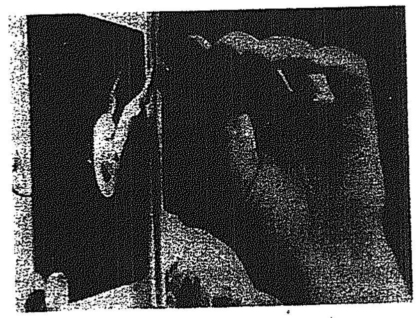
How Media Became New



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,

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.

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]

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 com-

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

puter. 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,

6. Ibid., 120.

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.

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

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

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

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

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

representation altogether, instead representing an image via different mathematical constructs (such as transforms).

(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

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 me-

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).

dia 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

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 (München: Akademie Zum Dritten Jahrtausend, 1995), 90–100.

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.

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

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.

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.

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).