefore, their underlying thoughts and desires—are unique, rather than preprogrammed and shared with others. As though trying to compensate for their earlier role in making us all the same, descendants of the Jacquard loom, the Hollerith tabulator, and Zuse's cinema-computer are now working to convince us that we are all unique.

The principle of variability as presented here has some parallels to the concept of "variable media," developed by the artist and curator Jon Ippolito.[23] I believe that we differ in two key respects. First, Ippolito uses variability to describe a characteristic shared by recent conceptual and some digital art, whereas I see variability as a basic condition of all new media, not only art. Second, Ippolito follows the tradition of conceptual art in which an artist can vary any dimension of the artwork, even its content; my use of the term aims to reflect the logic of mainstream culture in that versions of the object share some well-defined "data." This "data," which can be a well-known narrative (*Psycho*), an icon (Coca-Cola sign), a character (Mickey Mouse), or a famous star (Madonna), is referred to in the media industry as "property." Thus all cultural projects produced by Madonna will be automatically united by her name. Using the theory of prototypes, we can say that the property acts as a prototype, and different versions are derived from this prototype. Moreover, when a number of versions are being commercially released based on some "property," usually one of these versions is treated as the source of the "data," with others positioned as being derived from this source. Typically, the version that is in the same media as the original "property" is treated as the source. For instance, when a movie studio releases a new film, along with a computer game based on it, product tie-ins, music written for the movie, etc., the film is usually presented as the "base" object from which other objects are derived. So when George Lucas releases a new *Star Wars* movie, the original property—the original *Star Wars* trilogy—is referenced. The new movie becomes the "base" object, and all other media objects released along with it refer to this object. Conversely, when computer games such as *Tomb Raider* are remade into movies, the original computer game is presented as the "base" object.

Although I deduce the principle of variability from more basic principles of new media—numerical representation and modularity of information—the principle can also be seen as a consequence of the computer's way of representing data—and modeling the world itself—as variables rather than constants. As new media theorist and architect Marcos Novak notes, a computer—and computer culture in its wake—substitutes every constant with a variable.[24] In designing all functions and data structures, a computer programmer tries always to use variables rather than constants. On the level of the human-computer interface, this principle means that the user is given many options to modify the performance of a program or a media object, be it a computer game, Web site, Web browser, or the operating system itself. The user can change the profile of a game character, modify how folders appear on the desktop, how files are displayed, what icons are used, and so forth. If we apply this principle to culture at large, it would mean that every choice responsible for giving a cultural object a unique identity can potentially remain always open. Size, degree of detail, format, color, shape, interactive trajectory, trajectory through space, duration, rhythm, point of view, the presence or absence of particular characters, the development of plot—to name just a few dimensions of cultural objects in different media—can all be defined as variables, to be freely modified by a user.

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[22] "How Marketers 'Profile' Users," *USA Today* 9 November 1999, 2A.

[23] See http://www.three.org. Our conversations helped me to clarify my ideas, and I am very grateful to Jon for the ongoing exchange.

[24] Marcos Novak, lecture at the "Interactive Frictions" conference, University of Southern California, Los Angeles, 6 June 1999.

Do we want, or need, such freedom? As the pioneer of interactive filmmaking Grahame Weinbren argues, in relation to interactive media, making a choice involves a moral responsibility.[25] By passing on these choices to the user, the author also passes on the responsibility to represent the world and the human condition in it. (A parallel is the use of phone or Web-based automated menu systems by big companies to handle their customers; while companies have turned to such systems in the name of "choice" and "freedom," one of the effects of this type of automation is that labor is passed from the company's employees to the customer. If before a customer would get the information or buy the product by interacting with a company employee, now she has to spend her own time and energy navigating through numerous menus to accomplish the same result.) The moral anxiety that accompanies the shift from constants to variables, from traditions to choices in all areas of life in a contemporary society, and the corresponding anxiety of a writer who has to portray it, is well rendered in the closing passage of a short story by the contemporary American writer Rick Moody (the story is about the death of his sister):[26]

> I should fictionalize it more, I should conceal myself. I should consider the responsibilities of characterization, I should conflate her two children into one, or reverse their genders, or otherwise alter them, I should make her boyfriend a husband, I should explicate all the tributaries of my extended family (its remarriages, its internecine politics), I should novelize the whole thing, I should make it multigenerational, I should work in my forefathers (stonemasons and newspapermen), I should let artifice create an elegant surface, I should make the events orderly, I should wait and write about it later, I should wait until I'm not angry, I shouldn't clutter a narrative with fragments, with mere recollections of good times, or with regrets, I should make Meredith's death shapely and persuasive, not blunt and disjunctive, I shouldn't have to think the unthinkable, I shouldn't have to suffer, I should address her here directly (these are the ways I miss you), I should write only of affection, I should make our travels in this earthly landscape safe and secure, I should have a better ending, I shouldn't say her life was short and often sad, I shouldn't say she had demons, as I do too.

## 5. Transcoding

Beginning with the basic, "material" principles of new media—numeric coding and modular organization—we moved to more "deep" and far-reaching ones—automation and variability. The fifth and last principle of cultural transcoding aims to describe what in my view is the most substantial consequence of the computerization of media. As I have suggested, computerization turns media into computer data. While from one point of view, computerized media still displays structural organization that makes sense to its human users—images feature recognizable objects; text files consist of grammatical sentences; virtual spaces are defined along the familiar Cartesian coordinate system; and so on—from another point of view, its structure now follows the established conventions of the computer's organization of data. Examples of these conventions are different data structures such as lists, records, and arrays; the already-mentioned substitution of all constants by variables; the separation between algorithms and data structures; and modularity.

The structure of a computer image is a case in point. On the level of representation, it belongs on the side of human culture, automatically entering in dialog with other images, other cultural "semes" and "mythemes." But on another level, it is a computer file that consists of a machine-readable header, followed by numbers representing color values of its pixels. On this level it enters into a dialog with other computer files. The dimensions of this dialog are not the image's content, meanings, or formal qualities, but rather file size, file type, type of compression used, file format, and so on. In short, these dimensions belong to the computer's own cosmogony rather than to human culture.

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[25] Grahame Weinbren, "In the Ocean of Streams of Story," *Millennium Film Journal* 28 (Spring 1995), http://www.sva.edu/MFJ/journalpages/MFJ28/GWOCEAN.HTML.

[26] Rick Moody, *Demonology*, first published in *Conjunctions*, reprinted in *The KGB Bar Reader*, quoted in Vince Passaro, "Unlikely Stories," *Harper's Magazine* vol. 299, no. 1791 (August 1999), 88–89.

Similarly, new media in general can be thought of as consisting of two distinct layers—the "cultural layer" and the "computer layer." Examples of categories belonging to the cultural layer are the encyclopedia and the short story; story and plot; composition and point of view; mimesis and catharsis, comedy and tragedy. Examples of categories in the computer layer are process and packet (as in data packets transmitted through the network); sorting and matching; function and variable; computer language and data structure.

Because new media is created on computers, distributed via computers, and stored and archived on computers, the logic of a computer can be expected to significantly influence the traditional cultural logic of media; that is, we may expect that the computer layer will affect the cultural layer. The ways in which the computer models the world, represents data, and allows us to operate on it; the key operations behind all computer programs (such as search, match, sort, and filter); the conventions of HCI—in short, what can be called the computer's ontology, epistemology, and pragmatics—influence the cultural layer of new media, its organization, its emerging genres, its contents.

Of course, what I call "the computer layer" is not itself fixed but rather changes over time. As hardware and software keep evolving and as the computer is used for new tasks and in new ways, this layer undergoes continuous transformation. The new use of the computer as a media machine is a case in point. This use is having an effect on the computer's hardware and software, especially on the level of the human-computer interface, which increasingly resembles the interfaces of older media machines and cultural technologies—VCR, tape player, photo camera.

In summary, the computer layer and the culture layer influence each other. To use another concept from new media, we can say that they are being composited together. The result of this composite is a new computer culture—a blend of human and computer meanings, of traditional ways in which human culture modeled the world and the computer's own means of representing it.

Throughout the book, we will encounter many examples of the principle of transcoding at work. For instance, in "The Language of Cultural Interfaces," we will look at how conventions of the printed page, cinema, and traditional HCI interact in the interfaces of Web sites, CD-ROMs, virtual spaces, and computer games. The "Database" section will discuss how a database, originally a computer technology to organize and access data, is becoming a new cultural form in its own right. But we can also reinterpret some of the principles of new media already discussed as consequences of the transcoding principle. For instance, hypermedia can be understood as one cultural effect of the separation between an algorithm and a data structure, essential to computer programming. Just as in programming, where algorithms and data structures exist independently of each other, in hypermedia data is separated from the navigation structure. Similarly, the modular structure of new media can be seen as an effect of the modularity in structural computer programming. Just as a structural computer program consists of smaller modules that in turn consist of even smaller modules, a new media object has a modular structure.

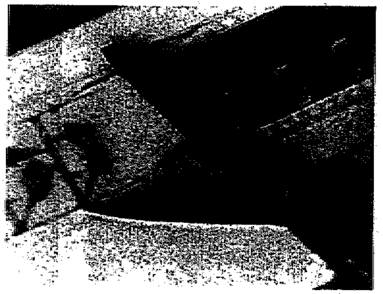
In new media lingo, to "transcode" something is to translate it into another format. The computerization of culture gradually accomplishes similar transcoding in relation to all cultural categories and concepts. That is, cultural categories and concepts are substituted, on the level of meaning and/or language, by new ones that derive from the computer's ontology, epistemology, and pragmatics. New media thus acts as a forerunner of this more general process of cultural reconceptualization.

Given the process of "conceptual transfer" from the computer world to culture at large, and given the new status of media as computer data, what theoretical framework can we use to understand it? On one level new media is old media that has been digitized, so it seems appropriate to look at new media using the perspective of media studies. We may compare new media and old media such as print, photography, or television. We may also ask about the conditions of distribution and reception and patterns of use. We may also ask about similarities and differences in the material properties of each medium and how these affect their aesthetic possibilities.

This perspective is important and I am using it frequently in this book, but it is not sufficient. It cannot address the most fundamental quality of new media that has no historical precedent—programmability. Comparing new media to print, photography, or television will never tell us the whole story. For although from one point of view new media is indeed another type of media, from another it is simply a particular type of computer data, something stored in files and databases, retrieved and sorted, run through algorithms and written to the output device. That the data represent pixels and that this device happens to be an output screen is beside the point. The computer may perform perfectly the role of the Jacquard loom, but underneath it is fundamentally Babbage's Analytical Engine—after all, this was its identity for 150 years. New media may look like media, but this is only the surface.

New media calls for a new stage in media theory whose beginnings can be traced back to the revolutionary works of Harold Innis in the 1950s and Marshall McLuhan in the 1960s. To understand the logic of new media, we need to turn to computer science. It is there that we may expect to find the new terms, categories, and operations that characterize media that became programmable. *From media studies, we move to something that can be called "software studies"—from media theory to software theory.* The principle of transcoding is one way to start thinking about software theory. Another way, which this book experiments with, is to use concepts from computer science as categories of new media theory. Examples here are "interface" and "database." And last but not least, along with analyzing "material" and logical principles of computer hardware and software, we can also look at the human-computer interface and the interfaces of software applications used to author and access new media objects. The two chapters that follow are devoted to these topics.

## What New Media Is Not



Having proposed a list of the key differences between new and old media, I now would like to address other potential candidates. Following are some of the popularly held notions about the difference between new and old media that I will subject to scrutiny:

1. New media is analog media converted to a digital representation. In contrast to analog media, which is continuous, digitally encoded media is discrete.
2. All digital media (texts, still images, visual or audio time data, shapes, 3-D spaces) share the same digital code. This allows different media types to be displayed using one machine—a computer—which acts as a multimedia display device.
3. New media allows for random access. In contrast to film or videotape, which store data sequentially, computer storage devices make it possible to access any data element equally fast.
4. Digitization inevitably involves loss of information. In contrast to an analog representation, a digitally encoded representation contains a fixed amount of information.
5. In contrast to analog media where each successive copy loses quality, digitally encoded media can be copied endlessly without degradation.
6. New media is interactive. In contrast to old media where the order of presentation is fixed, the user can now interact with a media object. In the process of interaction the user can choose which elements to display or which paths to follow, thus generating a unique work. In this way the user becomes the co-author of the work.

## Cinema as New Media

If we place new media within a longer historical perspective, we will see that many of the principles above are not unique to new media, but can be found in older media technologies as well. I will illustrate this fact by using the example of the technology of cinema.

> (1) New media is analog media converted to a digital representation. In contrast to analog media, which is continuous, digitally encoded media is discrete.

Indeed, any digital representation consists of a limited number of samples. For example, a digital still image is a matrix of pixels—a 2-D sampling of space. However, cinema was from its beginnings based on sampling—the sampling of time. Cinema sampled time twenty-four times a second. So we can say that cinema prepared us for new media. All that remained was to take this already discrete representation and to quantify it. But this is simply a mechanical step; what cinema accomplished was a much more difficult conceptual break—from the continuous to the discrete.

Cinema is not the only media technology emerging toward the end of the nineteenth century that employed a discrete representation. If cinema sampled time, fax transmission of images, starting in 1907, sampled a 2-D space; even earlier, the first television experiments (Carey 1875; Nipkow 1884) already involved sampling of both time and space.[27] However, reaching mass popularity much earlier than these other technologies, cinema was the first to make the principle of discrete representation of the visual public knowledge.

> (2) All digital media (texts, still images, visual or audio time data, shapes, 3-D spaces) share the same digital code. This allows different media types to be displayed using one machine—a computer—which acts as a multimedia display device.

Although computer multimedia became commonplace only around 1990, filmmakers had been combining moving images, sound, and text (whether the intertitles of the silent era or the title sequences of the later period) for a whole century. Cinema was thus the original modern "multimedia." We can also point to much earlier examples of multiple-media displays, such as medieval illuminated manuscripts that combine text, graphics, and representational images.

> (3) New media allow for random access. In contrast to film or videotape, which store data sequentially, computer storage devices make it possible to access any data element equally fast.

For example, once a film is digitized and loaded in the computer's memory, any frame can be accessed with equal ease. Therefore, if cinema sampled time but still preserved its linear ordering (subsequent moments of time become subsequent frames), new media abandons this "human-centered" representation altogether—to put represented time fully under human control. Time is mapped onto two-dimensional space, where it can be managed, analyzed, and manipulated more easily.

Such mapping was already widely used in the nineteenth-century cinema machines. The Phenakisticope, the Zootrope, the Zoopraxiscope, the Tachyscope, and Marey's photographic gun were all based on the same principle—placing a number of slightly different images around the perimeter of a circle. Even more striking is the case of Thomas Edison's first cinema apparatus. In 1887 Edison and his assistant, William Dickson, began experiments to adopt the already proven technology of a phonograph record for recording and displaying motion pictures. Using a special picture-recording camera, tiny pinpoint-size photographs were placed in spirals on a cylindrical cell similar in size to the phonography cylinder. A cylinder was to hold 42,000 images, each so small (1/32 inch wide) that a viewer would have to look at them through a microscope.[28] The storage capacity of this medium was twenty-eight minutes—twenty-eight minutes of continuous time taken apart, flattened on a surface, and mapped onto a two-dimensional grid. (In short, time was prepared for manipulation and reordering, something soon to be accomplished by film editors.)

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[27] Albert Abramson, *Electronic Motion Pictures: A History of the Television Camera* (Berkeley: University of California Press, 1955), 15–24.

[28] Charles Musser, *The Emergence of Cinema: The American Screen to 1907* (Berkeley: University of California Press, 1994), 65.

## The Myth of the Digital

Discrete representation, random access, multimedia—cinema already contained these principles. So they cannot help us to separate new media from old media. Let us continue interrogating the remaining principles. If many principles of new media turn out to be not so new, what about the idea of digital representation? Surely, this is the one idea that radically redefines media? The answer is not so straightforward, however, because this idea acts as an umbrella for three unrelated concepts—analog-to-digital conversion (digitization), a common representational code, and numerical representation. Whenever we claim that some quality of new media is due to its digital status, we need to specify which of these three concepts is at work. For example, the fact that different media can be combined into a single digital file is due to the use of a common representational code, whereas the ability to copy media without introducing degradation is an effect of numerical representation.

Because of this ambiguity, I try to avoid using the word *digital* in this book. In "Principles of New Media" I showed that numerical representation is the one really crucial concept of the three. Numerical representation turns media into computer data, thus making it programmable. And this indeed radically changes the nature of media.

In contrast, as I will show below, the alleged principles of new media that are often deduced from the concept of digitization—that analog-to-digital conversion inevitably results in a loss of information and that digital copies are identical to the original—do not hold up under closer examination; that is, although these principles are indeed logical consequences of digitization, they do not apply to concrete computer technologies in the way in which they are currently used.

> (4) Digitization inevitably involves loss of information. In contrast to an analog representation, a digitally encoded representation contains a fixed amount of information.

In his important study of digital photography *The Reconfigured Eye,* William Mitchell explains this principle as follows: "There is an indefinite amount of information in a continuous-tone photograph, so enlargement usually reveals more detail but yields a fuzzier and grainier picture. . . . A digital image, on the other hand, has precisely limited spatial and tonal resolution and contains a fixed amount of information."[29] From a logical point of view, this principle is a correct deduction from the idea of digital representation. A digital image consists of a finite number of pixels, each having a distinct color or tonal value, and this number determines the amount of detail an image can represent. Yet in reality this difference does not matter. By the end of the 1990s, even cheap consumer scanners were capable of scanning images at resolutions of 1,200 or 2,400 pixels per inch. So while a digitally stored image is still comprised of a finite number of pixels, at such resolution it can contain much finer detail than was ever possible with traditional photography. This nullifies the whole distinction between an "indefinite amount of information in a continuous-tone photograph" and a fixed amount of detail in a digital image. The more relevant question is how much information in an image can be useful to the viewer. By the end of new media's first decade, technology had already reached the point where a digital image could easily contain much more information than anyone would ever want.

But even the pixel-based representation, which appears to be the very essence of digital imaging, cannot be taken for granted. Some computer graphics software has bypassed the main limitation of the traditional pixel grid—fixed resolution. *Live Picture,* an image-editing program, converts a pixel-based image into a set of mathematical equations. This allows the user to work with an image of virtually unlimited resolution. Another paint program, *Matador,* makes possible painting on a tiny image, which may consist of just a few pixels, as though it were a high-resolution image. (It achieves this by breaking each pixel into a number of smaller sub-pixels.) In both programs, the pixel is no longer a "final frontier"; as far as the user is concerned, it simply does not exist. Texture-mapping algorithms make the notion of a fixed resolution meaningless in a different way. They often store the same image at a number of different resolutions. During rendering, the texture map of arbitrary resolution is produced by interpolating two images that are closest to this resolution. (A similar technique is used by VR software, which stores the number of versions of a singular object at different degrees of detail.) Finally, certain compression techniques eliminate pixel-based representation altogether, instead representing an image via different mathematical constructs (such as transforms).

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[29] William J. Mitchell, *The Reconfigured Eye* (Cambridge, Mass: MIT Press, 1982), 6.

> (5) In contrast to analog media where each successive copy loses quality, digitally encoded media can be copied endlessly without degradation.

Mitchell summarizes this as follows: "The continuous spatial and tonal variation of analog pictures is not exactly replicable, so such images cannot be transmitted or copied without degradation. . . . But discrete states can be replicated precisely, so a digital image that is a thousand generations away from the original is indistinguishable in quality from any one of its progenitors."[30] Therefore in digital culture, "an image file can be copied endlessly, and the copy is distinguishable from the original by its date since there is no loss of quality."[31] This is all true—in principle. In reality, however, there is actually much more degradation and loss of information between copies of digital images than between copies of traditional photographs. A single digital image consists of millions of pixels. All of this data requires considerable storage space in a computer; it also takes a long time (in contrast to a text file) to transmit over a network. Because of this, the software and hardware used to acquire, store, manipulate, and transmit digital images rely uniformly on *lossy compression*—the technique of making image files smaller by deleting some information. Examples of the technique include the JPEG format, which is used to store still images, and MPEG, which is used to store digital video on DVD. The technique involves a compromise between image quality and file size—the smaller the size of a compressed file, the more visible the visual artifacts introduced in deleting information become. Depending on the level of compression, these artifacts range from barely noticeable to quite pronounced.

One may argue that this situation is temporary, that once cheaper computer storage and faster networks become commonplace, lossy compression will disappear. Presently, however, the trend is quite the opposite, with lossy

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30. Ibid., 6.

31. Ibid., 49.

compression becoming more and more the norm for representing visual information. If a single digital image already contains a lot of data, this amount increases dramatically if we want to produce and distribute moving images in a digital form. (One second of video, for instance, consists of thirty still images.) Digital television with its hundreds of channels and video on-demand services, the distribution of full-length films on DVD or over the Internet, fully digital post-production of feature films—all of these developments are made possible by lossy compression. It will be a number of years before advances in storage media and communication bandwidth will eliminate the need to compress audio-visual data. So rather than being an aberration, a flaw in the otherwise pure and perfect world of the digital, where not even a single bit of information is ever lost, lossy compression is the very foundation of computer culture, at least for now. Therefore, while in theory, computer technology entails the flawless replication of data, its actual use in contemporary society is characterized by loss of data, degradation, and noise.

## The Myth of Interactivity

We have only one principle still remaining from the original list: interactivity.

> (6) New media is interactive. In contrast to old media where the order of presentation is fixed, the user can now interact with a media object. In the process of interaction the user can choose which elements to display or which paths to follow, thus generating a unique work. In this way the user becomes the coauthor of the work.

As with *digital* I avoid using the word *interactive* in this book without qualifying it, for the same reason—I find the concept to be too broad to be truly useful.

In relation to computer-based media, the concept of interactivity is a tautology. Modern HCI is by definition interactive. In contrast to earlier interfaces such as batch processing, modern HCI allows the user to control the computer in real-time by manipulating information displayed on the screen. Once an object is represented in a computer, it automatically becomes interactive. Therefore, to call computer media "interactive" is meaningless—it simply means stating the most basic fact about computers.

Rather than evoking this concept by itself, I use a number of other concepts, such as menu-based interactivity, scalability, simulation, image-interface, and image-instrument, to describe different kinds of interactive structures and operations. The distinction between "closed" and "open" interactivity is just one example of this approach.

Although it is relatively easy to specify different interactive structures used in new media objects, it is much more difficult to deal theoretically with users' experiences of these structures. This aspect of interactivity remains one of the most difficult theoretical questions raised by new media. Without pretending to have a complete answer, I would like to address some aspects of the question here.

All classical, and even moreso modern, art is "interactive" in a number of ways. Ellipses in literary narration, missing details of objects in visual art, and other representational "shortcuts" require the user to fill in missing information.[32] Theater and painting also rely on techniques of staging and composition to orchestrate the viewer's attention over time, requiring her to focus on different parts of the display. With sculpture and architecture, the viewer has to move her whole body to experience the spatial structure.

Modern media and art pushed each of these techniques further, placing new cognitive and physical demands on the viewer. Beginning in the 1920s, new narrative techniques such as film montage forced audiences to bridge quickly the mental gaps between unrelated images. Film cinematography actively guided the viewer to switch from one part of a frame to another. The new representational style of semi-abstraction, which along with photography became the "international style" of modern visual culture, required the viewer to reconstruct represented objects from a bare minimum—a contour, a few patches of color, shadows cast by the objects not represented directly. Finally, in the 1960s, continuing where Futurism and Dada left off, new forms of art such as happenings, performance, and installation turned art explicitly participational—a transformation that, according to some new media theorists, prepared the ground for the interactive computer installations that appeared in the 1980s.[33]

When we use the concept of "interactive media" exclusively in relation to computer-based media, there is the danger that we will interpret "interaction" literally, equating it with physical interaction between a user and a media object (pressing a button, choosing a link, moving the body), at the expense of psychological interaction. The psychological processes of filling-in, hypothesis formation, recall, and identification, which are required for us to comprehend any text or image at all, are mistakenly identified with an objectively existing structure of interactive links.[34]

This mistake is not new; on the contrary, it is a structural feature of the history of modern media. The literal interpretation of interactivity is just the latest example of a larger modern trend to externalize mental life, a process in which media technologies—photography, film, VR—have played a key role.[35] Beginning in the nineteenth century, we witness recurrent claims by the users and theorists of new media technologies, from Francis Galton (the inventor of composite photography in the 1870s) to Hugo Munsterberg, Sergei Eisenstein and, recently, Jaron Lanier, that these technologies externalize and objectify the mind. Galton not only claimed that "the ideal faces obtained by the method of composite portraiture appear to have a great deal in common with . . . so-called abstract ideas" but in fact he proposed to rename abstract ideas "cumulative ideas."[36] According to Münsterberg, who was a Professor of Psychology at Harvard University and an author of one of the earliest theoretical treatments of cinema entitled *The Film: A Psychological Study* (1916), the essence of film lies in its ability to reproduce or "objectify" various mental functions on the screen: "The photoplay obeys the laws of the mind rather than those of the outer world."[37] In the 1920s Eisenstein speculated that film could be used to externalize—and control—thinking. As an experiment in this direction, he boldly conceived a screen adaptation of Marx's *Capital*. "The content of CAPITAL (its aim) is now formulated: to teach the worker to think dialectically," Eisenstein writes enthusiastically in April of 1928.[38] In accordance with the principles of "Marxist dialectics" as canonized by the official Soviet philosophy, Eisenstein planned to present the viewer with the visual equivalents of thesis and anti-thesis so that the viewer could then proceed to arrive at synthesis, that is, the correct conclusion, as pre-programmed by Eisenstein.

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[32] Ernst Gombrich analyzes "the beholder's share" in decoding the missing information in visual images in his classic *Art and Illusion: A Study in the Psychology of Pictorial Representation* (Princeton, N.J.: Princeton University Press, 1960).

[33] The notion that computer interactive art has its origins in new art forms of the 1960s is explored in Söke Dinkla, "The History of the Interface in Interactive Art," ISEA (International Symposium on Electronic Art) 1994 Proceedings (http://www.uiah.fi/bookshop/isea_proc/nextgen/08.html; "From Participation to Interaction: Toward the Origins of Interactive Art," in Lynn Hershman Leeson, ed., *Clicking In: Hot Links to a Digital Culture* (Seattle: Bay Press, 1996), 279–290. See also Simon Penny, "Consumer Culture and the Technological Imperative: The Artist in Dataspace," in Simon Penny, ed., *Critical Issues in Electronic Media* (Albany: State University of New York Press, 1993), 47–74.

[34] This argument relies on a cognitivist perspective that stresses the active mental processes involved in comprehension of any cultural text. For examples of a cognitivist approach in film studies, see Bordwell and Thompson, *Film Art*, and David Bordwell, *Narration in the Fiction Film* (Madison: University of Wisconsin Press, 1989).

[35] For a more detailed analysis of this trend, see my article "From the Externalization of the Psyche to the Implantation of Technology," in *Mind Revolution: Interface Brain/Computer*, ed. Florian Rötzer (Münich: Akademie Zum Dritten Jahrtausend, 1995), 90–100.

In the 1980s, VR pioneer Jaron Lanier similarly saw VR technology as capable of completely objectifying—better yet, transparently merging with—mental processes. His descriptions of its capabilities did not distinguish between internal mental functions, events, and processes and externally presented images. This is how, according to Lanier, VR can take over human memory: "You can play back your memory through time and classify your memories in various ways. You'd be able to run back through the experiential places you've been in order to be able to find people, tools."[39] Lanier also claimed that VR will lead to the age of "post-symbolic communication," communication without language or any other symbols. Indeed, why should there be any need for linguistic symbols if everyone

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[36] Quoted in Allan Sekula, "The Body and the Archive," *October* 39 (1987): 51.

[37] Hugo Münsterberg, *The Photoplay: A Psychological Study* (New York: D. Appleton and Company, 1916), 41.

[38] Sergei Eisenstein, "Notes for a Film of 'Capital,'" trans. Maciej Sliwowski, Jay Leuda, and Annette Michelson, *October* 2 (1976): 10.

[39] Timothy Druckrey, "Revenge of the Nerds: An Interview with Jaron Lanier," *Afterimage* (May 1991), 9.

rather than being locked into a "prison-house of language" (Fredric Jameson),[40] will happily live in the ultimate nightmare of democracy—the single mental space that is shared by everyone, and where every communicative act is always ideal (Jürgen Habermas).[41] This is Lanier's example of how post-symbolic communication will function: "You can make a cup that someone else can pick when there wasn't a cup before, without having to use a picture of the word 'cup.'"[42] Here, as with the earlier technology of film, the fantasy of objectifying and augmenting consciousness, extending the powers of reason, goes hand in hand with the desire to see in technology a return to the primitive happy age of pre-language, pre-misunderstanding. Locked in virtual reality caves, with language taken away, we will communicate through gestures, body movements, and grimaces, like our primitive ancestors . . .

The recurrent claims that new media technologies externalize and objectify reasoning, and that they can be used to augment or control it, are based on the assumption of the isomorphism of mental representations and operations with external visual effects such as dissolves, composite images, and edited sequences. This assumption is shared not only by modern media inventors, artists, and critics but also by modern psychologists. Modern psychological theories of the mind, from Freud to cognitive psychology, repeatedly equate mental processes with external, technologically generated visual forms. Thus Freud in *The Interpretation of Dreams* (1900) compared the process of condensation with one of Francis Galton's procedures that became especially famous: making family portraits by overlaying a different negative image for each member of the family and then making a single print.[43] Writing in the same decade, the American psychologist Edward Titchener opened the discussion of the nature of abstract ideas in his textbook of psychology by noting that "the suggestion has been made that an abstract idea is a sort of composite photograph, a mental picture which results from the superimposition of many particular perceptions or ideas, and which therefore shows the common elements distinct and the individual elements blurred."[44] He then proceeds to consider the pros and cons of this view. We should not wonder why Titchener, Freud, and other psychologists take the comparison for granted rather than presenting it as a simple metaphor—contemporary cognitive psychologists also do not question why their models of the mind are so similar to the computer workstations on which they are constructed. The linguist George Lakoff asserted that "natural reasoning makes use of at least some unconscious and automatic image-based processes such as superimposing images, scanning them, focusing on part of them,"[45] and the psychologist Philip Johnson-Laird proposed that logical reasoning is a matter of scanning visual models.[46] Such notions would have been impossible before the emergence of television and computer graphics. These visual technologies made operations on images such as scanning, focusing, and superimposition seem natural.

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[40] Fredric Jameson, *The Prison-house of Language: A Critical Account of Structuralism and Russian Formalism* (Princeton, N.J.: Princeton University Press, 1972).

[41] Jürgen Habermas, *The Theory of Communicative Action: Reason and Rationalization of Society* (The Theory of Communicative Action, Vol. 1), trans. Thomas McCarthy (Boston: Beacon Press, 1985).

[42] Druckrey, "Revenge of the Nerds," 6.

[43] Sigmund Freud, *Standard Edition of the Complete Psychological Works* (London: Hogarth Press, 1953), 4: 293.

What to make of this modern desire to externalize the mind? It can be related to the demand of modern mass society for standardization. The subjects have to be standardized, and the means by which they are standardized need to be standardized as well. Hence the objectification of internal, private mental processes, and their equation with external visual forms that can easily be manipulated, mass produced, and standardized on their own. The private and individual are translated into the public and become regulated.

What before had been a mental process, a uniquely individual state, now became part of the public sphere. Unobservable and interior processes and representations were taken out of individual heads and placed outside—as drawings, photographs, and other visual forms. Now they could be discussed in public, employed in teaching and propaganda, standardized, and mass-

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[44] Edward Bradford Titchener, *A Beginner's Psychology* (New York: Macmillan, 1915), 114.

[45] George Lakoff, "Cognitive Linguistics," *Versus* 44/45 (1986): 149.

[46] Philip Johnson-Laird, *Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness* (Cambridge: Cambridge University Press, 1983).

distributed. What was private became public. What was unique became mass-produced. What was hidden in an individual's mind became shared.

Interactive computer media perfectly fits this trend to externalize and objectify the mind's operations. The very principle of hyperlinking, which forms the basis of interactive media, objectifies the process of association, often taken to be central to human thinking. Mental processes of reflection, problem solving, recall, and association are externalized, equated with following a link, moving to a new page, choosing a new image, or a new scene. Before we would look at an image and mentally follow our own private associations to other images. Now interactive computer media asks us instead to click on an image in order to go to another image. Before, we would read a sentence of a story or a line of a poem and think of other lines, images, memories. Now interactive media asks us to click on a highlighted sentence to go to another sentence. In short, we are asked to follow pre-programmed, objectively existing associations. Put differently, in what can be read as an updated version of French philosopher Louis Althusser's concept of "interpellation," we are asked to mistake the structure of somebody's else mind for our own.[47]

This is a new kind of identification appropriate for the information age of cognitive labor. The cultural technologies of an industrial society—cinema and fashion—asked us to identify with someone else's bodily image. Interactive media ask us to identify with someone else's mental structure. If the cinema viewer, male and female, lusted after and tried to emulate the body of the movie star, the computer user is asked to follow the mental trajectory of the new media designer.

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[47] Louis Althusser introduced his influential notion of ideological interpellation in "Ideology and Ideological State Apparatuses (Notes towards an Investigation)," in *Lenin and Philosophy*, trans. Ben Brewster (New York: Monthly Review Press, 1971).

# 5

# The Forms

August 5, 1999. I am sitting in the lobby of Razorfish Studios, which was named by *Adweek* one of the top ten interactive agencies in the world for 1998.[1] The company's story is Silicon Alley legend. It was founded in 1995 by two partners in their East Village loft; by 1997 it had forty-five employees; by 1999 the number grew to six hundred (this includes a number of companies around the world that Razorfish acquired). Razorfish projects range from screen savers to a Charles Schwab online trading Web site. At the time of my visit, the studios were housed on two floors of a building on Grand Street in Soho, between Broadway and Mercer, a few blocks from Prada, Hugo Boss, and other designer shops. The large, open space houses loosely positioned workspaces occupied mostly by twenty-something employees (although I notice one busy programmer who cannot be older then eighteen). The design of the space functions (intentionally so) as a metaphor for computer culture's key themes—interactivity, lack of hierarchy, modularity. In contrast to traditional office architecture, where the reception area acts as a gateway between the visitor and the company, here the desk looks like just another workstation, set aside from the entrance. On entering the space you can go to the reception desk, or you can directly make your way to any workstation on the floor. Stylishly dressed young employees of both genders appear and disappear in the elevator at regular intervals. It is fairly quiet, except for the little noises made by numerous computers as they save and retrieve files. One of the cofounders, still in his early thirties, gives me a quick tour of the place. Although Razorfish is the established design leader in the virtual world of computer screens and networks, our tour is focused on the physical world. He proudly points out that the workers are scattered around the open space regardless of their job titles—a programmer next to an interface designer next to a Web designer. He notes that the reception area, composed of a desk and two semicircular sofas, mimics the Razorfish logo. He talks about Razorfish's plans to venture into product design: "Our goal is to provide a total user experience. Right now, a client thinks that if he needs a design for buttons on the screen, he hires Razorfish; but if he needs real buttons, he goes to another shop. We want to change this."

The original 1970s paradigm of the Graphical User Interface (GUI) emulated familiar physical interfaces—a file cabinet, a desk, a trash can, a control panel.

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[1] http://www.adweek.com.

After leaving Razorfish Studios, I stop at Venus by Patricia Field, a funky store on West Broadway where I buy an orange and blue wallet that has two plastic buttons on its cover, an emulation of the forward and reverse buttons of a Web browser. The buttons do not do anything (yet); they simply signify "computer." Over the course of twenty years, the culture has come full circle. If with GUI the physical environment migrated into the computer screen, now the conventions of GUI are migrating back into our physical reality. The same trajectory can be traced in relation to other conventions, or forms, of computer media. A collection of documents and a navigable space, already traditional methods of organizing both data and human experience of the world itself, became two of the forms that today can be found in most areas of new media. The first form is a database, used to store any kind of data—from financial records to digital movie clips; the second form is a virtual interactive 3-D space, employed in computer games, motion rides, VR, computer animation, and human-computer interfaces. In migrating to a computer environment, the collection and the navigable space were not left unchanged; on the contrary, they came to incorporate a computer's particular techniques for structuring and accessing data, such as modularity, as well as its fundamental logic—that of computer programming. So, for instance, a computer database is quite different from a traditional collection of documents: It allows one to quickly access, sort, and reorganize millions of records; it can contain different media types, and it assumes multiple indexing of data, since each record besides the data itself contains a number of fields with user-defined values.

Today, in accordance with the transcoding principle, these two computer-based forms migrate back into culture at large, both literally and conceptually. A library, a museum—in fact, any large collection of cultural data—is replaced by a computer database. At the same time, a computer database becomes a new metaphor that we use to conceptualize individual and collective cultural memory, a collection of documents or objects, and other phenomena and experiences. Similarly, computer culture uses 3-D navigable space to visualize any kind of data—molecules, historical records, files in a computer, the Internet as a whole, the semantics of human language. (For instance, the software from plumbdesign renders an English thesaurus as a structure in 3-D space.)[2] And, with many computer games, the human experience of being in the world and the narrative itself are represented as continuous navigation through space (think, for example, of *Tomb Raider*). In short, the computer database and the 3-D computer-based virtual space have become true cultural forms—general ways used by the culture to represent human experience, the world, and human existence in this world.

Why does computer culture privilege these forms over other possibilities?[3] We may associate the first genre with work (the postindustrial labor of information processing) and the second with leisure and fun (computer games), yet this very distinction is no longer valid in computer culture. As I noted in the introduction to the "Interface" chapter, increasingly the same metaphors and interfaces are used at work and at home, for business and for entertainment. For instance, the user navigates through a virtual space both to work and to play, whether analyzing scientific data or killing enemies in *Quake*.

We may arrive at a better explanation if we look at how these two forms are used in new media design. From one perspective, all new media design can be reduced to these two approaches; that is, creating works in new media can be understood as either constructing the right interface to a multimedia database or as defining navigation methods through spatialized representations. The first approach is typically used in self-contained hypermedia and Web sites—in short, whenever the main goal is to provide an interface to data. The second approach is used in most computer games and virtual worlds. What is the logic here? Web sites and hypermedia programs usually aim to give the user efficient access to information, whereas games and virtual worlds aim to psychologically "immerse" the user in an imaginary universe. It is appropriate that the database has emerged as the perfect vehicle for the first goal while navigable space meets the demands of the second. It accomplishes the same effects that before were created by literary and cinematic narrative.

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[2] http://www.plumbdesign.com/thesaurus/.

[3] According to Janet Murray, digital environments have four essential properties: They are procedural, participatory, spatial, and encyclopedic. As can be seen, spatial and encyclopedic can be correlated with the two forms I describe here—navigable space and the database. Janet Murray, *Hamlet on the Holodeck—The Future of Narrative in Cyberspace* (Cambridge, Mass.: MIT Press, 1997), 73.

Sometimes, one alone of these two goals, information access and psychological engagement with an imaginary world, shapes the design of a new media object. An example of the former would be a search engine site; an example of the latter would be games such as *Riven* or *Unreal*. However, in general these two goals should be thought of as extreme cases of a single conceptual continuum. Such a supposedly "pure" example of an information-oriented object as a Yahoo, Hotbot, or other search site aims to "immerse" the user in its universe, prevent her from going to other sites. And such supposedly pure "psychological immersion" objects as *Riven* or *Unreal* have a strong "information processing" dimension. This dimension makes playing these games more like reading a detective story or playing chess than being engaged with traditional literary and film fictional narrative. Gathering clues and treasures; constantly updating a mental map of the universe of the game, including the positions of pathways, doors, places to avoid, and so on; keeping track of one's ammunition, health, and other levels—all this aligns playing a computer game with other "information processing" tasks typical of computer culture, like searching the Internet, scanning news groups, pulling records from a database, using a spreadsheet, or data mining large data stores.

Often, the two goals of information access and psychological engagement compete within the same new media object. *Along with surface versus depth, the opposition between information and "immersion" can be thought of as a particular expression of the more general opposition characteristic of new media—between action and representation.* And just as is the case with the surface and depth opposition, the results of this competition are often awkward and uneasy. For instance, an image that embeds within itself a number of hyperlinks offers neither a true psychological "immersion" nor easy navigation because the user has to search for hyperlinks. Appropriately, games such as *Johnny Mnemonic* (SONY, 1995) that aspired to become true interactive movies, chose to avoid hyperlinks and menus altogether, instead relying on a keyboard as the sole source of interactive control.

Narratology, the branch of modern literary theory devoted to the theory of narrative, distinguishes between narration and description. Narration is those parts of the narrative that move the plot forward; description is those parts that do not. Examples of description are passages that describe the landscape, or a city, or a character's apartment. In short, to use the language of the information age, description passages present the reader with descriptive information. As its name itself implies, narratology paid most attention to narration and hardly any to description. But in the information age, narration and description have changed roles. If traditional cultures provided people with well-defined narratives (myths, religion) and little "stand-alone" information, today we have too much information and too few narratives that can tie it all together. For better or worse, information access has become a key activity of the computer age. Therefore, *we need something that can be called "info-aesthetics"—a theoretical analysis of the aesthetics of information access as well as the creation of new media objects that "aestheticize" information processing.* In an age when all design has become "information design," and, to paraphrase the title of the famous book by the architectural historian Sigfried Giedion,[4] "the search engine takes command," information access is no longer just a key form of work but also a new key category of culture. Accordingly, it demands that we deal with it theoretically, aesthetically, and symbolically.

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[4] Sigfried Giedion, *Mechanization Takes Command, a Contribution to Anonymous History* (New York: Oxford University Press, 1948).

## The Database

### The Database Logic

After the novel, and subsequently cinema, privileged narrative as the key form of cultural expression of the modern age, the computer age introduces its correlate—the database. Many new media objects do not tell stories; they do not have a beginning or end; in fact, they do not have any development, thematically, formally, or otherwise that would organize their elements into a sequence. Instead, they are collections of individual items, with every item possessing the same significance as any other.

Why does new media favor the database form over others? Can we explain its popularity by analyzing the specificity of the digital medium and of computer programming? What is the relationship between the database and another form that has traditionally dominated human culture—narrative? These are the questions I will address in this section.

Before proceeding, I need to comment on my use of the word *database*. In computer science, *database* is defined as a structured collection of data. The data stored in a database is organized for fast search and retrieval by a computer and therefore, it is anything but a simple collection of items. Different types of databases—hierarchical, network, relational, and object-oriented—use different models to organize data. For instance, the records in hierarchical databases are organized in a treelike structure. Object-oriented databases store complex data structures, called "objects," which are organized into hierarchical classes that may inherit properties from classes higher in the chain.[5]

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[5] "Database," *Encyclopædia Britannica Online*, http://www.eb.com:180/cgi-bin/g?DocF=micro/160/23.html.

New media objects may or may not employ these highly structured database models; however, from the point of view of the user's experience, a large proportion of them are databases in a more basic sense. They appear as collections of items on which the user can perform various operations—view, navigate, search. The user's experience of such computerized collections is, therefore, quite distinct from reading a narrative or watching a film or navigating an architectural site. Similarly, a literary or cinematic narrative, an architectural plan, and a database each present a different model of what a world is like. It is this sense of database as a cultural form of its own that I want to address here. Following art historian Ervin Panofsky's analysis of linear perspective as a "symbolic form" of the modern age, we may even call database a new symbolic form of the computer age (or, as philosopher Jean-François Lyotard called it in his famous 1979 book *The Postmodern Condition*, "computerized society"),[6] a new way to structure our experience of ourselves and of the world. Indeed, if after the death of God (Nietzche), the end of grand Narratives of Enlightenment (Lyotard), and the arrival of the Web (Tim Berners-Lee), the world appears to us as an endless and unstructured collection of images, texts, and other data records, it is only appropriate that we will be moved to model it as a database. But it is also appropriate that we would want to develop a poetics, aesthetics, and ethics of this database.

Let us begin by documenting the dominance of the database form in new media. The most obvious examples are popular multimedia encyclopedias, collections by definition, as well as other commercial CD-ROM (or DVD), that feature collections of recipes, quotations, photographs, and so on.[7] The identity of a CD-ROM as a storage media is projected onto another plane, thereby becoming a cultural form in its own right. Multimedia works that have "cultural" content appear to particularly favor the database form. Consider, for instance, the "virtual museums" genre—CD-ROMs that take the user on a tour through a museum collection. A museum becomes a database of images representing its holdings, which can be accessed in different ways—chronologically, by country, or by artist. Although such CD-ROMs often simulate the traditional museum experience of moving from room to room in a continuous trajectory, this narrative method of access does not have any special status in comparison to other access methods offered by CD-ROMs. Thus narrative becomes just one method of accessing data among many. Another example of a database form is a multimedia genre that does not have an equivalent in traditional media—CD-ROMs devoted to a single cultural figure such as a famous architect, film director, or writer. Instead of a narrative biography, we are presented with a database of images, sound recordings, video clips, and/or texts that can be navigated in a variety of ways.

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[6] Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi (Minneapolis: University of Minnesota Press, 1984), 3.

[7] As early as 1985, Grolier, Inc. issued a text-only *Academic American Encyclopedia* on CD-ROM. The first multimedia encyclopedia was *Compton's MultiMedia Encyclopedia*, published in 1989.

CD-ROMs and other digital storage media proved to be particularly receptive to traditional genres that already had a database-like structure, such as the photo album; they also inspired new database genres, like the database biography. Where the database form really flourished, however, is the Internet. As defined by original HTML, a Web page is a sequential list of separate elements—text blocks, images, digital video clips, and links to other pages. It is always possible to add a new element to the list—all you have to do is to open a file and add a new line. As a result, most Web pages are collections of separate elements—texts, images, links to other pages, or sites. A home page is a collection of personal photographs. A site of a major search engine is a collection of numerous links to other sites (along with a search function, of course). A site of a Web-based TV or radio station offers a collection of video or audio programs along with the option to listen to the current broadcast, but this current program is just one choice among many other programs stored on the site. Thus the traditional broadcasting experience, which consists solely of a real-time transmission, becomes just one element in a collection of options. Similar to the CD-ROM medium, the Web offered fertile ground to already existing database genres (for instance, bibliography) and also inspired the creation of new ones such as sites devoted to a person or a phenomenon (Madonna, the Civil War, new media theory, etc.) that, even if they contain original material, inevitably center around a list of links to other Web pages on the same person or phenomenon.

The open nature of the Web as a medium (Web pages are computer files that can always be edited) means that Web sites never have to be complete; and they rarely are. They always grow. New links are continually added to what is already there. It is as easy to add new elements to the end of a list as it is to insert them anywhere in it. All this further contributes to the antinarrative logic of the Web. If new elements are being added over time, the result is a collection, not a story. Indeed, how can one keep a coherent narrative or any other development trajectory through the material if it keeps changing?

Commercial producers have experimented with ways to explore the database form inherent to new media, with offerings ranging from multimedia encyclopedias to collections of software and collections of pornographic images. In contrast, many artists working with new media at first uncritically accepted the database form as a given. Thus they became blind victims of database logic. Numerous artists' Web sites are collections of multimedia elements documenting their works in other media. In the case of many early artists' CD-ROMs as well, the tendency was to fill all the available storage space with different material—the main work, documentation, related texts, previous works, and so on.

As the 1990s progressed, artists increasingly began to approach the database more critically.[8] A few examples of projects investigating database politics and possible aesthetics are Chris Marker's "IMMEMORY," Olga Lialina's "Anna Karenina Goes to Paradise,"[9] Stephen Mamber's "Digital Hitchcock," and Fabian Wagmister's ". . . two, three, many Guevaras." The artist who has explored the possibilities of a database most systematically is George Legrady. In a series of interactive multimedia works ("The Anecdoted Archive," 1994; "[the clearing]," 1994; "Slippey Traces," 1996; "Tracing," 1998) he used different types of databases to create "an information structure where stories/things are organized according to multiple thematic connections."[10]

## Data and Algorithm

Of course, not all new media objects are explicitly databases. Computer games, for instance, are experienced by their players as narratives. In a game, the player is given a well-defined task—winning the match, being first in a race, reaching the last level, or attaining the highest score. It is this task that makes the player experience the game as a narrative. Everything that happens to her in a game, all the characters and objects she encounters, either take her closer to achieving the goal or further away from it. Thus, in contrast to a CD-ROM and Web database, which always appear arbitrary because the user knows additional material could have been added without modifying the logic, in a game, from the user's point of view, all the elements are motivated (i.e., their presence is justified).[11]

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[8] See *AI and Society* 13.3, a special issue on database aesthetics, ed. Victoria Vesna (http://arts.ucsb.edu/~vesna/AI_Society/); *SWITCH* 5, no. 3, "The Database Issue" (http://switch.sjsu.edu/).

[9] http://www.teleportacia.org/anna.

[10] George Legrady, personal communication, 16 September 1998.

Often the narrative shell of a game ("You are the specially trained commando who has just landed on a lunar base; your task is to make your way to the headquarters occupied by the mutant base personnel . . .") masks a simple algorithm well-familiar to the player—kill all the enemies on the current level, while collecting all the treasures it contains; go to the next level and so on until you reach the last level. Other games have different algorithms. Here is the algorithm of the legendary *Tetris:* When a new block appears, rotate it in such a way so that it will complete the top layer of blocks on the bottom of the screen, thus making this layer disappear. The similarity between the actions expected of the player and computer algorithms is too uncanny to be dismissed. While computer games do not follow a database logic, they appear to be ruled by another logic—that of the algorithm. They demand that a player execute an algorithm in order to win.

An algorithm is the key to the game experience in a different sense as well. As the player proceeds through the game, she gradually discovers the rules that operate in the universe constructed by this game. She learns its hidden logic—in short, its algorithm. Therefore, in games in which the game play departs from following an algorithm, the player is still engaged with an algorithm albeit in another way: She is discovering the algorithm of

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[11] Bordwell and Thompson define motivation in cinema in the following way: "Because films are human constructs, we can expect that any one element in a film will have some justification for being there. This justification is the motivation for that element." Here are some examples of motivation: "When Tom jumps from the balloon to chase a cat, we motivate his action by appealing to notions of how dogs are likely to act when cats are around"; "The movement of a character across a room may motivate the moving of the camera to follow the action and keep the character within a frame." Bordwell and Thompson, *Film Art,* 5th ed., 80.

the game itself. I mean this both metaphorically and literally: For instance, in a first-person shooter such as *Quake* the player may eventually notice that, under such and such conditions, the enemies will appear from the left; that is, she will literally reconstruct a part of the algorithm responsible for the game play. Or, in a different formulation of the legendary author of Sim games, Will Wright, "playing the game is a continuous loop between the user (viewing the outcomes and inputting decisions) and the computer (calculating outcomes and displaying them back to the user). The user is trying to build a mental model of the computer model."[12]

This is another example of the general principle of transcoding discussed in the first chapter—the projection of the ontology of a computer onto culture itself. If in physics the world is made of atoms and in genetics it is made of genes, computer programming encapsulates the world according to its own logic. The world is reduced to two kinds of software objects that are complementary to each other—data structures and algorithms. Any process or task is reduced to an algorithm, a final sequence of simple operations that a computer can execute to accomplish a given task. And any object in the world—be it the population of a city, or the weather over the course of a century, or a chair, or a human brain—is modeled as a data structure, that is, data organized in a particular way for efficient search and retrieval.[13] Examples of data structures are arrays, linked lists, and graphs. Algorithms and data structures have a symbiotic relationship. The more complex the data structure of a computer program, the simpler the algorithm needs to be, and vice versa. Together, data structures and algorithms are two halves of the ontology of the world according to a computer.

The computerization of culture involves the projection of these two fundamental parts of computer software—and of the computer's unique ontology—onto the cultural sphere. If CD-ROMs and Web databases are cultural manifestations of one half of this ontology—data structures—then computer games are manifestations of the second half—algorithms. Games (sports, chess, cards, etc.) are one cultural form that require algorithm-like behavior from players; consequently, many traditional games were quickly simulated on computers. In parallel, new genres of computer games such as the first-person shooter came into existence. Thus, as was the case with database genres, computer games both mimic already existing games and create new game genres.

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[12] McGowan and McCullaugh, *Entertainment in the Cyber Zone,* 71.

[13] This is true for a procedural programming paradigm. In an object-oriented programming paradigm, represented by such computer languages as Java and C++, algorithms and data structures are modeled together as objects.

It may appear at first sight that data is passive and algorithms active—another example of the passive-active binary categories so loved by human cultures. A program reads in data, executes an algorithm, and writes out new data. We may recall that before "computer science" and "software engineering" became established names in the computer field, this was called "data processing"—a name which remained in use for the few decades during which computers were mainly associated with performing calculations over data. However, the passive/active distinction is not quite accurate because data does not just exist—it has to be generated. Data creators have to collect data and organize it, or create it from scratch. Texts need to written, photographs need to be taken, video and audio material need to be recorded. Or they need to be digitized from already existing media. In the 1990s, when the new role of the computer as a Universal Media Machine became apparent, already computerized societies went into a digitizing craze. All existing books and videotapes, photographs, and audio recordings started to be fed into computers at an ever-increasing rate. Steven Spielberg created the Shoah Foundation, which videotaped and then digitized numerous interviews with Holocaust survivors; it would take one person forty years to watch all the recorded material. The editors of the journal *Mediamatic*, who devoted a whole issue to the topic of "the storage mania" (Summer 1994) wrote: "A growing number of organizations are embarking on ambitious projects. Everything is being collected: culture, asteroids, DNA patterns, credit records, telephone conversations; it doesn't matter."[14] In 1996, the financial company T. Rowe Price stored eight hundred gigabytes of data; by the fall of 1999 this number rose to ten terabytes.[15]

Once digitized, the data has to be cleaned up, organized, and indexed. The computer age brought with it a new cultural algorithm: reality→

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[14] *Mediamatic* 8, no. 1 (Summer 1994), 1860.

[15] Bob Laird, "Information Age Losing Memory," *USA Today*, 25 October 1999.

media→data→database. The rise of the Web, this gigantic and always changing data corpus, gave millions of people a new hobby or profession—data indexing. There is hardly a Web site that does not feature at least a dozen links to other sites; therefore, every site is a type of database. And, with the rise of Internet commerce, most large-scale commercial sites have become real databases, or rather front-ends to company databases. For instance, in the fall of 1998, Amazon.com, an online bookstore, had three million books in its database; and the maker of the leading commercial database *Oracle* has offered *Oracle 8i*, fully integrated with the Internet and featuring unlimited database size, natural-language queries, and support for all multimedia data types.[16] Jorge Luis Borges's story about a map equal in size to the territory it represents is rewritten as a story about indexes and the data they index. But now the map has become larger than the territory. Sometimes, much larger. Porno Web sites exposed the logic of the Web at its extreme by constantly reusing the same photographs from other porno Web sites. Only rare sites featured the original content. On any given date, the same few dozen images would appear on thousands of sites. Thus, the same data would give rise to more indexes than the number of data elements themselves.

## Database and Narrative

As a cultural form, the database represents the world as a list of items, and it refuses to order this list. In contrast, a narrative creates a cause-and-effect trajectory of seemingly unordered items (events). Therefore, database and narrative are natural enemies. Competing for the same territory of human culture, each claims an exclusive right to make meaning out of the world.

In contrast to most games, most narratives do not require algorithm-like behavior from their readers. However, narratives and games are similar in that the user must uncover their underlying logic while proceeding through them—their algorithm. Just like the game player, the reader of a novel gradually reconstructs the algorithm (here I use the term metaphorically) that the writer used to create the settings, the characters, and the events. From this perspective, I can rewrite my earlier equations between the two parts of the computer's ontology and its corresponding cultural forms. Data structures and algorithms drive different forms of computer culture. CD-ROMs, Web sites, and other new media objects organized as databases correspond to the data structure, whereas narratives, including computer games, correspond to algorithm.

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[16] http://www.amazon.com/exec/obidos/subst/misc/company-info.html/, http://www.oracle.com/database/oracle8i/.

In computer programming, data structures and algorithms need each other; they are equally important for a program to work. What happens in the cultural sphere? Do databases and narratives have the same status in computer culture?

Some media objects explicitly follow a database logic in their structure whereas others do not; but under the surface, practically all of them are databases. In general, creating a work in new media can be understood as the construction of an interface to a database. In the simplest case, the interface simply provides access to the underlying database. For instance, an image database can be represented as a page of miniature images; clicking on a miniature will retrieve the corresponding record. If a database is too large to display all of its records at once, a search engine can be provided to allow the user to search for particular records. But the interface can also translate the underlying database into a very different user experience. The user may be navigating a virtual three-dimensional city composed from letters, as in Jeffrey Shaw's interactive installation "Legible City."[17] Or she may be traversing a black-and-white image of a naked body, activating pieces of text, audio, and video embedded in its skin (Harwood's CD-ROM "Rehearsal of Memory.")[18] Or she may be playing with virtual animals that come closer or run away depending upon her movements (Scott Fisher et al., VR installation "Menagerie.")[19] Although each of these works engages the user in a set of behaviors and cognitive activities that are quite distinct from going through the records of a database, all of them are databases. "Legible City" is a database of three-dimensional letters that make up a city. "Rehearsal of Memory" is a database of texts and audio and video clips that are accessed through the interface of a body. And "Menagerie" is a database of virtual animals, including their shapes, movements, and behaviors.

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[17] http://artnetweb.com/guggenheim/mediascape/shaw.html.

[18] Harwood, *Rehearsal of Memory*, CD-ROM (London: Artec and Bookworks, 1996.)

[19] http://www.telepresence.com/MENAGERIE.

The database becomes the center of the creative process in the computer age. Historically, the artist made a unique work within a particular medium. Therefore the interface and the work were the same; in other words, the level of an interface did not exist. With new media, the content of the work and the interface are separated. It is therefore possible to create different interfaces to the same material. These interfaces may present different versions of the same work, as in David Blair's *WaxWeb*.[20] Or they may be radically different from each other, as in Olga Lialina's Last Real Net Art Museum.[21] This is one of the ways in which the principle of *variability* of new media manifests itself. But now we can give this principle a new formulation. *The new media object consists of one or more interfaces to a database of multimedia material.* If only one interface is constructed, the result will be similar to a traditional art object, but this is an exception rather than the norm.

This formulation places the opposition between database and narrative in a new light, thus redefining our concept of narrative. The "user" of a narrative is traversing a database, following links between its records as established by the database's creator. An interactive narrative (which can be also called a *hypernarrative* in an analogy with hypertext) can then be understood as the sum of multiple trajectories through a database. A traditional linear narrative is one among many other possible trajectories, that is, a particular choice made within a hypernarrative. Just as a traditional cultural object can now be seen as a particular case of a new media object (i.e., a new media object that has only one interface), traditional linear narrative can be seen as a particular case of hypernarrative.

This "technical," or "material," change in the definition of narrative does not mean that an arbitrary sequence of database records is a narrative. To qualify as a narrative, a cultural object has to satisfy a number of criteria, which literary theorist Mieke Bal defines as follows: It should contain both an actor and a narrator; it also should contain three distinct levels consisting of the text, the story, and the fabula; and its "contents" should be "a series of connected events caused or experienced by actors."[22] Obviously, not all cultural objects are narratives. However, in the world of new media, the word *narrative* is often used as an all-inclusive term, to cover up the fact that we have not yet developed a language to describe these new strange objects. It is usually paired with another overused word—*interactive*. Thus a number of database records linked together so that more than one trajectory is possible is assumed to constitute an "interactive narrative." But merely to create these trajectories is of course not sufficient; the author also has to control the semantics of the elements and the logic of their connection so that the resulting object will meet the criteria of narrative as outlined above. Another erroneous assumption frequently made is that, by creating her own path (i.e., choosing the records from a database in a particular order), the user constructs her own unique narrative. However, if the user simply accesses different elements, one after another, in a usually random order, there is no reason to assume that these elements will form a narrative at all. Indeed, why should an arbitrary sequence of database records, constructed by the user, result in "a series of connected events caused or experienced by actors"?

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[20] http://jefferson.village.virginia.edu/wax/.

[21] http://myboyfriendcamebackfromth.ewar.ru.

[22] Mieke Bal, *Narratology: Introduction to the Theory of Narrative* (Toronto: University of Toronto Press, 1985), 8.

In summary, database and narrative do not have the same status in computer culture. In the database/narrative pair, database is the unmarked term.[23] Regardless of whether new media objects present themselves as linear narratives, interactive narratives, databases, or something else, underneath, on the level of material organization, they are all databases. In new media, the database supports a variety of cultural forms that range from direct translation (i.e., a database stays a database) to a form whose logic is the opposite of the logic of the material form itself—narrative. More precisely, a database can support narrative, but there is nothing in the logic of the medium itself that would foster its generation. It is not surprising, then, that databases occupy a significant, if not the largest, territory of the new media landscape. What is more surprising is why the other end of the spectrum—narratives—still exist in new media.

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[23] The theory of markedness was first developed by linguists of the Prague School in relation to phonology, but subsequently applied to all levels of linguistic analysis. For example, "rooster" is a marked term and "chicken" an unmarked term. Whereas "rooster" is used only in relation to males, "chicken" is applicable to both males and females.

### Paradigm and Syntagm

The dynamics that exist between database and narrative are not unique in new media. The relation between the structure of a digital image and the languages of contemporary visual culture is characterized by the same dynamics. As defined by all computer software, a digital image consists of a number of separate layers, each layer containing particular visual elements. Throughout the production process, artists and designers manipulate each layer separately; they also delete layers and add new ones. Keeping each element as a separate layer allows the content and the composition of an image to be changed at any point—deleting a background, substituting one person for another, moving two people closer together, blurring an object, and so on. What would a typical image look like if the layers were merged together? The elements contained on different layers would become juxtaposed, resulting in a montage look. Montage is the default visual language of composite organization of an image. However, just as database supports both the database form and its opposite—narrative—a composite organization of an image on the material level (and compositing software on the level of operations) supports two opposing visual languages. One is modernist-MTV montage—two-dimensional juxtaposition of visual elements designed to shock due to its impossibility in reality. The other is the representation of familiar reality as seen by a film camera (or its computer simulation, in the case of 3-D graphics). During the 1980s and 1990s, all image-making technologies became computer-based, thus turning all images into composites. In parallel, a renaissance of montage took place in visual culture, in print, broadcast design, and new media. This is not unexpected—after all, this is the visual language dictated by the composite organization. What needs to be explained is why photorealist images continue to occupy such a significant space in our computer-based visual culture.

It would be surprising, of course, if photorealist images suddenly disappeared completely. The history of culture does not contain such sudden breaks. Similarly, we should not expect that new media would completely replace narrative with database. New media does not radically break with the past; rather, it distributes weight differently between the categories that hold culture together, foregrounding what was in the background, and vice versa. As Frederick Jameson writes in his analysis of another shift, that from modernism to postmodernism: "Radical breaks between periods do not generally involve complete changes but rather the restructuration of a certain number of elements already given: features that in an earlier period of system were subordinate become dominant, and features that had been dominant again become secondary."[24]

The database/narrative opposition is a case in point. To further understand how computer culture redistributes weight between the two terms of opposition in computer culture, I will bring in the semiological theory of syntagm and paradigm. According to this model, originally formulated by Ferdinand de Saussure to describe natural languages such as English and later expanded by Roland Barthes and others to apply to other sign systems (narrative, fashion, food, etc.), the elements of a system can be related in two dimensions—the syntagmatic and paradigmatic. As defined by Barthes, "The syntagm is a combination of signs, which has space as a support."[25] To use the example of natural language, the speaker produces an utterance by stringing together elements, one after another, in a linear sequence. This is the syntagmatic dimension. Now let us look at the paradigmatic dimension. To continue with the example of the language user, each new element is chosen from a set of other related elements. For instance, all nouns form a set; all synonyms of a particular word form another set. In the original formulation of Saussure, "The units which have something in common are associated in theory and thus form groups within which various relationships can be found."[26] This is the paradigmatic dimension.

Elements in the syntagmatic dimension are related *in praesentia*, while elements in the paradigmatic dimension are related *in absentia*. For instance, in the case of a written sentence, the words that comprise it materially exist on a piece of paper, while the paradigmatic sets to which these words belong only exist in the writer's and reader's minds. Similarly, in the case of a fashion outfit, the elements that compose it, such as skirt, blouse, and jacket, are present in reality, while pieces of clothing that could have been present instead—different skirt, different blouse, different jacket—exist only in the viewer's imagination. Thus, syntagm is explicit and paradigm is implicit; one is real and the other is imagined.

Literary and cinematic narratives work in the same way. Particular words, sentences, shots, and scenes that make up a narrative have a material existence; other elements that form the imaginary world of an author or a particular literary or cinematic style, and that could have appeared instead, exist only virtually. Put differently, the database of choices from which narrative is constructed (the paradigm) is implicit; while the actual narrative (the syntagm) is explicit.

New media reverse this relationship. Database (the paradigm) is given material existence, while narrative (the syntagm) is dematerialised. Paradigm is privileged, syntagm is downplayed. Paradigm is real; syntagm, virtual. To see this, consider the new media design process. The design of any new media object begins with assembling a database of possible elements to be used. (Macromedia Director calls this database "cast," Adobe Premiere calls it "project," ProTools calls it a "session," but the principle is the same.) This database is the center of the design process. It typically consists of a combination of original and stock material such as buttons, images, video and audio sequences, 3-D objects, behaviors, and so on. Throughout the design process, new elements are added to the database; existing elements are modified. The narrative is constructed by linking elements of this database in a particular order, that is by designing a trajectory leading from one element to another. On the material level, a narrative is just a set of links; the elements themselves remain stored in the database. Thus the narrative is virtual while the database exists materially.

The paradigm is privileged over syntagm in yet another way in interactive objects presenting the user with a number of choices at the same time—which is what typical interactive interfaces do. For instance, a screen may contain a few icons; clicking on each icon leads the user to a different screen. On the level of an individual screen, these choices form a paradigm of their own that is explicitly presented to the user. On the level of the whole object, the user is made aware that she is following one possible trajectory among many others. In other words, she is selecting one trajectory from the paradigm of all trajectories that are defined.

Other types of interactive interfaces make the paradigm even more explicit by presenting the user with an explicit menu of all available choices. In such interfaces, all of the categories are always available, just a mouse click away. The complete paradigm is present before the user, its elements neatly arranged in a menu. This is another example of how new media make explicit the psychological processes involved in cultural communication. Other examples include the (already discussed) shift from creation to selection, which externalizes and codifies the database of cultural elements existing in the creator's mind, as well as the very phenomena of interactive links. As I noted in chapter one, new media takes "interaction" literally, equating it with a strictly physical interaction between a user and a computer, at the expense of psychological interaction. The cognitive processes involved in understanding any cultural text are erroneously equated with an objectively existing structure of interactive links.

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[24] Fredric Jameson, "Postmodernism and Consumer Society," in *The Anti-Aesthetic: Essays on Postmodern Culture*, ed. Hal Foster (Seattle: Bay Press, 1983), 123.

[25] Barthes, *Elements of Semiology*, 58.

[26] Quoted in ibid., 58.

Interactive interfaces foreground the paradigmatic dimension and often make explicit paradigmatic sets. Yet they are still organized along the syntagmatic dimension. Although the user is making choices at each new screen, the end result is a linear sequence of screens that she follows. This is the classical syntagmatic experience. In fact, it can be compared to constructing a sentence in a natural language. Just as a language user constructs a sentence by choosing each successive word from a paradigm of other possible words, a new media user creates a sequence of screens by clicking on this or that icon at each screen. Obviously, there are many important differences between these two situations. For instance, in the case of a typical interactive interface, there is no grammar, and paradigms are much smaller. Yet the similarity of basic experience in both cases is quite interesting; in both cases, it unfolds along a syntagmatic dimension.

Why does new media insist on this language-like sequencing? My hypothesis is that they follow the dominant semiological order of the twentieth century—that of cinema. As I will discuss in more detail in the next chapter, cinema replaced all other modes of narration with a sequential narrative, an assembly line of shots that appear on the screen one at a time. For centuries, a spatialized narrative in which all images appear simultaneously dominated European visual culture; in the twentieth century it was relegated to "minor" cultural forms such as comics or technical illustrations. "Real" culture of the twentieth century came to speak in linear chains, aligning itself with the assembly line of the industrial society and the Turing machine of the postindustrial era. New media continue this mode, giving the user information one screen at a time. At least, this is the case when it tries to become "real" culture (interactive narratives, games); when it simply functions as an interface to information, it is not ashamed to present much more information on the screen at once, whether in the form of tables, normal or pull-down menus, or lists. In particular, the experience of a user filling in an online form can be compared to precinematic spatialized narrative: in both cases, the user follows a sequence of elements that are presented simultaneously.

### A Database Complex

To what extent is the database form intrinsic to modern storage media? For instance, a typical music CD is a collection of individual tracks grouped together. The database impulse also drives much of photography throughout its history, from William Henry Fox Talbot's *Pencil of Nature* to August Sander's monumental typology of modern German society *Face of Our Time,* to Bernd and Hilla Becher's equally obsessive cataloging of water towers. Yet the connection between storage media and database forms is not universal. The prime exception is cinema. Here the storage media support the narrative imagination.[27] Why then, in the case of photography storage media, does technology sustain database, whereas in the case of cinema it gives rise to a modern narrative form par excellence? Does this have to do with the method of media access? Shall we conclude that random-access media, such as computer storage formats (hard drives, removable disks, CD-ROMs, DVD), favor database, whereas sequential-access media, such as film, favor narrative? This does not hold either. For instance, a book, the perfect random-access medium, supports database forms such as photoalbums as well as narrative forms such as novels.

Rather than trying to correlate database and narrative forms with modern media and information technologies, or deduce them from these technologies, I prefer to think of them as two competing imaginations, two basic creative impulses, two essential responses to the world. Both have existed long before modern media. The ancient Greeks produced long narratives, such as Homer's epic poems *The Iliad* and *The Odyssey;* they also produced encyclopedias. The first fragments of a Greek encyclopedia to have survived were the work of Speusippus, a nephew of Plato. Diderot wrote novels—and also was in charge of the monumental *Encyclopédie,* the largest publishing project of the eighteenth century. Competing to make meaning out of the world, database and narrative produce endless hybrids. It is hard to find a pure encyclopedia without any traces of a narrative in it and vice versa. For instance, until alphabetical organization became popular a few centuries ago, most encyclopedias were organized thematically, with topics covered in a particular order (typically, corresponding to the seven liberal arts.) At the same time, many narratives, such as the novels by Cervantes and Swift, and even Homer's epic poems—the founding narratives of the Western tradition—traverse an imaginary encyclopedia.

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[27] Christian Metz, "The Fiction Film and Its Spectator: A Metapsychological Study," in *Apparatus,* ed. Theresa Hak Kyung Cha (New York: Tanam Press, 1980), p. 402.

Modern media is the new battlefield for the competition between database and narrative. It is tempting to read the history of this competition in dramatic terms. First, the medium of visual recording—photography—privileges catalogs, taxonomies, and lists. While the modern novel blossoms, and academicians continue to produce historical narrative paintings throughout the nineteenth century, in the realm of the new techno-image of photography, database rules. The next visual recording medium—film—privileges narrative. Almost all fictional films are narratives, with few exceptions. Magnetic tape used in video does not bring any substantial changes. Next, storage media—computer-controlled digital storage devices—privilege databases once again. Multimedia encyclopedias, virtual museums, pornography, artists' CD-ROMs, library databases, Web indexes, and, of course, the Web itself: The database is more popular than ever before.

The digital computer turns out to be the perfect medium for the database form. Like a virus, databases infect CD-ROMs and hard drives, servers and Web sites. Can we say that the database is the cultural form most characteristic of a computer? In her 1978 article "Video: The Aesthetics of Narcissism," probably the single most well-known article on video art, art historian Rosalind Krauss argued that video is not a physical medium but a psychological one. In her analysis, "Video's real medium is a psychological situation, the very terms of which are to withdraw attention from an external object—an Other—and invest it in the Self."[28] In short, video art is a support for the

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[28] Rosalind Krauss, "Video: The Aesthetics of Narcissism," in John Hanhardt, ed. *Video Culture* (Rochester: Visual Studies Workshop, 1987), 184.

psychological condition of narcissism.[29] Does new media similarly function to play out a particular psychological condition, something that might be called a "database complex"? In this respect, it is interesting that a database imagination has accompanied computer art from its very beginning. In the 1960s, artists working with computers wrote programs to systematically explore the combinations of different visual elements. In part, they were following art world trends such as minimalism. Minimalist artists executed works of art according to preexistent plans; they also created series of images or objects by systematically varying a single parameter. So when minimalist artist Sol LeWitt spoke of an artist's idea as "the machine which makes the work," it was only logical to substitute the human executing the idea with a computer.[30] At the same time, since the only way to make pictures with a computer was by writing a computer program, the logic of computer programming itself pushed computer artists in the same directions. Thus, for artist Frieder Nake, a computer was a "Universal Picture Generator," capable of producing every possible picture out of a combination of available picture elements and colors.[31] In 1967 he published a portfolio of twelve drawings that were obtained by successfully multiplying a square matrix by itself. Another early computer artist Manfred Mohr produced numerous images that recorded various transformations of a basic cube.

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[29] This analysis can also be applied to many interactive computer installations. The user of such an installation is presented with her own image; the user is given the possibility to play with this image and also to observe how her movements trigger various effects. In a different sense, most new media, regardless of whether it represents to the user her image or not, can be said to activate the narcissistic condition because they represent to the user her actions and their results. In other words, it functions as a new kind of mirror that reflects not only the human image but human activities. This is a different kind of narcissism—not passive contemplation but action. The user moves the cursor around the screen, clicks on icons, presses the keys on the keyboard, and so on. The computer screen acts as a mirror of these activities. Often this mirror does not simply reflect but greatly amplifies the user's actions—a second difference from traditional narcissism. For instance, clicking on a folder icon activates an animation accompanied by sound; pressing a button on a game pad sends a character off to climb a mountain; and so on. But even without this amplification, the modern GUI functions as a mirror, always representing the image of the user in the form of a cursor moving around the screen.

[30] Quoted in Sam Hunter and John Jacobus, *Modern Art: Painting, Sculpture, and Architecture*, 3d ed. (New York: Abrams, 1992), 326.

[31] Frank Dietrich, "Visual Intelligence: The First Decade of Computer Art (1965–1975)," *IEEE Computer Graphics and Applications* (July 1985), 39.

Even more remarkable were films by John Whitney, the pioneer of computer filmmaking. His films such as *Permutations* (1967), *Arabesque* (1975) and others systematically explored the transformations of geometric forms obtained by manipulating elementary mathematical functions. Thus they substituted successive accumulation of visual effects for narrative, figuration, or even formal development. Instead they presented the viewer with databases of effects. This principle reaches its extreme in Whitney's early film *Catalog*, which was made with an analog computer. In his important book on new forms of cinema of the 1960s entitled *Expanded Cinema* (1970), critic Gene Youngblood writes about this remarkable film: "The elder Whitney actually never produced a complete, coherent movie on the analog computer because he was continually developing and refining the machine while using it for commercial work. . . . However, Whitney did assemble a visual catalogue of the effects he had perfected over the years. This film, simply titled *Catalog*, was completed in 1961 and proved to be of such overwhelming beauty that many persons still prefer Whitney's analogue work over his digital computer films."[32] One is tempted to read *Catalog* as one of the founding moments of new media. As discussed in the "Selection" section, all software for media creation today arrives with endless "plug-ins"—the banks of effects that with a press of a button generate interesting images from any input whatsoever. In parallel, much of the aesthetics of computerized visual culture is effects-driven, especially when a new techno-genre (computer animation, multimedia, Web sites) is first becoming established. For instance, countless music videos are variations of Whitney's *Catalog*—the only difference is that the effects are applied to the images of human performers. This is yet another example of how the logic of a computer—in this case, the ability of a computer to produce endless variations of elements and to act as a filter, transforming its input to yield a new output—becomes the logic of culture at large.

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[32] Gene Youngblood, *Expanded Cinema* (New York: E. P. Dutton and Co., 1970), 210.

## Database Cinema: Greenaway and Vertov

Although the database form may be inherent to new media, countless attempts to create "interactive narratives" testify to our dissatisfaction with the computer in the sole role of encyclopedia or catalog of effects. We want new media narratives, and we want these narratives to be different from the narratives we have seen or read before. In fact, regardless of how often we repeat in public that the modernist notion of medium specificity ("every medium should develop its own unique language") is obsolete, we do expect computer narratives to showcase new aesthetic possibilities that did not exist before digital computers. In short, we want them to be new media specific. Given the dominance of the database in computer software and the key role it plays in the computer-based design process, perhaps we can arrive at new kinds of narrative by focusing our attention on how narrative and database can work together. How can a narrative take into account the fact that its elements are organized in a database? *How can our new abilities to store vast amounts of data, to automatically classify, index, link, search, and instantly retrieve it, lead to new kinds of narratives?*

Peter Greenaway, one of the few prominent film directors concerned with expanding cinema's language, once complained that "the linear pursuit—one story at a time told chronologically—is the standard format of cinema." Pointing out that cinema lags behind modern literature in experimenting with narrative, he asked: "Could it not travel on the road where Joyce, Eliot, Borges and Perec have already arrived?"[33] While Greenaway is right to direct filmmakers to more innovative literary narratives, new media artists working on the database-problem can learn from cinema "as it is." For cinema already exists right at the intersection between database and narrative. We can think of all the material accumulated during shooting as forming a database, especially since the shooting schedule usually does not follow the narrative of the film but is determined by production logistics. During editing, the editor constructs a film narrative out of this database, creating a unique trajectory through the conceptual space of all possible films that could have been constructed. From this perspective, every filmmaker engages with the database-narrative problem in every film, although only a few have done so self-consciously.

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[33] Peter Greenaway, *The Stairs—Munich—Projection 2* (London: Merrell Holberton Publishers, 1995), 21.

One exception is Greenaway himself. Throughout his career, he has been working on the problem of how to reconcile database and narrative forms. Many of his films progress by recounting a list of items, a catalog without any inherent order (for example, the different books in *Prospero's Books*). Working to undermine a linear narrative, Greenaway uses different systems to order his films. He wrote about this approach: "If a numerical, alphabetic color-coding system is employed, it is done deliberately as a device, a construct, to counteract, dilute, augment or complement the all-pervading obsessive cinema interest in plot, in narrative, in the 'I'm now going to tell you a story' school of film-making."[34] His favorite system is numbers. The sequence of numbers acts as a narrative shell that "convinces" the viewer that she is watching a narrative. In reality, the scenes that follow one another are not connected in any logical way. By using numbers, Greenaway "wraps" a minimal narrative around a database. Although Greenaway's database logic was already present in his "avant-garde" films such as *The Falls* (1980), it has also structured his "commercial" films. The *Draughtsman's Contract* (1982) is centered around twelve drawings in the process of being made by a draftsman. They do not form any order; Greenaway emphasizes this by having the draftsman work on a few drawings at once. Eventually, Greenaway's desire to take "cinema out of cinema" led to his work on a series of installations and museum exhibitions in the 1990s. No longer obliged to conform to the linear medium of film, the elements of a database are spatialized within a museum or even a whole city. This move can be read as the desire to create a database in its most pure form—as a set of elements not ordered in any way. If the elements exist in one dimension (the time of a film, the list on a page), they will inevitably be ordered. So the only way to create a pure database is to spatialize it, distributing the elements in space. This is exactly the path that Greenaway took. Situated in a three-dimensional space that does not have an inherent narrative logic, the 1992 installation "100 Objects to Represent the World" by its very title proposes that the world should be understood through a catalog rather than a narrative. At the same time, Greenaway does not abandon narrative; he continues to investigate how database and narrative can work together. Having presented "100 Objects" as an installation, Greenaway next turned it into an opera set. In the opera, the narrator Thrope uses the objects to conduct Adam and Eve through the whole of human civilization, thus turning one hundred objects into a sequential narrative.[35] In another installation, "The Stairs, Munich, Projection" (1995), Greenaway put up a hundred screens—each representing one year in the history of cinema—throughout Munich. Again, Greenaway presents us with a spatialized database—but also with a narrative. By walking from one screen to another, one follows cinema's history. The project uses Greenaway's favorite principle of organization by numbers, pushing it to the extreme: The projections on the screens contain no figuration, just numbers. The screens are numbered from 1895 to 1995, one screen for each year of cinema's history. Along with numbers, Greenaway introduces another line of development: Each projection is slightly different in color.[36] The hundred colored squares form an abstract narrative of their own that runs in parallel to the linear narrative of cinema's history. Finally, Greenaway superimposes yet a third narrative by dividing the history of cinema into five sections, each section staged in a different part of the city. The apparent triviality of the basic narrative of the project—one hundred numbers, standing for one hundred years of cinema's history—"neutralizes" the narrative, forcing the viewer to focus on the phenomenon of the projected light itself, which is the actual subject of this project.

Along with Greenaway, Dziga Vertov can be thought of as a major "database filmmaker" of the twentieth century. *Man with a Movie Camera* is perhaps the most important example of a database imagination in modern media art. In one of the key shots, repeated a few times throughout the film, we see an editing room with a number of shelves used to keep and organize the shot material. The shelves are marked "machines," "club," "the movement of a city," "physical exercise," "an illusionist," and so on. This is the database of the recorded material. The editor, Vertov's wife, Elizaveta Svilova, is shown working with this database—retrieving some reels, returning used reels, adding new ones.

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[34] Quoted in David Pascoe, *Peter Greenaway: Museums and Moving Images* (London: Reaktion Books, 1997), 9–10.

[35] http://www.tem-nanterre.com/greenaway-100objects/.

[36] Greenaway, *The Stairs, Munich, Projection 2*, 47–53.

Although I pointed out that film editing in general can be compared to creating a trajectory through a database, this comparison in the case of *Man with a Movie Camera* constitutes the very method of the film. Its subject is the filmmaker's struggle to reveal (social) structure among the multitude of observed phenomena. Its project is a brave attempt at an empirical epistemology that has but one tool—perception. The goal is to decode the world purely through the surfaces visible to the eye (natural sight enhanced, of course, by a movie camera). This is how the film's coauthor Mikhail Kaufman describes it:

> An ordinary person finds himself in some sort of environment, gets lost amidst the zillions of phenomena, and observes these phenomena from a bad vantage point. He registers one phenomenon very well, registers a second and a third, but has no idea of where they may lead. . . . But the man with a movie camera is infused with the particular thought that he is actually seeing the world for other people. Do you understand? He joins these phenomena with others, from elsewhere, which may not even have been filmed by him. Like a kind of scholar he is able to gather empirical observations in one place and then in another. And that is actually the way in which the world has come to be understood.[37]

Therefore, in contrast to standard film editing that consists of selection and ordering of previously shot material according to a preexistent script, here the process of relating shots to each other, ordering, and reordering them to discover the hidden order of the world constitutes the film's method. *Man with a Movie Camera* traverses its database in a particular order to construct an argument. Records drawn from a database and arranged in a particular order become a picture of modern life—but simultaneously an argument about this life, an interpretation of what these images, which we encounter every day, every second, actually mean.[38]

Was this brave attempt successful? The overall structure of the film is quite complex, and at first glance seems to have little to do with a database.

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[37] Mikhail Kaufman, "An Interview," *October* 11 (Winter 1979): 65.

[38] It can be said that Vertov uses "the Kuleshov's effect" to give meaning to the database records by placing them in a particular order.

Just as new media objects contain a hierarchy of levels (interface—content, operating system—application, Web page—HTML code, high-level programming language—assembly language—machine language), Vertov's film contains at least three levels. One level is the story of a cameraman shooting material for the film. The second level consists of the shots of the audience watching the finished film in a movie theater. The third level is the film itself, which consists of footage recorded in Moscow, Kiev, and Riga, arranged according to the progression of a single day: waking up—work—leisure activities. If this third level is a text, the other two can be thought of as its metatexts.[39] Vertov goes back and forth between the three levels, shifting between the text and its metatexts—between the production of the film, its reception, and the film itself. But if we focus on the film within the film (i.e., the level of the text) and disregard the special effects used to create many of the shots, we discover almost a linear printout, so to speak, of a database—a number of shots showing machines, followed by a number of shots showing work activities, followed by different shots of leisure, and so on. The paradigm is projected onto the syntagm. The result is a banal, mechanical catalog of subjects that one could expect to find in the city of the 1920s—running trams, city beach, movie theaters, factories . . .

Of course, watching *Man with a Movie Camera* is anything but a banal experience. Even after the 1990s, when designers and video-makers systematically had exploited every avant-garde device, the original still looks striking. What makes its striking is not its subjects and the associations Vertov tries to establish between them to impose "the communist decoding of the world," but rather the most amazing catalog of film techniques contained within it. Fades and superimpositions, freeze-frames, acceleration, split screens, various types of rhythm and intercutting, different montage techniques[40]—what film scholar Annette Michelson has called "a summation of the resources and techniques of the silent cinema"[41]—and of course, a multitude of unusual, "constructivist" points of view are strung together with such density that the film cannot simply be labeled "avant-garde." If a "normal" avant-garde film still proposes a coherent language different from the language of mainstream cinema, that is, a small set of techniques that are repeated, *Man with a Movie Camera* never arrives at anything like a well-defined language. Rather, it proposes an untamed, and apparently endless, unwinding of techniques, or, to use contemporary language, "effects," as cinema's new way of speaking.

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[39] Linguistics, semiotics, and philosophy use the concept of metalanguage. Metalanguage is the language used for the analysis of object language. Thus a metalanguage may be thought of as a language about another language. A metatext is a text in metalanguage about a text in object language. For instance, an article in a fashion magazine is a metatext about the text of clothes. Or an HTML file is a metatext that describes the text of a Web page.

[40] We should remember that various temporal montage techniques were still a novelty in the 1920s; they had the same status for viewers then as "special effects" such as 3-D characters have for viewers today. The original viewers of Vertov's film probably experienced it as one long special-effects sequence.

Traditionally, a personal artistic language or a style common to a group of cultural objects or a period requires a stability of paradigms and consistent expectations as to which elements of paradigmatic sets may appear in a given situation. For example, in the case of classic Hollywood style, a viewer may expect that a new scene will begin with an establishing shot or that a particular lighting convention such as high key or low key will be used throughout the film. (David Bordwell defines a Hollywood style in terms of paradigms ranked in terms of probabilities.)[42]

The endless new possibilities provided by computer software hold the promise of new cinematic languages, but at the same time they prevent such languages from coming into being. (I am using the example of film, but the same logic applies to all other areas of computer-based visual culture.) Since every software comes with numerous sets of transitions, 2-D filters, 3-D transformations, and other effects and "plug-ins," the artist, especially the beginner, is tempted to use many of them in the same work. In such a case, a paradigm becomes the syntagm; that is, rather than making singular choices from the sets of possible techniques, or, to use the term of Russian formalists, devices, and then repeating them throughout the work (for instance, using only cuts, or only cross-dissolves), the artist ends up using many options in the same work. Ultimately, a digital film becomes a list of different effects, which appear one after another. Whitney's *Catalog* is the extreme expression of this logic.

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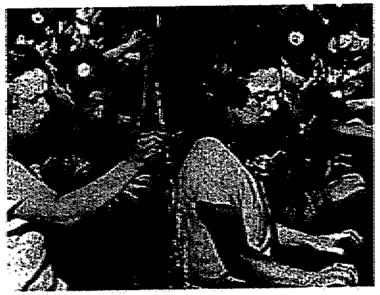
[41] Ibid., 55.

[42] David Bordwell, "Classical Hollywood Film," in Philip Rosen, ed., *Narrative, Apparatus, Ideology: Film Theory Reader* (New York: Columbia University Press, 1987).

The possibility of creating a stable new language is also subverted by the constant introduction of new techniques over time. Thus the new media paradigms not only contain many more options than old media paradigms, but they also keep growing. And in a culture ruled by the logic of fashion, that is, the demand for constant innovation, artists tend to adopt newly available options while simultaneously dropping already familiar ones. Every year, every month, new effects find their way into media works, displacing previously prominent ones and destabilizing any stable expectations that viewers might have begun to form.

And this is why Vertov's film has particular relevance to new media. It proves that it is possible to turn "effects" into a meaningful artistic language. Why is it that in Whitney's computer films and music videos effects are just effects, whereas in the hands of Vertov they acquire meaning? Because in Vertov's film they are motivated by a particular argument, which is that the new techniques of obtaining images and manipulating them, summed up by Vertov in his term "kino-eye," can be used to decode the world. As the film progresses, straight footage gives way to manipulated footage; newer techniques appear one after another, reaching a roller-coaster intensity by the film's end—a true orgy of cinematography. It is as though Vertov restages his discovery of the kino-eye for us, and along with him, we gradually realize the full range of possibilities offered by the camera. Vertov's goal is to seduce us into his way of seeing and thinking, to make us share his excitement, as he discovers a new language for film. This gradual process of discovery is film's main narrative, and it is told through a catalog of discoveries. Thus in the hands of Vertov, the database, this normally static and "objective" form, becomes dynamic and subjective. More important, Vertov is able to achieve something that new media designers and artists still have to learn—how to merge database and narrative into a new form.

## Navigable Space



### *Doom* and *Myst*

Looking at the first decade of new media—the 1990s—one can point at a number of objects that exemplify new media's potential to give rise to genuinely original and historically unprecedented aesthetic forms. Among them, two stand out. Both are computer games. Both were published in the same year, 1993. Each became a phenomenon whose popularity has extended beyond the hard-core gaming community, spilling into sequels, books, TV, films, fashion, and design. Together, they define the new field and its limits. These games are *Doom* (id Software, 1993) and *Myst* (Cyan, 1993).

In a number of ways, *Doom* and *Myst* are completely different. *Doom* is fast paced; *Myst* is slow. In *Doom* the player runs through the corridors trying to complete each level as soon as possible, and then moves to the next one. In *Myst*, the player moves through the world literally one step at a time, unraveling the narrative along the way. *Doom* is populated with numerous demons lurking around every corner, waiting to attack; *Myst* is completely empty. The world of *Doom* follows the convention of computer games: It consists of a few dozen levels. Although *Myst* also contains four separate worlds, each is more like a self-contained universe than a traditional computer game level. While in most games levels are quite similar to each other in structure and look, the worlds of *Myst* are distinctly different.

Another difference lies in the aesthetics of navigation. In *Doom*'s world, defined by rectangular volumes, the player moves in straight lines, abruptly turning at right angles to enter a new corridor. In *Myst*, the navigation is more free-form. The player, or more precisely, the visitor, slowly explores the environment: She may look around for a while, go in circles, return to the same place over and over, as though performing an elaborate dance.

Finally, the two objects exemplify two different types of cultural economy. With *Doom*, id software pioneered the new economy that critic of computer games J. C. Herz summarizes as follows: "It was an idea whose time had come. Release a free, stripped-down version through shareware channels, the Internet, and online services. Follow with a spruced-up, registered retail version of the software." Fifteen million copies of the original *Doom* game were downloaded around the world.[43] By releasing detailed descriptions of game formats and a game editor, id software also encouraged the players to expand the game, creating new levels. Thus hacking and adding to the game became an essential part of the game, with new levels widely available on the Internet for anyone to download. Here was a new cultural economy that transcended the usual relationship between producers and consumers or between "strategies" and "tactics" (de Certeau): *The producers define the basic structure of an object, and release a few examples as well as tools to allow consumers to build their own versions, to be shared with other consumers.* In contrast, the creators of *Myst* followed an older model of cultural economy. Thus *Myst* is more similar to a traditional artwork than to a piece of software—something to behold and admire rather than take apart and modify. To use the terms of the software industry, it is a closed, or proprietary, system, something that only the original creators can modify.

Despite all these differences in cosmogony, gameplay, and underlying economic model, the two games are similar in one key respect. Both are spatial journeys. Navigation though 3-D space is an essential, if not the key, component of the gameplay. *Doom* and *Myst* present the user with a space to be traversed, to be mapped out by moving through it. Both begin by dropping the player somewhere in this space. Before reaching the end of the game narrative, the player must visit most of it, uncovering its geometry and topology, learning its logic and its secrets. In *Doom* and *Myst*—and in a great many other computer games—narrative and time itself are equated with movement through 3-D space, progression through rooms, levels, or words. In contrast to modern literature, theater, and cinema, which are built around psychological tensions between characters and movement in psychological space, these computer games return us to ancient forms of narrative in which the plot is driven by the spatial movement of the main hero, traveling through distant lands to save the princess, to find the treasure, to defeat the dragon, and so on. As J. C. Herz writes about the experience of playing the classic text-based adventure game *Zork*, "You gradually unlocked a world in which the story took place, and the receding edge of this world carried you through to the story's conclusion."[44] Stripping away the representation of inner life, psychology, and other modernist nineteenth-century inventions, these are the narratives in the original ancient Greek sense, for, as Michel de Certeau reminds us, "in Greek, narration is called 'diagesis': it establishes an itinerary (it 'guides') and it passes through (it 'transgresses.')"[45]

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[43] J. C. Herz, *Joystick Nation*, 90, 84.

In the introduction to this chapter, I invoked the opposition between narration and description in narratology. As noted by Mieke Bal, the standard theoretical premise of narratology is that "descriptions interrupt the line of fabula."[46] For me, this opposition, in which description is defined negatively as absence of narration, has always been problematic. It automatically privileges certain types of narrative (myths, fairy tales, detective stories, classical Hollywood cinema), while making it difficult to think about other forms in which the actions of characters do not dominate the narrative (for instance, films by Andrey Tarkovskiy, or Hirokazu Kore-eda, the director of *Maborosi* and *After Life*).[47] Games structured around first-person navigation through space further challenge the narration-description opposition.

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[44] Ibid., 150.

[45] Michel de Certeau, *The Practice of Everyday Life*, trans. Steven Rendall (Berkeley: University of California Press, 1984), 129.

[46] Bal, *Narratology*, 130. Bal defines *fabula* as "a series of logically and chronologically related events that are caused or experienced by actors" (5).

[47] In *Understanding Comics*, Scott McLoud notes how, in contrast to Western comics, Japanese comics spend much more time on "description" not directly motivated by the narrative development. The same opposition holds between the language of classical Hollywood cinema and many films from the "east," such as the works of Tarkovsky and Kore-eda. Although I recognize the danger of such a generalization, it is tempting to connect the narration–description opposition to a much larger opposition between traditionally Western and Eastern ways of existence and philosophies—the drive of the Western subject to know and conquer the world outside versus the Buddhist emphasis on meditation and stasis. Scott McLoud, *Understanding Comics: The Invisible Art* (Harper Perennial, 1994).

Instead of narration and description, we may be better off thinking about games in terms of *narrative actions* and *exploration*. Rather than being narrated to the player herself has to perform actions to move narrative forward—talking to other characters she encounters in the game world, picking up objects, fighting enemies, and so on. If the player does nothing, the narrative stops. From this perspective, movement through the game world is one of the main narrative actions. But this movement also serves the self-sufficient goal of exploration. Exploring the game world, examining its details and enjoying its images, is as important for the success of games such as *Myst* and its followers as progressing through the narrative. Thus, while from one point of view, game narratives can be aligned with ancient narratives that are also structured around movement through space, from another perspective they are exact opposites. Movement through space allows the player to progress through the narrative, but it is also valuable in itself. It is a way for the player to explore the environment.

Narratology's analysis of description can be a useful start in thinking about exploration of space in computer games and other new media objects. Bal states that descriptive passages in fiction are motivated by speaking, looking, and acting. Motivation by looking works as follows: "A character sees an object. The description is the reproduction of what it sees." Motivation by acting means that "the actor carries out an action with an object. The description is then made fully narrative. The example of this is the scene in Zola's *La Bête* in which Jacques polishes [strokes] every individual component of his beloved locomotive."[48]

In contrast to the modern novel, action-oriented games do not have that much dialog, but looking and acting are indeed the key activities performed by a player. And if in modern fiction looking and acting are usually separate activities, in games they more often than not occur together. As the player comes across a door leading to another level, a new passage, ammunition for his machine gun, an enemy, or a "health potion," he immediately acts on these objects—opens a door, picks up ammunition or "health potion," fires at the enemy. Thus narrative action and exploration are closely linked together.

The central role of navigation through space, both as a tool of narration and of exploration, is acknowledged by the games' designers themselves.

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[48] Bal, *Narratology*, 130–132.

According to Robyn Miller, one of the two codesigners of *Myst*, "We are creating environments to just wander around inside of. People have been calling it a game for lack of anything better, and we've called it a game at times. But that's not what it really is; it's a world."[49] Richard Garriott, designer of the classic RPG *Ultima* series, contrasts game design and fiction writing: "A lot of them [fiction writers] develop their individual characters in detail, and they say what is their problem in the beginning, and what they are going to grow to learn in the end. That's not the method I've used . . . I have the world. I have the message. And then the characters are there to support the world and the message."[50]

Structuring the game as a navigation through space is common to games across all genres. This includes adventure games (for instance, *Zork, 7th Level, The Journeyman Project, Tomb Raider, Myst*); strategy games (*Command and Conquer*); role-playing games (*Diablo, Final Fantasy*); flying, driving, and other simulators (*Microsoft Flight Simulator*); action games (*Hexen, Mario*); and, of course, first-person shooters following in *Doom*'s steps (*Quake, Unreal*). These genres obey different conventions. In adventure games, the user explores a universe, gathering resources. In strategy games, the user engages in allocating and moving resources and in risk management. In RPGs (role-playing games), the user builds a character and acquires skills; the narrative is one of self-improvement. The genre conventions by themselves do not make it necessary for these games to employ a navigable space interface. The fact that they all consistently do, therefore, suggests to me that navigable space represents a larger cultural form. In other words, it is something that transcends computer games and in fact, as we will see later, computer culture as well. Just like a database, navigable space is a form that existed before computers, even if the computer becomes its perfect medium.

Indeed, the use of navigable space is common to all areas of new media. During the 1980s, numerous 3-D computer animations were organized around a single, uninterrupted camera move through a complex and extensive set. In a typical animation, a camera would fly over mountain terrain, or move through a series of rooms, or maneuver past geometric shapes. In contrast to both ancient myths and computer games, this journey had no goal, no purpose. In short, there was no narrative. Here was the ultimate "road movie," where navigation through space was sufficient in itself.

In the 1990s, these 3-D fly-throughs have come to constitute the new genre of postcomputer cinema and location-based entertainment—the motion simulator.[51] By using first-person point of view and by synchronizing the movement of the platform housing the audience with the movement of a virtual camera, motion simulators recreate the experience of traveling in a vehicle. Thinking about the historical precedents of a motion simulator, we begin to uncover some places where the form of navigable space has already manifested itself. They include *Hale's Tours and Scenes of the World*, a popular film-based attraction that debuted at the St. Louis Fair in 1904; roller-coaster rides; flight, vehicle, and military simulators, which have used a moving base since the early 1930s; and the fly-through sequences in *2001: A Space Odyssey* (Kubrick, 1968) and *Star Wars* (Lucas, 1977). Among these, *A Space Odyssey* plays a particularly important role; Douglas Trumbull, who since the late 1980s has produced some of the best-known motion-simulator attractions and was the key person behind the rise of the motion-simulator phenomenon, began his career by creating ride sequences for this film.

Along with providing a key foundation for new media aesthetics, navigable space has also become a new tool of labor. It is now a common way to visualize and work with any data. From scientific visualization to walk-throughs of architectural designs, from models of a stock market performance to statistical datasets, the 3-D virtual space combined with a camera model is the accepted way to visualize all information. It is as accepted in computer culture as charts and graphs were in a print culture.[52]

Since navigable space can be used to represent both physical spaces and abstract information spaces, it is only logical that it has also emerged as an important paradigm in human-computer interfaces. Indeed, on one level, HCI can be seen as a particular case of data visualization, the data being computer files rather than molecules, architectural models, or stock market figures. Examples of 3-D navigable space interfaces are the Information Visualizer (Xerox Parc), which replaces a flat desktop with 3-D rooms and planes rendered in perspective;[53] T_Vision (ART+COM), which uses a navigable 3-D representation of the earth as its interface;[54] and The Information Landscape (Silicon Graphics), in which the user flies over a plane populated by data objects.[55]

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[49] McGoman and McCullaugh, *Entertainment in the Cyber Zone*, 120.

[50] Quoted in J. C. Hertz, *Joystick Nation*, 155–156.

[51] For a critical analysis of the motion simulator phenomenon, see Erkki Huhtamo, "Phantom Train to Technopia," in Minna Tarkka, ed., *ISEA '94: The 5th International Symposium on Electronic Art Catalogue* (Helsinki: University of Art and Design, 1994); "Encapsulated Bodies in Motion: Simulators and the Quest for Total Immersion," in Simon Penny, ed., *Critical Issues in Electronic Media*.

[52] See www.cybergeography.com.

The original (i.e., the 1980s) vision of cyberspace called for a 3-D space of information to be traversed by a human user or, to use the term of William Gibson, a "data cowboy."[56] Even before Gibson's fictional descriptions of cyberspace were published, cyberspace was visualized in the film *Tron* (Disney, 1982). Although *Tron* takes place inside a single computer rather than a network, its vision of users zapping through immaterial space defined by lines of light is remarkably similar to the one articulated by Gibson in his novels. In an article that appeared in the 1991 anthology *Cyberspace: First Steps*, Marcos Novak still defined *cyberspace* as "a completely spatialized visualization of all information in global information processing systems."[57] In the first part of the 1990s, this vision has survived among the original designers of VRML. In designing the language, they aimed to "create a unified conceptualization of space spanning the entire Internet, a spatial equivalent of WWW."[58] They saw VRML as a natural stage in the evolution of the Net from an abstract data network toward a "'perceptualized' Internet where the data has been sensualized," that is, represented in three dimensions.[59]

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[53] Stuart Card, George Robertson, and Jock Mackingly, "The Information Visualizer, an Information Workplace," in *CHI '91: Human Factors in Computing Systems Conference Proceedings* (New York: ACM, 1991), 181–186; available online at http://www.acm.org/pubs/articles/proceedings/chi/108844/p181-card/p181-card.pdf.

[54] http://www.artcom.de/projects/t_vision/.

[55] http://www.acm.org/sigchi/chi95/proceedings/panels/km_bdy.htm.

[56] William Gibson, *Neuromancer* (New York: Ace Books, 1984).

[57] Marcos Novak, "Liquid Architecture in Cyberspace," in Michael Benedikt, ed., *Cyberspace: First Steps* (Cambridge, Mass.: MIT Press, 1991), 225–254.

[58] Mark Pesce, Peter Kennard, and Anthony Parisi, "Cyberspace," 1994, http://www.hyperreal.org/~mpesce/www.html.

[59] Ibid.

The term *cyberspace* is derived from another term—*cybernetics*. In his 1947 book *Cybernetics*, mathematician Norbert Wiener defined it as "the science of control and communications in the animal and machine." Wiener conceived of cybernetics during World War II when he was working on problems concerning gunfire control and automatic missile guidance. He derived the term *cybernetics* from the ancient Greek word *kybernetikos*, which refers to the art of the steersman and can be translated as "good at steering." Thus the idea of navigable space lies at the very origins of the computer era. The steersman navigating the ship and the missile traversing space on its way to a target have given rise to a whole number of new figures—the heroes of William Gibson, "data cowboys" moving through the vast terrains of cyberspace; "drivers" of motion simulators; computer users navigating through scientific data sets and computer data structures, molecules and genes, the earth's atmosphere and the human body; and last but not least, players of *Doom*, *Myst*, and their endless imitations.

From one point of view, navigable space can legitimately be seen as a particular kind of an interface to a database, and thus something that does not deserve special focus. I would like, however, to think of it also as a cultural form in its own right, not only because of its prominence across the new media landscape and, as we will later see, its persistence in new media history, but also because, more than a database, it is a new form that may be unique to new media. Of course, both the organization of space and its use to represent or visualize something else have always been a fundamental part of human culture. Architecture and ancient mnemonics, city planning and diagramming, geometry and topology, are just some of the disciples and techniques that were developed to harness space's symbolic and economic capital.[60] Spatial constructions in new media draw on all these existing traditions—but they are also fundamentally different in one key respect. For the first time, *space becomes a media type.* Just as other media types—audio, video, stills, and text—it can now be instantly transmitted, stored, and retrieved; compressed, reformatted, streamed, filtered, computed, programmed, and interacted with. In other words, all operations that are possible with media as a result of its conversion to computer data can also now apply to representations of 3-D space.

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[60] Michael Benedikt explores the relevance of some of these disciplines to the concept of cyberspace in the introduction to his groundbreaking anthology *Cyberspace: First Steps*, which remains one of the best books on the topic of cyberspace.

Recent cultural theory has paid increasing attention to the category of space. Examples are Henri Lefebvre's work on the politics and anthropology of everyday space, Michel Foucault's analysis of the Panopticon's topology as a model of modern subjectivity, the writings of Fredric Jameson and David Harvey on the postmodern space of global capitalism, and Edward Soja's work on political geography.[61] At the same time, new media theoreticians and practitioners have come forward with many formulations of how cyberspace should be structured and how computer-based spatial representations might be used in new ways.[62] What has received little attention, however, both in cultural theory and in new media theory, is the particular category of *navigation through space.* And yet, this category characterizes new media as it actually exists; in other words, new media spaces are always spaces of navigation. At the same time, as we will see later in this section, this category also fits a number of developments in other cultural fields such as anthropology and architecture.

To summarize, along with a database, navigable space is another key form of new media. It is already an accepted way of interacting with any kind of data, a familiar interface in computer games and motion simulators, and a possible form for nearly any computing practice. Why does computer culture spatialize all representations and experiences (the library is replaced by cyberspace; narrative is equated with traveling through space; all kinds of data are rendered in three dimensions through computer visualization)? Shall we try to oppose this spatialization (i.e., what about time in new

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[61] Henri Lefebvre, *The Production of Space* (Oxford: Blackwell, 1991); Michel Foucault, *Discipline and Punish: The Birth of the Prison* (New York: Pantheon Books, 1977); Fredric Jameson, *The Geopolitical Aesthetic: Cinema and Space in the World System* (Bloomington: Indiana University Press, 1992); David Harvey, *The Condition of Postmodernity* (Oxford: Blackwell, 1989); Edward Soja, *Postmodern Geographies: The Reassertion of Space in Critical Social Theory* (London: Verso, 1989).

[62] See, for instance, Benedikt, *Cyberspace: First Steps* and the articles of Marcos Novak (http://www.aud.ucla.edu/~marcos).

media?) And, finally, what are the aesthetics of navigation through virtual space?

## Computer Space

The very first coin-op arcade game was called *Computer Space.* The game simulated a dogfight between a spaceship and a flying saucer. Released in 1971, it was a remake of the first computer game, *Spacewar,* programmed on PDP-1 at MIT in 1962.[63] Both of these legendary games included the word *space* in their titles; and appropriately, space was one of the main characters in each of them. In the original *Spacewar,* the players navigated two spaceships around the screen while shooting torpedoes at one another. The player also had to be careful in maneuvering the ships to make sure they would not get too close to the star in the center of the screen that pulled them toward it. Thus along with the spaceships, the player had to interact with space itself. And although, in contrast to such films as *2001, Star Wars,* and *Tron,* the space of *Spacewar* and *Computer Space* was not navigable—one could not move through it—the simulation of gravity made it a truly active presence. Just as the player had to engage with the spaceships, he also had to engage with space itself.

This active treatment of space is the exception rather than the rule in new media. Although new media objects favor the use of space for representations of all kinds, virtual spaces are most often not true spaces but collections of separate objects. Or, to put this in a slogan: There is no space in cyberspace.

To explore this thesis further, we can borrow categories developed by art historians early in this century. Alois Riegl, Heinrich Wölfflin, and Erwin Panofsky, the founders of modern art history, defined their field as the history of the representation of space. Working within the paradigm of cyclic cultural development, they related the representation of space in art to the spirit of entire epochs, civilizations, and races. In his 1901 *Die Spätrömische Kunstindustrie* (The late-Roman art industry), Riegl characterized mankind's cultural development as the oscillation between two ways of understanding space, which he called "haptic" and "optic." Haptic perception isolates the object in the field as a discrete entity, whereas optic perception unifies objects in a spatial continuum. Riegl's contemporary, Heinrich Wölfflin, similarly proposed that the temperament of a period or a nation expresses itself in a particular mode of seeing and representing space. Wölfflin's *Principles of Art History* (1913) plotted the differences between Renaissance and baroque styles along five axes: linear/painterly; plane/recession; closed form/open form; multiplicity/unity; and clearness/unclearness.[64] Erwin Panofsky, another founder of modern art history, contrasted the "aggregate" space of the Greeks with the "systematic" space of the Italian Renaissance in his famous essay *Perspective as Symbolic Form* (1924–1925).[65] Panofsky established a parallel between the history of spatial representation and the evolution of abstract thought. The former moves from the space of individual objects in antiquity to the representation of space as continuous and systematic in modernity. Correspondingly, the evolution of abstract thought progresses from ancient philosophy's view of the physical universe as discontinuous and "aggregate," to the post-Renaissance understanding of space as infinite, homogeneous, isotropic, and with ontological primacy in relation to objects—in short, as systematic.

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[63] http://icwhen.com/the70s/1971.html.

We do not have to believe in grand evolutionary schemes in order to usefully retain such categories. What kind of space is virtual space? At first glance, the technology of 3-D computer graphics exemplifies Panofsky's concept of systematic space, which exists prior to the objects in it. Indeed, the Cartesian coordinate system is built into computer graphics software and often into the hardware itself.[66] A designer launching a modeling program is typically presented with an empty space defined by a perspectival grid; the space will be gradually filled by the objects created. If the built-in message of a music synthesizer is a sine wave, the built-in world of computer graphics is an empty Renaissance space—the coordinate system itself.

Yet computer-generated worlds are actually much more haptic and aggregate than optic and systematic. The most commonly used computer-

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[64] Heinrich Wölfflin, *Principles of Art History*, trans. M. D. Hottinger (New York: Dover Publications, 1950).

[65] Erwin Panofsky, *Perspective as Symbolic Form*, trans. Christopher S. Wood (New York: Zone Books, 1991).

[66] See my article "Mapping Space: Perspective, Radar, and Computer Graphics."

graphics technique of creating 3-D worlds is polygonal modeling. The virtual world created with this technique is a vacuum containing separate objects defined by rigid boundaries. What is missing from computer space is space in the sense of medium—an environment in which objects are embedded and the effect of these objects on each other, what Russian writers and artists call *prostranstvennaya sreda*. Pavel Florensky, a legendary Russian philosopher and art historian, described it in the following way in the early 1920s: "The space-medium is objects mapped onto space . . . We have seen the inseparability of Things and space, and the impossibility of representing Things and space by themselves."[67] This understanding of space also characterizes a particular tradition of modern painting that stretches from Seurat to Giacometti and de Kooning. These painters tried to eliminate the notions of a distinct object and empty space as such. Instead they depicted a dense field that occasionally hardens into something that we can read as an object. Following the example of Gilles Deleuze's analysis of cinema as an activity of articulating new concepts akin to philosophy,[68] it can be said that modern painters belonging to this tradition worked to articulate a particular philosophical concept in their painting—that of space-medium. This concept is something mainstream computer graphics still has to discover.

Another basic technique used in creating virtual worlds also leads to aggregate space. It involves superimposing animated characters, still images, digital movies, and other elements over a separate background. Traditionally, this technique was used in video and computer games. Responding to the limitations of the available computers, the designers of early games would limit animation to a small part of a screen. 2-D animated objects and characters called "sprites" were drawn over a static background. For example, in *Space Invaders* the abstract shapes representing the invaders would fly over a blank background, while in *Pac-Man* the tiny character moved across the picture of a maze. The sprites were essentially animated 2-D cutouts thrown over the background image at game time, so no real interaction between them and the background took place. In the second half of the 1990s, much faster processors and 3-D graphics cards made it possible for games to switch to real-time 3-D rendering. This allowed for modeling of visual interactions between objects and the space in which they were located, such as reflections and shadows. Consequently, the game space became more of a coherent, true 3-D space, rather than a set of 2-D planes unrelated to each other. However, the limitations of earlier decades returned in another area of new media—online virtual worlds. Because of the limited bandwidth of the 1990s Internet, virtual world designers have to deal with constraints similar to and sometimes even more severe than those faced by game designers two decades earlier. In online virtual worlds, a typical scenario may involve an avatar animated in real time in response to the user's commands. The avatar is superimposed on a picture of a room in the same way as in video games sprites are superimposed on backgrounds. The avatar is controlled by the user; the picture of the room is provided by a virtual-world operator. Because the elements come from different sources and are put together in real time, the result is a series of 2-D planes rather than a real 3-D environment. Although the image depicts characters in a 3-D space, it is an illusion since the background and the characters do not "know" about each other, and no interaction between them is possible.

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[67] Quoted in Alla Efimova and Lev Manovich, "Object, Space, Culture: Introduction," in *Tekstura: Russian Essays on Visual Culture*, eds. Alla Efimova and Lev Manovich (Chicago: University of Chicago Press, 1993), xxvi.

[68] Gilles Deleuze, *Cinema* (Minneapolis: University of Minnesota Press, 1986–1989).

Historically, we can connect the technique of superimposing animated sprites on backgrounds to traditional cell animation. To save labor, animators similarly divided an image between a static background and animated characters. In fact, the sprites of computer games can be thought of as reincarnated animation characters. Yet the use of this technique did not prevent Fleischer and Disney animators from thinking of space as a space-medium (to use Florensky's term), although they created this space-medium in a different way than did modern painters. (Thus while the masses run away from serious and "difficult" abstract art to enjoy the funny and figurative images of cartoons, what they saw was not that different from Giacometti's and de Kooning's canvases.) Although all objects in cartoons have hard edges, the total anthropomorphism of the cartoon universe breaks distinctions both between subjects and objects and objects and space. Everything is subjected to the same laws of stretch and squash, everything moves and twists in the same way, everything is alive to the same extent. It is as though everything—the character's body, chairs, walls, plates, food, cars, and so on—is made from the same bio-material. This monism of the cartoon worlds stands in opposition to the binary ontology of computer worlds in which the space and the sprites/characters appear to be made from two fundamentally different substances.

In summary, although 3-D computer-generated virtual worlds are usually rendered in linear perspective, they are really collections of separate objects, unrelated to each other. In view of this, the common argument that 3-D computer simulations return us to Renaissance perspective and therefore, from the viewpoint of twentieth-century abstraction, should be considered regressive, turns out to be ungrounded. If we are to apply the evolutionary paradigm of Panofsky to the history of virtual computer space, we must conclude that it has not yet reached its Renaissance stage. It is still at the level of ancient Greece, which could not conceive of space as a totality.

Computer space is also aggregate yet in another sense. As I already noted, using the example of *Doom*, traditionally the world of a computer game is not a continuous space but a set of discrete levels. In addition, each level is also discrete—it is a sum of rooms, corridors, and arenas built by the designers. Thus rather than conceiving space as a totality, one is dealing with a set of separate places. The convention of levels is remarkably stable, persisting across genres and numerous computer platforms.

If the World Wide Web and the original VRML are any indications, we are not moving any closer toward systematic space; instead, we are embracing aggregate space as a new norm, both metaphorically and literally. The space of the Web, in principle, cannot be thought of as a coherent totality: It is, rather, a collection of numerous files, hyperlinked but without any overall perspective to unite them. The same holds for actual 3-D spaces on the Internet. A 3-D scene as defined by a VRML file is a list of separate objects that may exist anywhere on the Internet, each created by a different person or a different program. A user can easily add or delete objects without taking into account the overall structure of the scene.[69] Just as in the case of a database, the narrative is replaced by a list of items; a coherent 3-D scene becomes a list of separate objects.

With its metaphors of navigation and homesteading, the web has been compared to the American Wild West. The spatialized Web envisioned by VRML (itself a product of California) reflects the treatment of space in

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[69] John Hartman and Josie Wernecke, *The VRML 2.0 Handbook.*

American culture generally, in its lack of attention to any zone that is not functionally used. The marginal areas that exist between privately owned houses, businesses, and parks are left to decay. The VRML universe, as defined by software standards and the default settings of software tools, pushes this tendency to the limit: It does not contain space as such but only objects that belong to different individuals. Obviously, the users can modify the default settings and use the tools to create the opposite of what the default values suggest. In fact, the actual muti-user spaces built on the Web can be seen precisely as a reaction against the anticommunal and discrete nature of American society, an attempt to compensate for the much discussed disappearance of traditional community by creating virtual ones. (Of course, if we follow the nineteenth-century sociologist Ferdinand Tönnies, the shift from traditional close-knit scale community to modern impersonal society had already taken place in the nineteenth century and was an inevitable side-effect as well as prerequisite for modernization.)[70] However, it is important that the ontology of virtual space as defined by software itself is fundamentally aggregate, a set of objects without a unifying point of view.

Art historians and literary and film scholars have traditionally analyzed the structure of cultural objects as reflecting larger cultural patterns (for instance, Panofsky's reading of perspective); in the case of new media, we should look not only at the finished objects but first of all at the software tools, their organization and default settings.[71] This is particularly important because in new media the relation between production tools and media objects is one of continuity; in fact, it is often hard to establish the boundary between them. Thus we may connect the American ideology of democracy with its paranoid fear of hierarchy and centralized control with the flat structure of the Web, where every page exists on the same level of importance as any other and where any two sources connected through hyperlinking have equal weight. Similarly, in the case of virtual 3-D spaces on the Web, the lack of a unifying perspective in U.S. culture, whether in the space of an American city or in the space of an increasingly fragmented public discourse, can be correlated with the design of VRML, which substitutes a collection of objects for a unified space.

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[70] See Ferdinand Tönnies, *Community and Society,* trans. Charles P. Loomis (East Lansing: Michigan State University Press, 1957).

[71] One important exception was the apparatus theory developed by film theoreticians in the 1970s.

### The Poetics of Navigation

In order to analyze computer representations of 3-D space, I have used theories from early art history, but it would not be hard to find other theories that could work as well. Navigation through space, however, is a different matter. While art history, geography, anthropology, sociology, and other disciplines have come up with many approaches to analyze space as a static, objectively existing structure, we do not have the same wealth of concepts to help us think about the poetics of navigation through space. And yet, if I am right to claim that the key feature of computer space is its navigability, we need to be able to address this feature theoretically.

As a way to begin, we may take a look at some of the classic navigable computer spaces. The 1978 project *Aspen Movie Map,* designed at the MIT Architecture Machine Group, headed by Nicholas Negroponte (the group later expanded into the MIT Media Laboratory), is acknowledged as the first interactive virtual navigable space, and also as the first hypermedia program to be shown publicly. The program allowed the user to "drive" through the city of Aspen, Colorado. At each intersection the user was able to select a new direction using a joystick. To construct this program, the MIT team drove through Aspen in a car taking pictures every three meters. The pictures were then stored on a set of videodiscs. Responding to the information from the joystick, the appropriate picture or sequence of pictures was displayed on the screen. Inspired by a mockup of an airport used by Israeli commandos to train for the Entebbe hostage-freeing raid of 1973, *Aspen Movie Map* was a simulator and, therefore, its navigation modeled the real-life experience of moving in a car with all its limitations.[72] Yet its realism also opened up a new set of aesthetic possibilities, which, unfortunately, later designers of navigable spaces did not explore further. They relied on interactive 3-D computer graphics to construct their spaces. In contrast, the designers of *Aspen Movie Map* utilized a set of photographic images; in addition, because the images were taken every three meters, the result was an interesting sampling of three-dimensional space. Although in the 1990s Apple's QuickTime VR technology made this technique quite accessible, the idea of constructing a large-scale virtual space from photographs or a video of a real space was never systematically attempted again, despite the fact that it opens up unique aesthetic possibilities not available with 3-D computer graphics.

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[72] Stewart Brand, *The Media Lab* (New York: Penguin Books, 1988), 141.

Jeffrey Shaw's *Legible City* (1988–1991), another well-known and influential computer navigable space, is also based on an existing city.[73] As in *Aspen Movie Map,* the navigation also simulates a real, physical situation, in this case, riding a bicycle. Its virtual space, however, is not tied to the simulation of physical reality: it is an imaginary city made from 3-D letters. In contrast to most navigable spaces whose parameters are chosen arbitrarily, every value of virtual space in *Legible City* (Amsterdam and Karlsruhe versions) is derived from the actual existing physical space it replaces. Each 3-D letter in the virtual city corresponds to an actual building in a physical city; the letter's proportions, color, and location are derived from the building it replaces. By navigating through the space, the user reads the texts composed by the letters; these texts are drawn from the archive documents describing the city's history. Through this mapping, Shaw foregrounds, or, more precisely, "stages," one of the fundamental problematics of new media and the computer age as a whole—the relation between the virtual and the real. In his other works Shaw has systematically "staged" other key aspects of new media such as the interactive relation between the viewer and the image, or the discrete quality of all computer-based representations. *Legible City* functions not only as a unique navigable virtual space of its own, but also as a comment on all the other navigable spaces. It suggests that instead of creating virtual spaces that have nothing to do with actual physical spaces, or spaces that are closely modeled after existing physical structures, such as towns or shopping malls (this holds for most commercial virtual worlds and VR works), we may take a middle road. In *Legible City,* the memory of the real city is carefully preserved without succumbing to illusionism; the virtual representation encodes the city's genetic code, its deep structure rather than its surface. Through this mapping Shaw proposes an ethics of the virtual. Shaw suggests that the virtual can at least preserve the memory of the real it replaces, encoding its structure, if not its aura, in a new form.

Although *Legible City* was a landmark work in that it presented a symbolic rather than illusionistic space, its visual appearance in many ways reflected the default real-time graphics capability of SGI workstations on which it was running: flat-shaded shapes attenuated by a fog. Char Davies and her development team at SoftImage have consciously addressed the goal of creating a different, more painterly aesthetic for the navigable space in their interactive VR installation *Osmose* (1994–1995).[74] From the point of view of the history of modern art, the result hardly represented something new. *Osmose* simply replaced the usual hard-edge, polygonal; Cézanne-like look of 3-D computer graphics with a softer, more atmospheric, Renoir- or late Monet-like environment made of translucent textures and flowing particles. Yet, in the context of other 3-D virtual worlds, it was an important advance. The "soft" aesthetic of *Osmose* is further supported through the use of slow cinematic dissolves between its dozen or so worlds. Like in *Aspen Movie Map* and *Legible City,* the navigation in *Osmose* is modeled on a real-life experience, in this case, scuba diving. The "immersant" controls navigation by breathing: Breathing in sends the body upward, while breathing out makes it fall. The resulting experience, according to the designers, is one of floating, rather than flying or driving, typical of virtual worlds. Another important aspect of *Osmose*'s navigation is its collective character. While only one person can be "immersed" at a time, the audience can witness her or his journey through the virtual worlds as it unfolds on a large projection screen. At the same size, another translucent screen enables the audience to observe the body gestures of the "immersant" as a shadow-silhouette. The "immersant" thus becomes a kind of ship captain, taking the audience along on a journey; like a captain, she occupies a visible and symbolically marked position, being responsible for the audience's aesthetic experience.

Tamás Waliczky's *The Forest* (1993) liberated the virtual camera from its enslavement to the simulation of humanly possible navigation—walking, driving a car, pedaling a bicycle, scuba diving. In *The Forest* the camera slides through the endless black-and-white forest in a series of complex and melancholic moves. If modern visual culture exemplified by MTV can be thought of as a mannerist stage of cinema, its perfected techniques of cinematography, mise-en-scène, and editing self-consciously displayed and paraded for its own sake, Waliczky's film presents an alternative response to cinema's classical age, which is now behind us. In this metafilm, the camera, part of cinema's apparatus, becomes the main character (and in this respect, we can connect *The Forest* to another metafilm, *Man with a Movie Camera*). On first glance, the logic of camera movements can be identified as the quest of a human being trying to escape from the forest (which, in reality, is just a single picture of a tree repeated over and over). Yet just as in some of the animated films of the Brothers Quay, such as *The Street of Crocodiles,* the virtual camera of *The Forest* neither simulates natural perception nor does it follow the standard grammar of cinema's camera; instead, it establishes a distinct system of its own. In *The Street of Crocodiles,* the camera suddenly takes off, rapidly moving in a straight line parallel to an image plane, as though mounted on some robotic arm, and just as suddenly stops to frame a new corner of the space. The logic of these movements is clearly non-human; this is the vision of some alien creature. In contrast, the camera never stops at all in *The Forest,* the whole film being one uninterrupted camera trajectory. The camera system of *The Forest* can be read as a commentary on the fundamentally ambiguous nature of computer space. On the one hand, while not indexically tied to physical reality or the human body, computer space is isotropic. In contrast to human space, in which the verticality of the body and the direction of the horizon are two dominant directions, computer space does not privilege any particular axis. In this way it is similar to the space of El Lissitzky's *Prouns* and Kazimir Malevich's suprematist compositions—an abstract cosmos, unencumbered by either earth's gravity or the weight of a human body. (Thus the game *Spacewar* with its simulated gravity got it wrong!) William Gibson's term "matrix," which he used in his novels to refer to cyberspace, captures well this isotropic quality. But, on the other hand, computer space is also the space of a human dweller, something used and traversed by a user, who brings her own anthropological framework of horizontality and verticality along with her. The camera system of *The Forest* foregrounds this double character of computer space. While no human figures or avatars appear in the film and we are never shown either the ground or the sky, it is centered around a stand-in for the human subject—a tree. The constant movements of the camera along the vertical dimension throughout the film—sometimes getting closer to where we imagine the ground plane is located, sometimes moving toward (but again, never actually showing) the sky—can be interpreted as an attempt to negotiate between isotropic space and the space of human anthropology, with its horizontality of the ground plane and the horizontal and vertical dimension of human bodies. The navigable space of *The Forest* thus mediates between human subjectivity and the very different and ultimately alien logic of a computer—the ultimate and omnipresent Other of our age.

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[73] Manuela Abel, ed., *Jeffrey Shaw—A User's Manual* (Karlsruhe, Germany: ZKM, 1997), 127–129. Three different versions of Legible City were created based on the plans of Manhattan, Amsterdam, and Karlsruhe.

[74] http://www.softimage.com/Projects/Osmose/.

While the works discussed so far all create virtual navigable spaces, George Legrady's interactive computer installation *Transitional Spaces* (1999) moves from the virtual back to the physical. Legrady locates an already existing architectural navigable space (the Siemens headquarters building in Munich) and makes it into an "engine" that triggers three cinematic projections. As regular office employees and visitors move through the main entrance section and second-level entrance/exit passageways, their motions are picked up by cameras and are used to control the projections. Legrady writes in his installation proposal:

> As the speed, location, timing, and number of individuals in the space control the sequence and timing of projection sequences, the audience will have the opportunity to "play" the system, that is, engage consciously by interacting with the camera sensing to control the narrative flow of the installation.
>
> All three projections will comment on the notion of "transitional space" and narrative development. Image sequences will represent transitional states: from noise covered to clear, from empty to full, from open to closed, from dark to light, from out of focus to in-focus.[75]

Legrady's installation begins to explore one element in the "vocabulary" of the navigable space "alphabet"—the transition from one state to another. (Other potential elements of this alphabet include the character of a trajectory; the pattern of the user's movement—for instance, rapid geometric movement in *Doom* versus wandering in *Myst;* possible interactions between the user and the space, such as the character acting as a center of perspective in Waliczky's *The Garden* (1992); and, of course, the architecture of space itself.) Earlier I invoked a definition of narrative by Bal that may be too restrictive in relation to new media. Legrady quotes another, much broader definition by literary theorist Tzvetan Todorov, according to whom minimal narrative involves the passage from "one equilibium to another" (or, in different words, from one state to another). Legrady's installation suggests that we can think of a subject's movement from one "stable" point in space to another (for instance, moving from a lobby to a building to an office) like a narrative; by analogy, we may also think of a transition from one state of a new media object to another (for instance, from a noisy image to a noise-free image) as a minimal narrative. For me, the second analogy is more problematic than the first, because, in contrast to a literary narrative, it is hard to say what constitutes a "state of equilibrium" in a typical new media object. Nevertheless, rather than concluding that Legrady's installation does not really create narratives, we should recognize it instead as an important example of a whole trend among new media artists—exploration of the minimal condition of a narrative in new media.

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[75] George Legrady, *Transitional Spaces* (Munich: Siemens Kultur Programm, 1999), 5.

Each of the computer spaces just discussed, from *Aspen Movie Map* to *Forest,* establishes a distinct aesthetic of its own. However, the majority of navigable virtual spaces mimic existing physical reality without proposing any coherent aesthetic program. What artistic and theoretical traditions can the designers of navigable spaces draw upon to make them more interesting? One obvious candidate is modern architecture. From Melnikov, Le Corbusier, and Frank Lloyd Wright to *Archigram* and Bernard Tschumi, modern architects have elaborated a variety of schemes for structuring and conceptualizing space to be navigated by users: We can look, for instance, at the 1925 USSR Pavilion (Melnikov), Villa Savoye (Le Corbusier), Walking City (Archigram), and Parc de la Villette (Tschumi).[76] Even more relevant is the tradition of "paper architecture"—designs that were not intended to be built and whose authors therefore felt unencumbered by the limitations of materials, gravity, and budgets.[77] Another highly relevant tradition is film architecture.[78] As discussed in the "Language of Cultural Interfaces" section, the standard interface to computer space is the virtual camera modeled after the film camera rather than a simulation of unaided human sight. After all, film architecture is architecture designed for navigation and exploration by a film camera.

Along with different architectural traditions, designers of navigable spaces can find a wealth of relevant ideas in modern art. They may consider, for instance, the works of modern artists situated between art and architecture, which, like the projects of paper architects, display a spatial imagination freed from the questions of utility and economy—the warped worlds of Jean Dubuffet, mobiles by Alexander Calder, earth works by Robert Smithson, moving-text spaces by Jenny Holzer. While many modern artists felt compelled to create 3-D structures in real spaces, others were satisfied with painting virtual worlds: Think, for, instance, of the melancholic cityscapes of Giorgio de Chirico, the biomorphic worlds of Yves Tanguy, the economical wireframe structures of Alberto Giacometti, and the existential landscapes of Anselm Kiefer. Besides providing us with many examples of imaginative spaces, both abstract and figurative, modern painting is relevant to the design of virtual navigable spaces in two additional ways. First, given that new media are most often experienced, like paintings, via a rectangular frame, virtual architects can study how painters organized their spaces within the constraints of a rectangle. Second, modern painters who belong to what I call the "space-medium tradition" elaborated the concept of space as a homogeneous, dense field, where everything is made from the same "stuff"—in contrast to architects who always have to work with the basic dichotomy between built structure and empty space. And although the virtual spaces that have thus far been realized, with the possible exception of *Osmose,* accept the same dichotomy between rigid objects and the void between them, on the level of material organization they are intrinsically related to the monistic ontology of modern painters such as Matta, Giacometti, or Pollock, for everything in them is also made from the same material—pixels, on the level of surface; polygons or voxels, on the level of 3-D representation. Thus virtual computer space is structurally closer to modern painting than it is to architecture.

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[76] For a discussion of the Archigram group in the context of computer-based virtual spaces, see Hans-Peter Schwarz, *Media-Art-History: Media Museum* (Munich: Prestel, 1997), 74-76.

[77] See, for instance, *Visionary Architects: Boullee, Ledoux, Lequeu* (Houston: University of St. Thomas, 1968); Heinrich Klotz, ed., *Paper Architecture: New Projects from the Soviet Union* (Frankfurt: Deutsches Architekturmuseum, 1988).

[78] See, for instance, Dietrich Neumann, ed., *Film Architecture: Set Designs from Metropolis to Blade Runner* (Munich: Prestel, 1996).

Along with painting, a genre of modern art with particular relevance to the design of navigable virtual spaces is installation. Seen in the context of new media, many installations can be thought of as dense multimedia information spaces. They combine images, video, texts, graphics, and 3-D elements within a spatial layout. While most installations leave it up to the viewer to determine the order of "information access" to their elements, one of the most well-known installation artists, Ilya Kabakov, elaborated a system of strategies to structure the viewer's navigation through his spaces.[79] In most installations, according to Kabakov, "the viewer is completely free because the space surrounding her and the installation remain completely indifferent to the installation it encloses."[80] In contrast, by creating a separate, enclosed space with carefully chosen proportions, colors, and lighting within the larger space of a museum or a gallery, Kabakov aims to completely "immerse" the viewer inside his installation. He calls this installation type a "total installation."

For Kabakov, a "total" installation has a double identity. On the one hand, it belongs to the plastic arts designed to be viewed by an immobile spectator—painting, sculpture, architecture. On the other hand, it also belongs to time-based arts such as theater and cinema. We can say the same about virtual navigable spaces. Another concept of Kabakov directly applicable to virtual space design is his distinction between the spatial structure of an installation and its dramaturgy, that is, the time-space structure created by the movement of a viewer through an installation.[81] Kabakov's strategies of dramaturgy include dividing the total space of an installation into two or more connected spaces and creating a well-defined path through the space

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[79] Ilya Kabakov, *On the "Total Installation"* (Bonn: Cantz Verlag, 1995).

[80] Ibid., 125. This and the following translations from the Russian text of Kabakov are mine.

[81] Ibid., 200.

that does not preclude the viewer from wandering on her own, yet prevents her from feeling lost and bored. To make such a path, Kabakov constructs corridors and abrupt openings between objects; he also places objects in strange places to obstruct passage. Another strategy of the "total installation" is the choice of particular kinds of narratives that in and of themselves lead to spatialization. These are narratives that take place around a main event that becomes the center of an installation: "The beginning [of the installation] leads to the main event [of the narrative] while the last part exists after the event took place." Yet another strategy involves the positioning of text within the space of an installation as a way to orchestrate the attention and navigation of the viewer. For instance, placing two to three pages of text at a particular point in the space creates a deliberate stop in the navigation rhythm.[82] Finally, Kabakov "directs" the viewer to keep alternating between focusing her attention on particular details and the installation as a whole. He describes these two kinds of spatial attention (which we can correlate with haptic and optic perception as theorized by Riegl and others) as follows: "wandering, total ("summarnaia") orientation in space—and active, well-aimed 'taking in' of the partial, the small, the unexpected."[83]

All these strategies can be directly applied to the design of virtual navigable spaces (and interactive multimedia in general). In particular, Kabakov is very successful at making viewers of his installations read carefully the significant amounts of text included in them—something that represents a constant challenge for new media designers. His constant concern is the viewer's attention and reaction to what she will encounter: "The reaction of the viewer during her movement through the installation is the main concern of the designer . . . The loss of the viewer's attention is the end of the installation."[84] This focus on the viewer offers an important lesson for new media designers, who often forget that what they are designing is not an object in itself but a viewer's experience in time and space.

I have purposefully used the word *strategy* to refer to Kabakov's techniques. To evoke the terminology of Michel de Certeau's *The Practice of*

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[82] Ibid., 200–208.

[83] Ibid., 162.

[84] Ibid., 162.

*Everyday Life,* Kabakov uses strategies to impose a particular matrix of space, time, experience, and meaning on his viewers; they, in turn, use "tactics" to create their own trajectories (this is a term actually used by de Certeau) within this matrix. If Kabakov is perhaps the most accomplished architect of navigable spaces, de Certeau could very well be their best theoretician. Like Kabakov, he never deals with computer media directly, and yet *The Practice of Everyday Life* contains a multitude of ideas directly applicable to new media. His analysis of the ways in which people employ "tactics" to create their own trajectories through the spaces defined by others (both metaphorically and in the case of spatial tactics, literally) offers a good model for thinking about the ways in which computer users navigate through computer spaces they did not design:

> Although they are composed with the vocabularies of established languages (those of television, newspapers, supermarkets of established sequences) and although they remain subordinated to prescribed syntactical forms (temporal modes of schedules, paradigmatic orders of spaces, etc.), the trajectories trace out the rules of other interests and desires that are neither determined, nor captured by, the system in which they develop.[85]

### The Navigator and the Explorer

Why is navigable space such a popular construct in new media? What are the historical origins and precedents of this form?

In his famous 1863 essay "The Painter of Modern Life," Charles Baudelaire documented the new modern male urban subject—the flâneur.[86] (Recent writings on visual culture, film theory, cultural history, and cyberculture have invoked the figure of the flâneur much too often; my justification for invoking it once again here is that I hope to use it in new ways.) An anonymous observer, the flâneur navigates through the space of a Parisian crowd, mentally recording and immediately erasing the faces and figures of passersby. From time to time, his gaze meets the gaze of a passing woman,

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[85] De Certeau, *The Practice of Everyday Life,* xviii.

[86] Charles Baudelaire, "The Painter of Modern Life," in *My Heart Laid Bare and Other Prose Writings* (London: Soho Book Company, 1986).

engaging her in a split-second virtual affair, only to be unfaithful to her with the next female passerby. The flâneur is only truly at home in one place—moving through the crowd. Baudelaire writes: "To the perfect spectator, the impassioned observer, it is an immense joy to make his domicile amongst numbers, amidst fluctuation and movement, amidst the fugitive and infinite . . . To be away from home, and yet to feel at home; to behold the world, to be in the midst of the world and yet to remain hidden from the world." There is a theory of navigable virtual spaces hidden here, and we can turn to Walter Benjamin to help us in articulating it. According to Benjamin, the flâneur's navigation transforms the space of the city: "The Crowd is the veil through which the familiar city lures the flâneur like a phantasmagoria. In it the city is now a landscape, now a room."[87] The navigable space is thus a subjective space, its architecture responding to the subject's movement and emotion. In the case of the flâneur moving through the physical city, this transformation, of course, only happens in the flâneur's perception, but in the case of navigation through a virtual space, the space can literally change, becoming a mirror of the user's subjectivity. The virtual spaces built on this principle can be found in Waliczky's *The Garden* and also in the commercial film *Dark City* (Proyas, 1998).

Following European tradition, the subjectivity of the flâneur is determined by his interaction with a group—even though it is a group of strangers. In place of the close-knit community of the small-scale traditional society (Gemeinschaft), we now have the anonymous associations of modern society (Gesellshaft).[88] We can interpret the flâneur's behavior as a response to this historical shift. It is as though he is trying to compensate for the loss of a close relationship with his group by inserting himself into the anonymous crowd. He thus exemplifies the historical shift from Gemeinschaft to Gesellshaft, and the fact that he only feels at home in a crowd of strangers shows the psychological price paid for modernization. Still, the subjectivity of the flâneur is, in essence, intersubjectivity—an exchange of glances between him and other human beings.

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[87] Walter Benjamin, "Paris, Capital of the Nineteenth Century," in *Reflections* (New York: Schocken Books, 1986), 156.

[88] The distinction between Gemeinschaft and Gesellshaft was developed by Tönnies in *Community and Society.*

A very different image of navigation through space—and of subjectivity—is presented in the novels of nineteenth-century American writers such as James Fenimore Cooper (1789–1851) and Mark Twain (1835–1910). The main character of Cooper's novels, the wilderness scout Natty Bumppo, alias Leatherstocking, navigates through spaces of nature rather than culture. Similarly, in Twain's *Huckleberry Finn,* the narrative is organized around the voyage of the two boy heroes down the Mississippi River. Instead of the thickness of the urban human crowd, the milieu of a Parisian flâneur, the heroes of these American novels are most at home in the wilderness, away from the city. They navigate forests and rivers, overcoming obstacles and fighting enemies. Subjectivity is constructed through conflicts between the subject and nature, and between the subject and his enemies, rather than through interpersonal relations within a group. This structure finds its ultimate expression in the unique American form, the Western, and its hero, the cowboy—a lonely explorer who only occasionally shows up in town to get a drink at the saloon. Rather than providing a home for the cowboy, as it does for the flâneur, the town is a hostile place, full of conflict which eventually erupts into the inevitable showdown.

Both the flâneur and the explorer find their expression in different subject positions, or phenotypes, of new media users. Media theoretician and activist Geert Lovink describes the figure of the present-day media user and Net surfer, whom he calls "the Data Dandy." Although Lovink's reference is Oscar Wilde rather than Baudelaire, his Data Dandy exhibits behaviors that also qualify him to be called a "Data Flâneur." "The Net is to the electronic dandy what the metropolitan street was for the historical dandy."[89] A perfect aesthete, the Data Dandy loves to display his private and totally irrelevant collection of data to other Net users. "Wrapped in the finest facts and the most senseless gadgets, the new dandy deregulates the time economy of the info = money managers . . . if the anonymous crowd in the streets was the audience of the Boulevard dandy, the logged-in Net-users are that of the data dandy."[90] While displaying his dandyism, the data dandy does not want to be above the crowd; like Baudelaire's flâneur, he wants to lose himself in its mass, to be moved by the semantic vectors of mass media icons, themes, and trends. As Lovink points out, a data dandy "can only play with the rules of the Net as a non-identity. What is exclusivity in the age of differentiation? . . . Data dandyism is born of an aversion to being exiled into a subculture of one's own."[91] Although Lovink positions the Data Dandy exclusively in data space ("Cologne and pink stockings have been replaced by precious Intel"), the Data Dandy does have a dress code of his own. This look was popular with new media artists of the 1990s—no labels, no distinct design, no bright colors or extravagant shapes—a non-identity that is nevertheless paraded as style and, in fact, is carefully constructed (as I learned while shopping in Berlin in 1997 with Russian net.artist Alexei Shulgin). The designers who best exemplify this style in the 1990s are Hugo Boss and Prada, whose restrained no-style style contrasts with the opulence of Versace and Gucci, the stars of the 1980s era of exess. The new style of non-identity corresponds perfectly to the rise of the Net, where endless mailing lists, newsgroups, and sites delude any single topic, image, or idea: "On the Net, the only thing which appears as a mass is information itself. . . . Today's new theme is tomorrow's 23 newsgroups."[92]

If the Net surfer, who keeps posting to mailing lists and newsgroups and accumulating endless data, is a reincarnation of Baudelaire's flâneur, the user navigating a virtual space assumes the position of the nineteenth-century explorer, a character from Cooper or Twain. This is particularly true for the navigable spaces of computer games. The dominance of spatial exploration in games exemplifies the classical American mythology in which the individual discovers his identity and builds character by moving through space. Correspondingly, in many American novels and short stories (O. Henry, Hemingway), narrative is driven by the character's movements in the outside space. In contrast, nineteenth-century European novels do not feature much movement in physical space because the action takes place in a psychological space. From this perspective, most computer games follow the logic of American rather than European narratives. Their heroes are not developed, and their psychology is not represented. But as these heroes move through space, defeating enemies, acquiring resources, and, more importantly, skill, they are "building character." This is particularly true for Role Playing Games (RPG), whose narrative is one of self-improvement. But it also holds true for other game genres (action, adventure, simulators) that put the user in command of a character (*Doom, Mario, Tomb Raider*). As the character progresses through the game, the game player acquires new skills and knowledge. She learns how to outwit the mutants lurking in the levels of *Doom,* how to defeat the enemies with just a few kicks in *Tomb Raider,* how to solve the secrets of the playful world in *Mario,* and so on.[93]

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[89] Adilkno, *The Media Archive* (Brooklyn, New York: Autonomedia, 1998), 99.

[90] Ibid., 100.

[91] Ibid.

[92] Ibid.

While movement through space as a means of building character is one theme of American frontier mythology, another is exploring and "culturing" unknown space. This theme is also reflected in the structure of computer games. A typical game begins at some point in a large, unknown space; in the course of the game, the player has to explore this space, mapping out its geography and unraveling its secrets. In the case of games organized into discrete levels such as *Doom,* the player has to investigate systematically all the spaces of a given level before he can move to the next level. In other games taking place in one large territory, the game play gradually involves larger and larger parts of this territory (*Adventure, War Craft*).

Although I focus in this section on navigating a space in a literal sense, that is, moving through a 3-D virtual space, this concept is also a key metaphor in the conceptualization of new media. From the 1980s concept of cyberspace to 1990s software such as Netscape Navigator, interacting with computerized data and media has been consistently framed in spatial terms. Computer scientists adopted this metaphor as well: They use the term ***navigation*** to refer to different methods of organizing and accessing hypermedia, even though a 3-D virtual space interface is not at all the most common method. For instance, in his *Elements of Hypermedia Design,* Peter Gloor lists "seven design concepts for navigation in dataspace": linking, searching, sequentialization, hierarchy, similarity, mapping, guides and agents.[94] Thus, "navigating the Internet" includes following hyperlinks, using menus

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[93] This narrative of maturation can also be seen as a particular case of an initiation ceremony, something traditionally a part of every human society.

[94] Peter Gloor, *Elements of Hypermedia Design* (Boston: Birkhäuser, 1997).

commonly provided by Web sites, as well as using search engines. If we accept this spatial metaphor, both the nineteenth-century European flâneur and the American explorer find their reincarnation in the figure of the net surfer. We may even correlate these two historical figures with the names of the two most popular Web browsers: the flâneur of Baudelaire—Netscape Navigator; the explorer of Cooper, Twain, and Hemingway—Internet Explorer. Of course, names apart, these two browsers are functionally quite similar. However, given that they both focus on a single user navigating through Web sites rather than more communal experiences, such as newsgroups, mailing lists, text-based chat, and IRC, we can say that they privilege the explorer rather than the flâneur—a single user navigating through an unknown territory rather than a member of a group, even if this group is a crowd of strangers. And although different software solutions have been developed to make Internet navigation more of a social experience—for instance, allowing remote users to navigate the same Web site together, simultaneously, or allowing the user to see who has already accessed a particular document—individual navigation through "history-free" data was still the norm at the end of the 1990s.

### *Kino-Eye* and Simulators

I have presented two historical trajectories: from flâneur to Net surfer, and from nineteenth-century American explorer to the explorer of navigable virtual space. It is also possible to construct another trajectory, leading from the Parisian flanerie to navigable computer spaces. In *Window Shopping,* film historian Anne Friedberg presents an archeology of a mode of perception that, according to her, characterizes modern cinematic, televisual, and cyber cultures. This mode, which she calls a "mobilized virtual gaze,"[95] combines two conditions: "a received perception mediated through representation" and travel "in an imaginary flanerie through an imaginary elsewhere and an imaginary elsewhen."[96] According to Friedberg's archeology, this mode emerged when a new nineteenth-century technology of virtual representation—photography—merged with the mobilized gaze of tourism, urban shopping, and flanerie.[97] As can be seen, Friedberg connects Baudelaire's flâneur with a range of other modern practices: "The same impulses which send flâneurs through the arcades, traversing the pavement and wearing thin their shoe leather, sent shoppers into the department stores, tourists to exhibitions, spectators into the panorama, diaroma, wax museum, and cinema."[98] The flâneur occupies a privileged position among these nineteenth-century subjects because he embodied most strongly the desire to combine perception with motion through a space. All that remained in order to arrive at the "mobilized virtual gaze" was to virtualize this perception—something that cinema accomplished in the last decade of the nineteenth century.

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[95] Friedberg, *Window Shopping,* 2.

[96] Ibid.

Although Friederg's account ends with television and does not consider new media, the form of navigable virtual space fits well in her historical trajectory. Navigation through a virtual space, whether in a computer game, motion simulator, data visualizations, or 3-D human-computer interface, follows the logic of the "virtual mobile gaze." Instead of Parisian streets, shopping windows, and the faces of the passersby, the virtual flâneur travels through virtual streets, highways, and planes of data; the eroticism of a split-second virtual affair with a passerby of the opposite sex is replaced with the excitement of locating and opening a particular file or zooming into the virtual object. Like Baudelaire's flâneur, the virtual flâneur is happiest on the move, clicking from one object to another, traversing room after room, level after level, data volume after data volume.

Thus just as a database form can be seen as an expression of a "database complex," an irrational desire to preserve and store everything, navigable space is not just a purely functional interface. It is also an expression and gratification of a psychological desire, a state of being, a subject position—or rather, a subject's trajectory. If the subject of modern society looked for refuge from the chaos of the real world in the stability and balance of the static composition of a painting, and later in the cinematic image, the subject of the information society finds peace in the knowledge that she can slide over endless fields of data, locating any morsel of information with the click of a button, zooming through file systems and networks. She is comforted

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[97] Ibid., 184.

[98] Ibid., 94.

not by an equilibrium of shapes and colors, but by the variety of data manipulation operations at her control.

Does this mean that we have reached the end of the trajectory described by Friedberg? While still enjoying a privileged place in computer culture, flanerie now shows its age. Here we can make an analogy with the history of the GUI (Graphical User Interface). Developed at Xerox PARC in the 1970s and commercialized by Apple in the early 1980s, it was appropriate when a typical user's hard drive contained dozens or even hundreds of files. But for the next stage of Net-based computing, in which the user is accessing millions of files, it is no longer sufficient.[99] Bypassing the ability to display and navigate files graphically, the user resorts to a text-based search engine. Similarly, while the "mobilized virtual gaze" described by Friedberg was a significant advancement over earlier more static methods of data organization and access (static image, text, catalog, library), its "bandwidth" is too limited in the information age. Moreover, a simple simulation of movement through a physical space defeats the computer's new capabilities of data access and manipulation. Thus for the virtual flâneur, such operations as search, segmentation, hyperlinking, visualization, and data mining are more satisfying than just navigating through a simulation of a physical space.

In the 1920s Dziga Vertov already understood this very well. *Man with a Movie Camera* is an important point in the trajectory that leads from Baudelaire's flanerie to *Aspen Movie Map*, *Doom*, and VRML worlds, not simply because Vertov's film is structured around the camera's active exploration of city spaces, and not only because it fetishizes the camera's mobility. Vertov wanted to overcome the limits of human vision and human movement through space to arrive at more efficient means of data access. However, the data with which he worked is raw visible reality—not reality digitized and stored in a computer's memory as numbers. Similarly, his interface was a film camera, that is, an anthropomorphic simulation of human vision—not computer algorithms. Thus, *Vertov stands halfway between Baudelaire's flâneur and today's computer user: No longer just a pedestrian walking down a street, but not yet Gibson's data cowboy who zooms through pure data armed with data-mining algorithms.*

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[99] See Don Gentner and Jakob Nielson, "The Anti-Mac Interface," *Communications of the ACM* 39, no. 8 (August 1996): 70–82. Available online at http://www.acm.org/cacm/AUG96/antimac.htm.

In his research on what can be called the "kino-eye interface," Vertov systematically tried different ways to overcome what he thought were the limits of human vision. He mounted cameras on the roof of a building and a moving automobile; he slowed and sped up film speed; he superimposed a number of images together in time and space (temporal montage and montage within a shot). *Man with a Movie Camera* is not only a database of city life in the 1920s, a database of film techniques, and a database of new operations of visual epistemology, but also a database of new interface operations that together aim to go beyond simple human navigation through physical space.

Along with *Man with a Movie Camera,* another key point in the trajectory from the navigable space of a nineteenth-century city to the virtual navigable computer space is flight simulators. At the same time as Vertov was working on his film, young American engineer E. A. Link, Jr. developed the first commercial flight simulator. Significantly, Link's patent for his simulator filed in 1930 refers to it as a "Combination Training Device for Student Aviators and Entertainment Apparatus."[100] Thus, rather than being an afterthought, the adaptation of flight simulator technology to consumer entertainment that took place in the 1990s was already envisioned by its inventor. Link's design was a simulation of a pilot's cockpit with all the controls, but, in contrast to a modern simulator, it had no visuals. In short, it was a motion ride without a movie. In the 1960s, visuals were added by using new video technology. A video camera was mounted on a movable arm positioned over a room-size model of an airport. The movement of the camera was synchronized with the simulator controls; its image was transmitted to a video monitor in the cockpit. While useful, this approach was limited because it was based on the physical reality of an actual model set. As we saw in the "Compositing" section, a filmed and edited image is a better simulation technology than a physical construction; and a virtual image controlled by a computer is better still. Not surprisingly, soon after interactive 3-D computer graphics technology was developed, it was applied to produce visuals for the simulators by one of its developers. In 1968, Ivan Sutherland, who had already pioneered interactive computer-aided design ("Sketchpad," 1962) and virtual reality (1967), formed a company to produce computer-based simulators. In the 1970s and 1980s simulators were one of the main applications of real-time 3-D computer graphics technology, thus determining to a significant degree the way this technology was developed. For instance, simulation of particular landscape features typically seen by a pilot, such as flat terrain, mountains, sky with clouds, and fog, all became important research problems.[101] The application of interactive graphics to simulators has also shaped the imagination of researchers regarding how this technology can be used. It naturalized a particular idiom—flying through a simulated spatial environment.

Thus, one of the most common forms of navigation used today in computer culture—flying through spatialized data—can be traced back to 1970s military simulators. From Baudelaire's flâneur strolling through physical streets, we move to Vertov's camera mounted on a moving car and then to the virtual camera of a simulator that represents the viewpoint of a military pilot. Although it was not an exclusive factor, the end of the Cold War played an important role in the extension of the military mode of perception into general culture. Until 1990, such companies as Evans and Sutherland, Boeing, and Lockheed were busy developing multi-million-dollar simulators, but as military orders dried up, they were forced to look for consumer applications of their technology. During the 1990s, these and other companies converted their expensive simulators into arcade games, motion rides, and other forms of location-based entertainment. By the end of the decade, Evans and Sutherland's list of products included image-generators for use in military and aviation simulators; a virtual set technology for use in television production; Cyber Fighter, a system of networked game stations modeled after networked military simulators; and Virtual Glider, an immersive, location-based entertainment station.[102] As military budgets continued to diminish and entertainment budgets soared, the entertainment industry and the military often came to share the same technologies and employ the same visual forms. Probably the most graphic example of the ongoing circular transfer of technology and imagination between the military and the civilian sector in new media is *Doom*. Originally developed and released over the Internet as a consumer game in 1993 by id software, it was soon picked up by the U.S. Marine Corps, which customized it into a military simulator for group-combat training.[103] Instead of using multi-million-dollar simulators, the Army could now train soldiers on a fifty-dollar game. The Marines, who were involved in the modifications, then went on to form their own company in order to market the customized *Doom* as a commercial game.

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[100] Benjamin Wooley, *Virtual Worlds* (Oxford: Blackwell, 1992), 39, 43.

[101] For more on the history of 3-D computer graphics, see my article "Mapping Space: Perspective, Radar, and Computer Graphics."

[102] http://www.es.com/product_index.html.

The discussion of the military origins of the navigable space form would be incomplete without acknowledging the pioneering work of Paul Virilio. In his brilliant 1984 book *War and Cinema,* Virilio documented numerous parallels between the military and film cultures of the twentieth century, including the use of a mobile camera moving through space in military aerial surveillance and in cinematography.[104] Virilio went on to suggest that, whereas space was the main category of the nineteenth century, the main category of the twentieth century was time. As I already discussed, telecommunication technology for Virilio eliminates the category of space altogether as it makes every point on Earth as accessible as any other—at least in theory. This technology also leads to a real-time politics, which requires instant reactions to events transmitted at the speed of light and, ultimately, can only be handled efficiently by computers responding to each other without human intervention. From a post-Cold War perspective, Virilio's theory can be seen as another example of the imagination transfer from the military to the civilian sector. In this case, the techno-politics of the Cold War nuclear arms equilibrium between the two superpowers capable of striking each other or any point on Earth at any moment is seen as a fundamentally new stage of culture, in which real time triumphs over space.

Although Virilio did not write on computer interfaces, the logic of his books suggests that the ideal computer interface for a culture of real-time politics would be the War Room in *Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb* (Kubrick, 1964), with its direct lines of communication between the generals and the pilots; or DOS command lines, with their military economy of command and response, rather than the more spectacular but inefficient VRML worlds. Uneconomical and inefficient as it may be, the navigable space interface is nevertheless thriving in all areas of new media. How can we explain its popularity? Is it simply a result of cultural inertia? A leftover from the nineteenth century? A way to make the ultimately alien space of a computer compatible with humans by anthropomorphizing it, superimposing a simulation of a Parisian flanerie over abstract data? A relic of Cold War culture?

While all these answers make sense, it would be unsatisfactory to see navigable space as merely the end of a historical trajectory; it is also a new beginning. The few computer spaces discussed here point toward some of the aesthetic possibilities of this form; more possibilities are contained in the works of modern painters, installation artists, and architects. Theoretically as well, navigable space represents a new challenge. Rather than considering only the topology, geometry, and logic of a static space, we need to take into account the new way in which space functions in computer culture—as something traversed by a subject, as a trajectory rather than an area. But computer culture is not the only field where the use of the category of navigable space makes sense. I will now briefly look at two other fields—anthropology and architecture—in which we find more examples of "navigable space imagination."

In his book *Non-places: Introduction to an Anthropology of Supermodernity,* French anthropologist Marc Auge advances the hypothesis that "supermodernity produces non-places, meaning spaces which are not themselves anthropological places and which, unlike Baudelairean modernity, do not integrate with earlier places."[105] Place is what anthropologists have studied traditionally; it is characterized by stability, and it supports stable identity, relations, and history.[106] Auge's main source for his distinction between place and space, or non-place, is Michel de Certeau: "Space, for him, is a

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[103] Elizabeth Sikorovsky, "Training Spells Doom for Marines," *Federal Computer Week,* 15 July 1996, available online at http://www.fcm.com/pubs/fcw/0715/guide.htm.

[104] Paul Virilio, *War and Cinema* (London: Verso, 1989).

[105] Marc Auge, *Non-places: Introduction to an Anthropology of Supermodernity,* trans. John Howe (London: Verso, 1995), 78.

[106] Ibid., 53–53.

'frequent place,' 'an intersection of moving bodies': it is the pedestrians who transform a street (geometrically defined as a place by town planners) into a space"; it is an animation of a place by the motion of a moving body.[107] Thus from one perspective we can understand place as a product of cultural producers, while non-places are created by users; in other words, non-place is an individual trajectory through a place. From another perspective, in supermodernity, traditional places are replaced by equally institutionalized non-places, a new architecture of transit and impermanence: hotel chains and squats, holiday clubs and refugee camps, supermarkets, airports, and highways. Non-place becomes the new norm, the new way of existence.

It is interesting that Auge chooses the counterpart of the pilot or the user of the flight simulator—the airline passenger—as the subject who exemplifies the condition of supermodernity. "Alone, but one of many, the user of a non-place has contractual relations with it." This contract relieves the person of his usual determinants. "He becomes no more than what he does or experiences in the role of passenger, customer or driver."[108] Auge concludes that "as anthropological places create the organically social, so non-places create solitary contractuality," the very opposite of the traditional object of sociology: "Try to imagine a Durkheimian analysis of a transit lounge at Roissy!"[109]

Architecture by definition stands on the side of order, society, and rules; it is thus a counterpart of sociology as it deals with regularities, norms, and "strategies" (to use de Certeau's term). Yet the very awareness of these assumptions underlying architecture led many contemporary architects to focus their attention on the activities of users who through their "speech acts" "reappropriate the space organized by the techniques of sociocultural production" (de Certeau).[110] Architects come to accept that the structures they design will be modified by users' activities, and that these modifications represent an essential part of architecture. They also took up the challenge of "a Durkheimian analysis of a transit lounge at Roissy," putting their energy and imagination into the design of non-places such as airports (Kansai International Airport in Osaka by Renzo Piano), train terminals (Waterloo International Terminal in London by Nicholas Grimshaw) and highway control stations (Steel Cloud or Los Angeles West Coast Gateway by Asymptote Architecture group).[111] Probably the ultimate in non-place architecture is the one-million-square-meter Euralille project, which redefined the city of Lille, France as the transit zone between the Continent and London. The project attracted some of the most interesting contemporary architects—Rem Koolhaas designed the masterplan, and Jean Nouvel built Centre Euralille, which contains a shopping center, school, hotel, and apartments next to the train terminal. Centered around the entrance to the Chunnel, the underground tunnel for cars that connects the Continent and England, and the terminal for the high-speed train that travels between Lille, London, Brussels, and Paris, Euralille is a space of navigation par excellence, a mega-non-place. Like the network players of *Doom,* Euralille users emerge from trains and cars to temporarily inhabit a zone defined through their trajectories, an environment "to just wander around inside of" (Robyn Miller), "an intersection of moving bodies" (de Certeau).

### *EVE* and *Place*

We have come a long way since *Spacewar* (1962) and *Computer Space* (1971)—at least in terms of graphics. The images of these early computer games seem to have more in common with the abstract paintings of Malevich and Mondrian than with the photorealistic renderings of *Quake* (1996) and *Unreal* (1997). Whether this evolution in graphics was also accompanied by a conceptual evolution is another matter. Compared to the richness of modern concepts of space developed by artists, architects, filmmakers, art historians, and anthropologists, our computer spaces have a long way to go.

Often the way to go forward is to go back. As this section has suggested, designers of virtual spaces may find a wealth of relevant ideas by looking at twentieth-century art, architecture, film, and other arts. Similarly, some of the earliest computer spaces, such as *Spacewar* and *Aspen Movie Map,* con-

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107. Ibid., 79–80.

108. Ibid., 101, 103.

109. Ibid., 94.

110. De Certeau, *The Practice of Everyday Life,* xiv.

111. Jean-Claude Dubost and Jean-François Gonthier, eds., *Architecture for the Future* (Paris: Éditions Pierre Terrail, 1996), 171.

tained aesthetic possibilities that are still waiting to be explored. In conclusion, I will discuss two more works by Jeffrey Shaw, who probably draws on various cultural traditions of space construction and representation more systematically than any other new media artist.

While Friedberg's concept of the virtual mobile gaze is useful in allowing us to see the connections between a number of technologies and practices of spatial navigation, such as panorama, cinema, and shopping, it can also make us blind to the important differences between them. In contrast, Shaw's *EVE* (1993–present) and *Place: A User's Manual* (1995) emphasize both the similarities and differences between various technologies of navigation.[112] In these works, Shaw evokes the navigation methods of panorama, cinema, video, and VR. But rather than collapsing different technologies into one, he "layers" them side by side; that is, he literally encloses the interface of one technology within the interface of another. For instance, in the case of *EVE*, visitors find themselves inside a large semisphere reminiscent of the nineteenth-century panorama. The projectors located in the middle of the sphere throw a rectangular image on the inside surface of the semisphere. In this way, the interface of cinema (an image enclosed by a rectangular frame) is placed inside the interface of panorama (a semispherical enclosed space). In *Place: A User's Manual*, a different "layering" takes place: A panorama interface is placed inside a typical computer-space interface. The user navigates a virtual landscape using a first-person perspective characteristic of VR, computer games, and navigable computer spaces in general. Inside this landscape are eleven cylinders with photographs mapped on them. Once the user moves inside one of these cylinders, she switches to a mode of perception typical of the panorama tradition.

By placing interfaces of different technologies next to one other within a single work, Shaw foregrounds the unique logic of seeing, spatial access, and user behavior characteristic of each. The tradition of the framed image, that is, a representation that exists within the larger physical space that contains the viewer (painting, cinema, computer screen), meets the tradition of "total" simulation, or "immersion," that is, a simulated space that encloses the viewer (panorama, VR).

Another historical dichotomy staged for us by Shaw is that between the traditions of collective and individualized viewing in screen-based arts. The first tradition spans from magic-lantern shows to twentieth-century cinema. The second passes from the camera obscura, stereoscope, and kinescope to head-mounted displays of VR. Both have their dangers. In the first tradition, the individual's subjectivity can be dissolved in a mass-induced response. In the second, subjectivity is defined through the interaction of an isolated subject with an object at the expense of intersubjective dialogue. In the case of viewers' interactions with computer installations, as I noted when discussing *Osmose*, something quite new begins to emerge—a combination of individualized and collective spectatorship. The interaction of one viewer with the work (via a joystick, mouse, or head-mounted sensor) becomes in itself a new text for other viewers, situated within the work's arena, so to speak. This affects the behavior of this viewer, who acts as a representative for the desires of others, and who is now oriented both to them and to the work.

*EVE* rehearses the whole Western history of simulation, functioning as a kind of Plato's cave in reverse: Visitors progress from the real world into the space of simulation, where instead of mere shadows they are presented with technologically enhanced (via stereo) images, which look more real than their normal perceptions.[113] At the same time, *EVE*'s enclosed round shape refers us back to the fundamental modern desire to construct a perfect, self-sufficient utopia, whether visual (the nineteenth-century panorama) or social. (For instance, after 1917, Russian architect G. I. Gidoni designed a monument to the revolution in the form of a semitransparent globe that could hold several thousand spectators.) Yet rather than being presented with a simulated world that has nothing to do with the real space of the viewer (as in typical VR), visitors who enter *EVE*'s enclosed space discover that *EVE*'s apparatus shows the outside reality they ostensibly just left behind. Moreover, instead of being fused in a single collective vision (Gesamtkunstwerk, cinema, mass society), visitors are confronted with a subjective and partial view. Visitors see only what one person who wears a head-mounted sensor chooses to show them; that is, they are literally limited by this person's point of view. In addition, instead of a 360-degree view, they see a small rectangular image—a mere sample of the world outside. The one visitor wearing a sensor, who thus literally acts as an eye for the rest of the audience, occupies many positions at once—master subject, visionary who shows the audience what is worth seeing, and (at the same time) mere object, an interface between them and outside reality, that is, a tool for others; a projector, light, and reflector, all at once.

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[112] Abel, *Jeffrey Shaw*, 138–139, 142–145.

[113] Here I am describing the particular application of EVE that I saw at the "Multimediale 4" exhibition, Karlsruhe, Germany, May 1995.

Having examined the two key forms of new media—database and navigable space—one is tempted to see their privileged role in computer culture as a sign of a larger cultural change. If we use Auge's distinction between modernity and supermodernity, the following scheme can be established:

1. modernity—"supermodernity,"
2. narrative (= hierarchy)—database, hypermedia, network (= flattening of hierarchy),
3. objective space—navigable space (trajectory through space),
4. static architecture—"liquid architecture,"[114] and
5. geometry and topology as theoretical models for cultural and social analysis—trajectory, vector, and flow as theoretical categories.

As can be seen from this scheme, the two "supermodern" forms of database and navigable space are complementary in their effects on the forms of modernity. On the one hand, a narrative is "flattened" into a database. A trajectory through events and/or time becomes a flat space. On the other hand, a flat space of architecture or topology is narrativized, becoming a support for individual users' trajectories.

But this is only one possible scheme. What is clear, however, is that we have left modernity for something else. We are still searching for names to describe it. Yet the names that we have come up with—"supermodernity," "transmodernity," "second modern"—all seem to reflect the sense of the continuity of this new stage with the old. If the 1980s' concept of "postmodernism" implied a break with modernity, we now seem to prefer to think of cultural history as a continuous trajectory through a single conceptual and aesthetic space. Having lived through the twentieth century, we learned all too well the human price of "breaking with the past," "building from scratch," "making new," and other similar claims—whether involving aesthetic, moral, or social systems. The claim that new media should be totally new is only one in the long list of such claims.

Such a notion of a continuous trajectory is more compatible with human anthropology and phenomenology. Just as a human body moves through physical space in a continuous trajectory, the notion of history as a continuous trajectory is, in my view, preferable to the one that postulates epistemological breaks or paradigm shifts from one era to the next. This notion, articulated by Michel Foucault and Thomas Kuhn, in the 1960s, fits with the aesthetics of modernist montage of Eisenstein and Godard—rather than our own aesthetics of continuity as exemplified by compositing, morphing, and navigable spaces.[115]

These thinkers also seem to have projected onto a diachronic plane of history the traumatic synchronic division of their time—the split between the capitalist West and the communist East. But with the official (although not necessarily actual) collapse of this split in the 1990s, we have seen how history has reasserted its continuity in powerful and dangerous ways. The return of nationalism and religion and the desire to erase everything associated with the Communist regime and return to the past—pre-1917 Russia and pre-1945 Eastern Europe—are only some of the more dramatic signs of this process. A radical break with the past has a price. Despite the interruption, the historical trajectory keeps accumulating potential energy until one day it reasserts itself with new force, breaking out into the open and crushing whatever new has been created in the meantime.

In this book, I have chosen to emphasize the continuities between the new media and the old, the interplay between historical repetition and innovation. I wanted to show how new media appropriate old forms and conventions of different media, in particular, cinema. Like a river, cultural history can not suddenly change its course; its movement is that of a spline rather than a set of straight lines between points. In short, I wanted to create trajectories through the space of cultural history that would pass through new media, thus grounding it in what came before.

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[114] See Novak, "Liquid Architectures in Cyberspace."

[115] Another notion that belongs to this paradigm of discontinuity is René Thom's catastrophe theory. See his *Structural Stability and Morphogenesis* (Reading, Mass.: W. A. Benjamin, 1975).