1 Design in an Evolving Medium

The best way to predict the future is to invent it.
—Alan Kay, <http://www.smalltalk.org/alankay.html>

Design as Framing and Reframing

To **design** is to shape a specific **artifact** or process by choosing among alternate strategies in order to achieve explicit goals. Design is always concerned with discretionary choices that take into account the benefits and liabilities of alternate strategies. A designer must be able to envision multiple approaches to the same design problem, including novel approaches that exploit the **affordances** of new materials.

Design can be directed at objects meant to last for a season or a century, for pleasure or utility, for comfort or style. But design is always *the conscious creation of a particular artifact within a longer cultural tradition of practice.* It always involves a choice of **conventions** in a context in which there is not just one correct way of doing something. Most of all, good design is aimed simultaneously at perfecting the object and at improving the overall practice of the field. This double focus is particularly important for the designer of **digital media** because the field is so new and because there are so many competing methodologies that are relevant to the design of a digital artifact.

Professional designers in any field know how to **frame** a new design problem within existing traditions, practices, and goals. We know how to design a toaster because we know how people use it, and the underlying technology of heating element and regulators has not changed. Innovation in toaster design can focus on **refining** familiar elements: making them a little bit more reliable (less burnt toast), usable (easier to get the toast out of the slot), functional (more slots, bigger slots, a defrost setting), visually appealing (e.g., ceramic toasters with whimsical shapes), or marketable (designer-brand toasters). Some tasks in digital media design involve similar refinement of established artifacts. For example, the laptop computer can be designed for greater reliability (longer battery life, tougher shell, fewer viruses), usability (ergonomic keyboard design, less heat generation, lighter weight), functionality (faster operation,

Figure 1.1
Standard web conventions for a retail site on <http://www.landsend.com> include logo banner, keyword search, store locator, order tracker, account sign-in, shopping bag, and menu bar with conventional clothing categories.

Figure 1.2
Standard web conventions similar to the Lands' End website are found on <http://www.macys.com> with the additional features of a rotating ad space (here promoting "Online Deals") and a rating system for customers to recommend purchases.

larger hard-drive capacity, increased connectivity), visual appeal (custom colors, minimalist design), or marketability (Apple or PC brand appeal).

Designing a website for a retail operation can be a matter of refining existing conventions, similar to designing a new toaster, because retail websites currently rest on standardized technical elements (shopping basket with secure credit-card entry, inventory stored in a database, web pages generated on the fly) and include **genre** features that consumers are familiar with (home page, menu navigation, product images, sorting by size, recommendation systems). Like toasters, retail websites are stable enough in design to compete on style and relatively small functional refinements (see figures 1.1–1.4).

But many tasks in digital media design are not a matter of refining clearly established traditions and practices, but of inventing new conventions within a more open-ended context of possibilities. Creating a virtual world, a social networking site, a media-playing device, a handheld communication device, a website for a newspaper or a television station are much more open-ended tasks that cannot be approached within a single-standard framework. They require us to reframe familiar practices to take advantage of the new affordances of digital technology.

Innovative design is often the result of **reframing** familiar activities, such as rethinking the context in which they can be performed. The small portable radios introduced with the invention of transistors are based on reframing the activity of listening to music, which was previously thought of as something done in the home, or perhaps

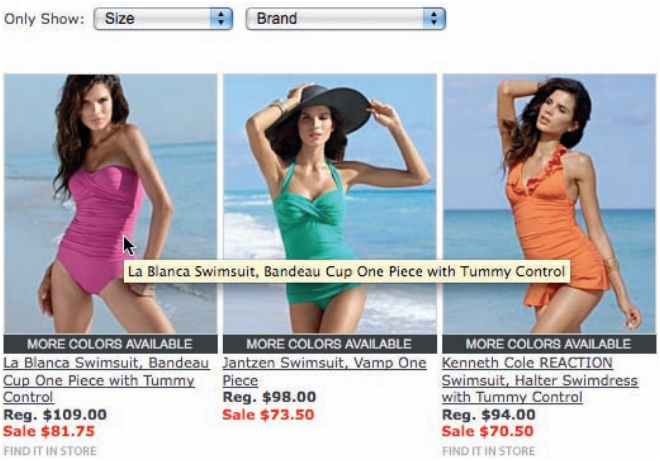

Figure 1.3
Macy's display of merchandise provides rollover text that duplicates the information below the picture.

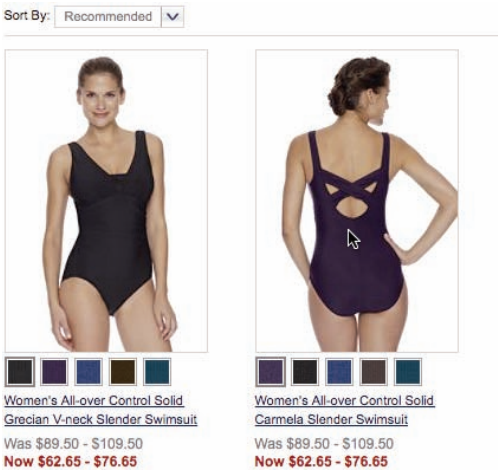

Figure 1.4
On the Lands' End site, rolling over the front-view image of a swimsuit displays the back of the garment, a refinement of the standard retail web convention.

while sitting on the grass or the beach with a "portable" radio the size of a toaster. The addition of earphones to the transistor radio made music listening into something that you could do privately, even when walking around outdoors and in public, paving the way for later inventions such as the tape-driven (and later CD-based) Sony Walkman and the digital mpeg3 player like the widely popular iPod. Telephoning has seen a similar shift in the past twenty years, changing the circumstances under which people contact one another and conduct conversations. For designers of digital artifacts, there is always the possibility of introducing a similarly durable reframing of a common activity.

Reframing can also be done at the level of social context. We see this quite often in advertising. For example, the bathing suits in figures 1.3 and 1.4, though both meant to present images of attractive women, are based on very different assumptions about shopper's motivations. The Macy's models are photographed in sexually seductive poses, an exaggeration of the cultural convention of objectifying women's bodies as objects of male desire; they also suggest urban sophistication about fashion trends since high fashion is often framed in risqué poses. The Lands' End images reframe the conventional bathing suit pose to suggest wholesome athleticism and a less overtly sexual attractiveness. Similarly, the Apple "I'm a Mac/I'm a PC" advertising campaign framed the Microsoft operating system as the unreliable choice of unimaginative nerds and the Mac platform as the hassle-free choice of the creative and cool. Advertising works by exaggerating such cultural connotations, so it is a good guide to the stereotypes considered mainstream by corporate culture. The designer should strive to identify such stereotypes and conventional value assumptions, and to be aware of whose interest they serve. It is often useful to reframe the scenario by reversing roles. For example, suppose the Microsoft people rewrote the Apple ads: would the hip Apple guy seem pretentious and incompetent and the PC guy seem coolly efficient and in control?

Cultural values and economic imperatives drive the direction of design innovation in ways that we usually take for granted, making some objects the focus of intense design attention while others are ignored altogether. For example, over the past century, music distribution and listening devices have experienced intense redesign, including dramatic changes in technology, from wax cylinder recordings and crystal radios to vinyl, tape, CDs, and Internet distribution. As a result we have gone in one hundred years from poor reproduction of a limited range of music, available to relatively few people worldwide, to a massive, globally distributed shared library of every conceivable form of musical performance. If a similar level of engineering resources and design inventiveness had been devoted to solar energy devices in the past fifty years, we might have made similar progress in an area more directly related to human survival.

Military technologies have been pursued with diligence over centuries, leading to many design innovations in the history of swords, missiles, vehicles, and gun mechanisms. But the massive funding of military equipment does not necessarily favor improvements. Organizations become attached to equipment because it is familiar, or because it has political support through the influence of the manufacturer. Contractors are most eager to innovate in areas of large profit, and may not give equal resources to developing body armor, for example, over much more lucrative missile systems. Design sometimes gets fossilized around "good enough" solutions. The Russian-made Kalashnikov rifle or AK-47 is widely believed to be easier for soldiers to maintain than the corresponding American weapon, the M16, which is more accurate. Despite the half century of hostility and proxy warfare between the United States and communist bloc countries, with billions spent on weapons, neither side has produced an assault rifle that combines accuracy and ease of maintenance. If research budgets were in the hands of infantry soldiers, body armor and assault rifles might have gotten more design attention than fighter jets and missile defense systems.

Everyone has cultural biases, expectations, and value judgments that are the result of living in a particular society or subgroup. *It is the job of the designer to identify and consciously examine these biases so they can become the subject of active choices rather than passive acceptance.* In order to uncover unspoken cultural biases for an assigned task, designers can bring multiple stakeholder groups into the design process and elicit their different perspectives and needs. They can also ask themselves how the project would be different if it were being designed for people of a different social class, ethnicity, nationality, gender, age, profession, neighborhood, educational background, or physical ability. The more we imagine such alternatives, the richer the set of possible strategies from which to make our design choices.

For example, the joystick game controller is an explicitly phallic device, evocative of male sexual excitement and potency. It reinforces the macho cultural values of shooting and driving games, which are structured around pressured individual performance and competition. But in Mary Flanagan's art installation piece [giantJoystick] (2006), the classic Atari game controller is reproduced in a ten-foot-tall version, turning it into a device that must be controlled collectively and cooperatively (see figure 1.5). Although we may not want to market a 10-foot joystick commercially, it is important to keep such creative reframing in mind in order to understand the cultural assumptions and design conventions behind the familiar version.

Three Layers of Media Design: Inscription, Transmission, Representation

In common parlance the word "medium" (and its plural form "media") can refer to anything from a set of charcoal pencils to a multinational entertainment corporation, encompassing technologies as tangible as marble sculpture or as imperceptible as radio

Figure 1.5
Mary Flanagan's [giantJoystick]—ten-foot-tall giant working model based on the handheld controller from the classic Atari 2600 video game system—is an art installation that redefines the social context of the familiar device by increasing its scale to provoke group play. See <http://www.maryflanagan.com/giant-joystick>.

waves. The term refers equally to a television news broadcast aimed at hundreds of millions of people or a private diary hidden under a teenager's pillow. In order to understand how best to develop the digital environment as an expressive medium, we need to distinguish the common elements of all of these varied phenomena and to identify the several levels at which design takes place.

For our purposes, a *medium is any combination of materials and cultural practices that is used by human beings to support the intentional communication of meaning*. It is important to remember that a medium is both material and cultural: a stone and chisel only become a medium for writing when a society develops practices of marking the stone and interpreting the chisel marks. Furthermore, the materials and cultural practices that make up any medium serve three nested processes: **inscription**, **transmission**, and **representation.** Design choices shape all three levels, and a change in any one of these levels can have consequences up and down the structure. For designers, it is helpful to think of anything made out of electronic **bits** and meant to be directly used by human beings as an **artifact** created in the emerging **digital medium.** A digital artifact might be a website, a research archive, a video game, a mobile device, a virtual environment, a wired piece of clothing, an art installation, an interactive television

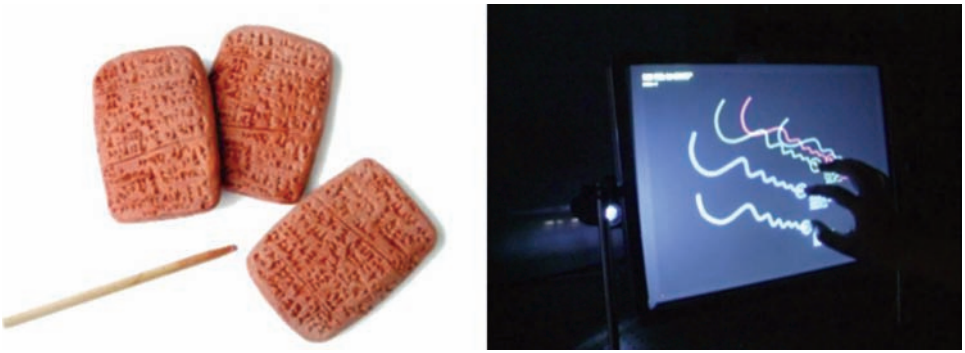

Figure 1.6
Two inscription technologies: a modern reproduction of biblical-era stylus and clay tablets and a digital multitouch screen created by Jefferson Y. Han of New York University.

program, and so on. Anything that is inscribed in bits and transmitted in computer **code** is part of the emerging, evolving, constantly changing, and significantly immature digital medium.

In a mature medium, the processes of inscription—of making perceptible marks on a receptive material—are so reliable and well-learned that they become **transparent:** we can perform them with little conscious effort. Writing on paper with a pencil has been a transparent process only since the mid-nineteenth century. Before that, paper was scarce and the pencil was an unreliable tool, differing from one maker to another, producing uneven markings, breaking easily, and lacking an eraser (Petroski 2000). The digital medium includes some inscription technologies, like the desktop computer keyboard, that work as reliably as pencil and paper do today, and some, like the too-small keyboards on mobile devices, that are more like pre-nineteenth-century pencils—unreliable and distractingly clumsy to use. Inscription remains an active area of digital innovation for input and output devices (figure 1.6).

Similarly, in a mature medium, transmission—the transfer of a message across space or time or both—is stable, standardized, and transparent. Transmission involves turning a meaningful **message** into a coded **signal** of some kind, and conveying it from sender to receiver with a minimum of **noise** (meaningless transmissions like static in a radio broadcast or misprints in a newspaper). Inscription involves marking a malleable material with a perceptible imprint; transmission involves arranging the marking into recognizable patterns we can think of as a transmission codes. Transmission codes are logical structures established by social agreement, like Morse code patterns that correspond to letters of the alphabet, or the unique phone number assigned to every landline or cell phone. The digital medium includes some mature (though still evolving) transmission codes such as data transfer **protocols**, media compression **formats**,

and computer languages, as well as some relatively inelegant and unreliable codes that make the medium less transparent, such as the triple tap system for writing alphabetically on a telephone keypad and the many password barriers that regularly challenge our memory and patience. In a mature medium, the inscription and transmission layers become standardized into formats by socially established customs, and are so well learned or so buried under more meaningful layers that they do not distract the human being who is depending on them.

Inscription technologies and transmission codes change over time (table 1.1). When they coalesce into lasting arrangements, we recognize stable formats or platforms. Representational forms are also changing, but they tend not to disappear even over long periods of time and remain available for meaning making. The digital medium rests on **binary** code inscribed on electrical charges, and it includes multiple evolving inscription and transmission technologies. Its formats and platforms are therefore also shifting, making it harder to stabilize conventions of representation. For example, electronic book readers and tablet computers have sold many millions of units and led to the downloading of billions of dollars worth of electronic books and magazines, even though the conventions for display and navigation are far from stabilized.

In any medium, the transmission layer is logical and well organized but meaningless until it is interpreted through our shared systems of representation. Morse code or alphabetical writing, for example, mean nothing until translated into a message in a human language. But the meaning of words in a language is much more elusive than the one-to-one relationship of Morse code to written alphabets. The representational layer is characterized by open cultural codes in which meaning is fuzzier, less stable, and more dependent on interpretation by **discourse communities** than the meaning of logical transmission codes.

The words of a language, the images we create for one another, the stories that we tell are all part of the representational layer of media. The inscription layer is grounded in the physicality of the inscription materials; the transmission layer is grounded in the logic of the coding system. The representational layer is more diffuse, created by cultural tradition and open to an ongoing process by which we negotiate meaning with one another. We understand what words mean not because the meanings are fixed or absolute, but because we draw on shared contexts and associations to interpret them. The combination of the written letters D-O-G, or the vocalized sounds represented by this alphabetical sequence, denote an animal with four legs, a tail, and a loyal disposition because English speakers have collectively associated these letters and sounds with the perceptions and experiences that make up our familiarity with dogs. But words and other cultural constructs are also **connotative.** For example, we can standardize pronunciation of a word like “mother” so that all English speakers will recognize it as the same word, but we can never standardize all the meanings that the

Table 1.1
Examples of Stable Formats, Conventions, and Genres

Inscription Materials	Transmission Codes	Stable Formats	Conventions of Representation	Genres of Representation
Pencils and paper	Alphabets, numbers	Loose sheets, bound books, conventions for the direction of writing and reading (e.g., left to right)	Words, lists, tables	Letters, shopping lists, love notes, financial records
Printing presses	Alphabets, numbers, letter press machines	Newsprint sizes and folding patterns, fonts, photography in newsprint	Words, lists, tables, headlines, bylines, photographs with captions	News stories, feature stories, editorials, letters to the editor
Video cameras (analog or digital)	Analog or digital TV signals via satellite, cable, wireless broadcast	Network TV delivery by broadcast or subscription	Program guide as a grid, remote control as channel selector, title sequences, credit sequences, commercial breaks between acts	Sit-coms, news broadcasts, police dramas, hospital dramas, reality shows, quiz shows, live sports, etc.
Electrical charges in transistors Multiple input devices like keyboard, mouse, touch screen, game controller, and multiple display technologies like computer screens, mobile device screens, digital or analog TV screens	Binary code ASCII code Audio and video codices Internet protocols HTML RSS Proprietary encodings (e.g., iTunes, Kindle)	Webpage Internet Protocol Television (IPTV) Electronic music and books in proprietary platforms	Shopping carts, navigation bars, headings Audio and video software players Page-turning and bookmarking in electronic "readers"	Retail sites, news sites, personal journals, university sites, online radio, search engines, etc.

word might have for different individuals (an eight-year-old child, a woman with twin babies) and subcultures (stereotypical Jewish mothers, Chinese mothers limited to one child), and in different contexts (the "mother of all battles," a "mean mother" of a convict). We build up these related but divergent meanings experientially and we decode the meaning of our sentences by referring to these specifically situated experiences.

Abstract nouns like "justice" require even more complex patterns of shared cultural interpretation. To explain what "dog" denotes we just point to Lassie and Fido. To explain what "mother" means in all these connotative contexts we might point to specific people in movies and news reports as well as in our own families. To explain what "justice" means we need an extensive system of shared **schema** and the ability to evoke multiple alternate outcomes and complex chains of events. Media help us to form these complex concepts by allowing us to organize our fluid culture codes into fixed units of meaning—sentences, manuscripts, diagrams, and rules—so that they can be externalized, shared, and refined. We need stability of inscription and transmission in order to focus our attention on what our words and images represent. New technologies and codes introduce new possibilities and destabilize older formats.

Design decisions involve all three levels of a medium—physical inscription, logical transmission codes, and cultural conventions of meaning. *In the digital medium, inscription and transmission technologies are constantly changing, subverting existing formats and opening up new design possibilities*. For example, digital technology has led to new kinds of mobile devices that contain degraded voice processing, making telephoning less reliable and harder to decipher, but opening up new uses for telephones as messaging devices, navigators, and cameras. Similarly, the shift from **analog** to digital television—from inscribing the image on the screen as analog lines to inscribing it as an array of pixels—has given designers higher resolution to work with, increasing the amount of information that can be included in the frame, rendering the standard remote control obsolete while multiplying the choices available to the viewer. Refinement of digital transmission codes can change the platform available for design. For example, the first versions of **HTML** (the transmission code by which programmers tell browsers how to display pages on the **World Wide Web**) did not allow designers to create tables on web pages. The extension of HTML to include tables allowed designers to format a web page as a **grid**, a big step forward in the visual organization of the web.

When inscription and transmission conventions become linked and standardized, designers can think in terms of a stable format (like a web page, a video compression codec, a music CD). When delivery is linked to specific hardware and software combinations, like a particular game console or mobile device with its own operating system, hardwired (inscribed and coded) chips, and input technologies (keypad, game controller, accelerometer) system, a number of formats, each with their own affordances and **constraints**, are fused into a fixed **platform**. The establishment of a stable

Figure 1.7
The Apple iPod device, iTunes software, and iTunes online store together make a stable platform for the distribution of music without infringement of copyright.

platform like the Atari 2600, the Macintosh operating system, or the World Wide Web is an important precondition for the sustained development of expressive genres like arcade video games, word-processing applications, or retail websites. Platforms usually require social and economic arrangements, not just technical engineering (figure 1.7).

Limiting design to a strongly branded, widely used format or platform can provide assurance of technical support and a customer base for a new product. It can save development time and provide useful constraints to design, limiting the scope of a project within manageable, familiar boundaries. Every established format and platform configuration has its own set of affordances and constraints, which the designer should consider carefully. Designing a game for the Nintendo Wii offers different possibilities and problems than designing the same game for a smartphone. It is best to postpone format and platform decisions until the functional requirements and expressive goals of a project are clearly understood. Designers should then survey available options and perform a competitive analysis by creating a table that summarizes the relevant features and limitations of each implementation strategy. Wherever possible, components of the project should be developed in platform-independent formats to increase the flexibility of implementation and delivery.

Although it is easiest to work with stable platforms—with established combinations of inscription technologies and transmission codes—*designers can also work with digital components to invent their own platforms.* Inscription can be shaped with the choice of input and output devices: keyboard, mouse, joystick, gestural controller, environmental sensor, computer screen, vibrating tactile device, projected images, directional sound, and so on. Designers can also establish their own standardized transmission formats, such as customized database tables and fields, specialized tagging conventions for digital **documents**, unique sets of bar patterns to be read by mobile devices, or new gestural codes for the control of multitouch screens or sensors.

Just as conventions of inscription and transmission become fixed in standardized configurations called formats, conventions in the representational layer (like newspaper headlines and bylines) coalesce into larger units of meaning that we refer to as **genres** (like newspaper news stories). Genres are sometimes tightly tied to specific formats (like print newspapers), but formats can support multiple representational genres (like advertising supplements, comics sections, television listing booklets as well as standard news pages) and genres can exist on multiple formats (like newspapers on line, or news reporting in print, radio, television, and web pages). The television sitcom genre and the game show genre both rest on the television format of the half-hour commercial television show, and they share common TV formatting conventions such as commercial breaks, intro music, credit screens, and so on. TV sitcoms and TV game shows can be thought of as media-specific genres. When we put a TV sitcom on the web, advertising and credit conventions are reinvented for the new transmission format. Genres can also transcend media. For example, a television sitcom might belong to the cross-media genre of romantic comedy, which exists on stage and film and has contributed to the plot of novels, poems, operas, and country songs. A game show belongs to the cross-media genre of games, which includes mystery dinner theater, radio game shows, and board games.

The communications theorist James Carey proposed the **ritual** model of communication as an alternative to the **transmission model** of **information theory**. In Carey's view, reading a newspaper cannot be understood as the decoding of logical code, but as the performance of a meaningful social ritual:

> A ritual view of communication will . . . view reading a newspaper less as sending or gaining information and more as attending a mass, a situation in which nothing new is learned but in which a particular view of the world is portrayed and confirmed. News reading, and writing, is a ritual act and moreover a dramatic one. What is arrayed before the reader is not pure information but a portrayal of the contending forces in the world. . . . The model here is not that of information acquisition, though such acquisition occurs, but of dramatic action in which the reader joins a world of contending forces as an observer at a play. We do not encounter questions about the effect or functions of messages as such, but the role of presentation and involvement in the structuring of the reader's life and time. (Carey 1989, 16–17)

A media genre is more than the organizing structures that allow us to decode the words; it is a set of practices by the people who create and consume it, and a context of interpretation in which it is understood. When we introduce new media formats or disrupt established inscription and transmission technologies, we are also disrupting the rituals that have formed around these artifacts. Television was blamed, for example, for disrupting family rituals centered around reading together or playing board games or outdoor sports; more recently computers have been blamed for disrupting the shared ritual of family TV viewing.

In a mature medium, we rely on familiar formats and genres to guide us in making sense of complex media artifacts. Because so much of our communication is in cultural codes that require experiential knowledge to decode, we need to have our attention focused on the salient parts of the communication. Mature media have developed elaborate conventions like newspaper columns, headlines, sections, bylines, and so on, to focus us on the most important parts of the communication. We recognize the kind of communication we are receiving because it has common elements with similar communications. We know what to expect of a commercial television program in general, and of a sitcom or a game show in particular because we recognize the common format and the familiar genres. Similarly, we know what to expect of a first-person shooter video game or a retail website because we recognize the format and the genre that provide the conventions of interaction.

In a mature medium, format and genre are well matched and reinforce one another. For example, television writers use commercial breaks to build suspense for the comic climax of the sitcom or the big-money question on the game show; newspaper editors use page position and headline size to indicate the importance of a story. In the digital medium, the mapping of a pointing device, like a game controller or a mouse, to a graphical user interface (**GUI**) has been foundational to establishing stable formats and genres by giving designers *a set of conventions for coordinating the attention of the interactor with the attention of the machine* (figure 1.8). The pointing system allows us to create icons that mean one thing to the human (a trash can, a Pac-Man figure) and another to the computer (a command to delete the addresses of particular places in memory, a change in a pattern of pixel display) but whose behavior is coherent to both.

Where existing conventions, formats, and genres are a good fit for the immediate project, it is the designer's responsibility to employ them and to refine them as necessary. Refining individual media conventions—how we open a file, how we choose the attributes of an **avatar**, how we steer a virtual vehicle, or what label we give to a database field, menu item, or website section—all contribute to the development of the medium as a whole. For example, the Lands' End convention of showing the back of a garment on rollover of a catalog image (figure 1.4) is a refinement of the rollover convention of merely displaying a text message. If other designers use it, it could become a standard feature of retail sites.

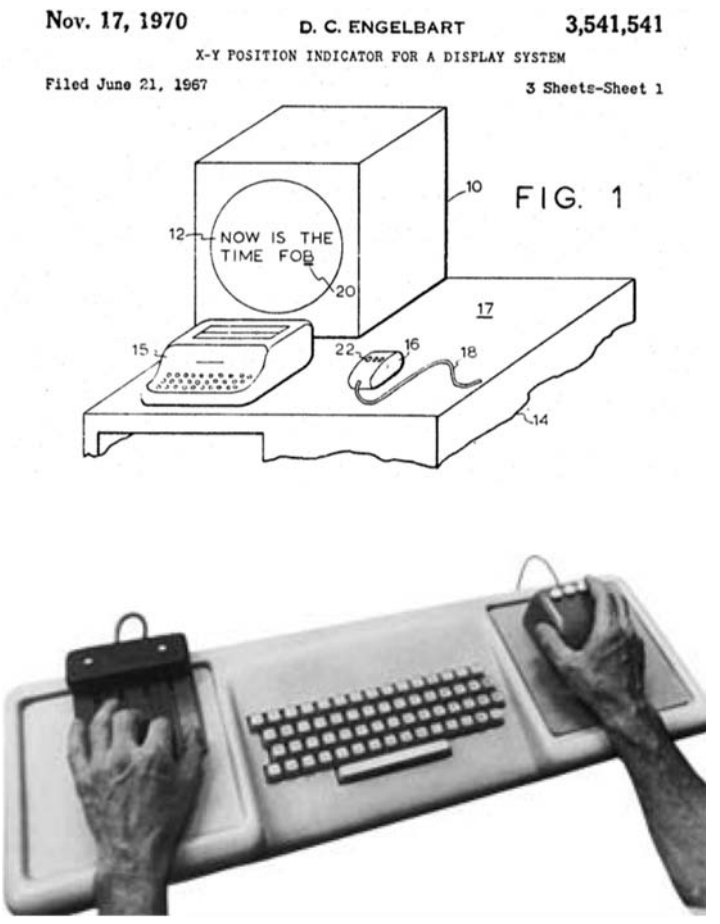

Figure 1.8
Image from the original mouse patent, filed in 1967 by Douglas Engelbart, showing it controlling a "tracking point" (cursor) on the screen, and a still image from Engelbart's public demonstration of his system in 1968 in which he is using the mouse with his right hand and a chording system similar to command keys with his left hand.

In an evolving medium, formats are unstable and genre conventions of older media are disrupted, making it harder to create expressive works. There is disruption of inscription methods, such as the confusion over nonstandard keyboards and the pressure to use telephone keypads to do the work of typewriter keyboards. There is incompatibility of transmission formats, between older and newer versions of devices or software packages, and between competing operating systems and compression technologies. These shifts in the underlying technologies make for disruptions at the

level of representation, leaving interactors confused about which conventions to employ to perform common tasks.

In addition, formats and genres may prematurely fossilize around particular devices or authoring applications that are widely adopted but soon become outdated. This can make for stable platforms that have the wrong functionality. For example, designers of CD-ROMs in the 1990s relied on an authoring system that was optimized for animation, thereby limiting the possibilities for interactivity in their projects. Genres that have large numbers of enthusiastic early adopters—like specialized business applications, social networking sites, or certain kinds of games—may standardize around these highly specialized user communities, creating conventions of interaction that are unnecessarily hard for novice users to learn, but that developers cannot change for fear of alienating their most loyal customers. It is therefore not always good design to conform to an established genre, no matter how many people are using it. Instead, an innovative design team could *take the longer-term view, and work to develop new conventions, formats, and genres that will better serve a broader range of applications*. For example, DOS, the command-line operating system for PCs, had millions of loyal users in the mid-1990s when Microsoft belatedly followed Apple and Xerox PARC by introducing the now-standard Windows interface. The fact that PC users have become habituated to DOS, a severely limited form of representation based on a more limited inscription and transmission format (e.g., no graphics, slower processors), seems in hindsight like a foolish reason for retaining it. Yet the current digital environment includes many similarly feeble and cumbersome interfaces—such as the television remote, the joystick-and-button game controller, and the form-based query systems for many relational databases (such as course registration systems in universities). Designers should be alert to opportunities to radically rethink familiar interaction patterns when they no longer support the transparent interaction necessary for the experience of user agency.

The digital medium is still in an immature state but it is evolving rapidly and unevenly, with some very stable genres and others still quite disorganized. It will continue to evolve and to experience disruptions and unexpected opportunities arising from changes in inscription and transmission technologies. *It is the designer's task to work at all three levels of media making—inscription, transmission, and especially representation—to accelerate the collective project of inventing a new medium by creating and refining the conventions that will bring coherence to new artifacts and enhance their expressive power.*

Designing for the Core Human Needs

The design process begins by asking: Who needs this object and for what? This question must be asked at three levels:

• *Function* How will specific end-users employ the product in particular tasks and activities?
• *Context* What social and cultural customs, relationships, institutions, and value structures does this product reflect or subvert?
• *Core* What deeper, enduring general human activities and values does this object serve?

It is simplest to frame a design problem in terms of known genres and formats and immediately observable functions. *But innovative design requires that we look beyond received opinion and familiar solutions to identify the deeper, cultural connections*. This method can uncover potential users and functionalities that might otherwise be overlooked and will help us to expand the design palette and to sharpen our design goals.

The designer's task must be in the service of specific human needs. A design is not good or bad because it uses a particular technology, makes money or fails to make money, or preserves or erodes a particular power structure. It is good or bad according to how well it serves a core human need whose value is larger than the immediate task. Examples of core needs would be: increasing understanding of complex phenomena, fostering the acquisition of skills, supporting works of the creative imagination, expanding communication across distances. We can recognize the core need (or needs) behind a design problem when it can be identified independent of the technology that currently supports it. We should not be focused on making an electronic version of a book, record collection, television show, etc.; we should be focused on serving the information, entertainment, or community needs that these particular books, records, television shows are addressed to, by rethinking those needs in terms of the affordances of digital media.

For example, if we are making an online newspaper with only a print newspaper as a guide, and a narrow sense of the end-user as a newspaper reader, then we might focus design on reproducing the masthead and the columns of the front page as accurately as possible. By shifting to a more open-ended assessment of needs, we widen our range of design choices.

• At the level of function, in addition to duplicating current coverage, we can look for unserved news needs of potential interactors, including those who do not currently read the newspaper (Do they want more local sports coverage? Are there local demographic or interest groups that would welcome more coverage?), and examine the likely conditions in which people would consume news in digital rather than paper form (on a mobile device in frequent, short bursts while out and about, or on a larger screen for longer periods?).
• At the context level, we would want to understand the role of the paper in the community it serves, and also how the switch to online publication would affect the social and economic structure of the newspaper organization. We would look for

the strengths of the paper in particular genres of reporting (political news? sports? lifestyle?), each of which has its own associated social rituals and media conventions.

- Most importantly we can identify the core human activities—the media-independent needs—that make newspapers important to us: our curiosity about what is happening around us; our need for speed, frequency, accuracy, and reliability in reporting; and our reliance on shared information to connect us to the communities we belong to.

By identifying the design task as furthering the media-independent core activity of news consumption, we can capture a wider range of potentially useful format and genre conventions. We can think historically and cross-culturally about oral news sources like town criers and barbershop gossips; print sources like letters, newspapers, and magazines; and broadcast sources like local and national TV and radio news, discussion, and documentaries. We can think about digital news genres, such as texting, webcasts, podcasts, aggregators, and blogs. This exercise reframes the immediate task, giving us *a larger palette of design conventions* to choose from, and helping us to see the advantages and liabilities of previous approaches. Framing our goals in terms of the core human needs also helps us to *prioritize design choices* so that we are not overwhelmed by all these alternatives. For example, in order to maximize the pleasure of satisfying curiosity we might increase the number of headlines and teasers we display, allowing interactors to choose which stories to follow, rather than limiting their choices with longer initial story segments or pop-up ads that block content. Knowing that news serves the important core human need of connecting us to others, we might prioritize popularity ratings or user-created content (like the neighborhood bulletin board). Or we might prioritize location-sensitive news bulletins to serve the core need for anticipating opportunities and dangers in our immediate surroundings (like the town crier).

Although it may seem obvious that we as designers should orient ourselves to the core human needs served by the artifacts that we make, in practice other forces often dominate. Because digital artifacts are based on changing technologies, the demand for new applications is sometimes driven by a delight in novel features or an appeal to the status value of the latest gadgetry. But *novelty cannot drive the design process* because whatever is new and fashionable today will be displaced tomorrow by a yet newer fashion. New platforms come and go quite quickly, while the development of interactive applications is necessarily slow. Solutions that only work on one device or that emphasize a single innovative feature risk seeming out of date by the time they are released, or losing users when the novelty wears off.

Designers should therefore resist the easy excitement that comes from merely employing emerging technologies. Technical experimentation is crucial to keeping

current in a changing field, but it should not drive the design process. A project that has no clear human need behind it may engage the skills of talented people, and may generate contracts for design firms, but it cannot be a focus for truly professional design because it will lack coherence. If you do not know why you are making something you will not be able to tell whether or not you are getting it right. *The designer's task must be grounded in the service of specific human needs: this is what gives the work clarity and direction.*

Advancing the medium does not mean choosing the newest platform to implement a project or adding in the coolest new bells and whistles. Such superficial advances may appeal to a forward-thinking designer and may get immediate attention, but they do not serve the task. Because newly introduced technologies are unstable, they are best explored for demonstration projects, in a research context like a university or industry laboratory; they are risky for projects that have to be done within limited time spans and which must work on a regular basis for a wide population of users.

Even if the new technology is stable, it is not helpful to use it if it distracts from the task served or meaning expressed by the artifact. For example, in the early days of the World Wide Web blinking buttons were an easily implemented, reliable, and therefore irresistible addition to websites. They expressed an exuberant embrace of the vitality of the new medium, but they very quickly went from being a **sign** of advanced skillfulness to the defining symbol of naive design. A clear focus on the expressive goals of your design can save you from similar missteps, while helping you to look for appropriate applications of new technologies. For example, a similar technique to the one that produced the annoying blinking buttons is now used routinely to rotate informational or promotional images on a home page, with each image linked to more information deeper in the site. The wise designer avoids employing novel technical formats—like blinking buttons—for their own sake and looks for the longer-lasting expressive uses—like the more slowly changing hyperlinked images—that might be built on top of them.

To avoid seduction by mere novelty, it is best to keep a separate playpen or scratch pad area for trying out new technologies. It is often a good idea to test something out as an alternate version of an existing project. Project leaders often make the mistake of testing out an innovation with phony data or filler content, but the expressive potential of a new format only becomes clear when it is implemented with real content, when it is measured against a specific human purpose that exists outside of the excitement of technological wizardry. Because the digital medium depends on interaction, *the true usefulness of a new approach cannot be assessed until it is mocked up with real information* that will provoke interactors to come up with specific expectations and actions.

Identifying the core activity is useful as a counterweight to technophilia and infatuation with mere novelty. It is also useful in coping with the opposite problem:

technophobia and resistance to change. Domain experts and design clients often define a task in terms of work patterns that have been shaped by legacy media. Users of consumer products can also be closely wedded to their familiar ways of doing things. Finding the alignment between the abstracted, generalized, core human need—something so basic that you can state it without any specialized jargon—and the particular digital design task often takes patience and hard work. Designers have to think about the needs of their users that lie beneath the particular artifacts and practices by which they currently go about satisfying those needs. For example, a group of scholars once asked me for advice on how to make a better scholarly edition of Shakespeare's works but became agitated at the thought that their end product might shift from a book to a digital artifact, such as a CD-ROM. They knew that the footnote on a paper-based page was a clumsy way of expressing the depth of research that went into a scholarly edition. Their own editions often separated the note from the text by several pages, or squeezed the text into a few lines per page in order to accommodate the dozens of lines of footnotes chasing after them. But an "edition" to them meant paper pages bound between covers. They were not thinking as designers, or even as scholars, but as members of a print culture with a deep attachment to the physical form of the book.

Designers should be prepared to encounter this mindset and they should be prepared to show appropriate respect for the core task—such as creating a variorum edition of a Shakespeare play or using a card catalog or "leaning back" to watch a conventional, noninteractive television program—while tactfully discounting panicky attachment to the physical formats of print and analog culture—such as an insistence on squeezing a complex, **multisequential** knowledge structure into the **unisequential** format of a bound book. Thinking as a designer means focusing on the core task of a variorum edition: the coherent presentation of centuries of commentary on Shakespeare's plays. This is a task that has a clear human imperative behind it, linked to the more general goal of expanding human knowledge and understanding. Focusing on the physical format of the delivery medium—the creation of a bound book or a simulated bound book (as in a PDF photo facsimile of each page)—distorts the design task.

There is always a temptation to use the digital medium as a means of duplicating the appearance and behaviors of legacy media. We can make an excellent facsimile of a book in digital form, and in some circumstances it can be helpful to do so. But it is a poor use of the affordances of the digital medium to create an artifact that must be paged through, and in which footnotes remain cryptic abbreviations, displayed separately from the items they are commenting on.

Addressing the core need may be harder for others on the team than for the designer. Clients often resist rethinking media structures that legitimize well-established professional distinctions. For example, expanding the available space for

commentary in a variorum edition reopens the awkward question of how the editors decide which commentaries to include and which to exclude. Such decisions may not be as easy to justify when space is no longer the constraint. Reconfiguring the database system of a complex organization, such as the index-card based catalog of a library, may eliminate some jobs, change the skill sets for other jobs, foster more open access to formerly closed information, or otherwise disrupt political and social arrangements. Changing the delivery structure of television disrupts the advertising model and therefore the revenue stream that supports the production of entertainment. The anxiety produced from such disruptions can make it harder to get a clear fix on the patterns of information and interaction that the designer most needs to serve.

Orienting oneself to the core human task provides the designer with a necessary corrective to the distractions of organizational politics and the fetishism of legacy formats, focusing design choices toward empowerment of the most enduring and valuable functions. Of course some clients may prefer outdated solutions. In that case it is the designer's job to make sure that the client understands the trade-offs. As a practical matter, one might try in such situations to help people move to the next comfortable stage of digital organization, such as moving the production of the variorum editions from shoeboxes of index cards into a uniform electronic database, or delivering the variorum as a book with a CD-ROM tucked into it. In that way, the integrity of the information is preserved in the eyes of the clients, by the production of the book, and also for the designer, by the digital organization that might one day support a better-organized digital version.

As we have seen, focusing on the core task can protect us against both the seduction of new technologies and the fetishism of older media. The scholars holding onto their shoeboxes of index cards are at the opposite end of the spectrum from the marketing manager who wants the latest bells and whistles on the company website. But sophisticated practitioners can also derail design by insisting on fitting each new project into their own favorite software or hardware framework. As the proverb goes, to a man with a hammer, everything looks like a nail. Designers should be skeptical of any project that begins with an implementation strategy. *Instead, we must discipline ourselves to begin by identifying the core human need, without reference to whether it is going to be served with bits or boom boxes or bowling balls.*

Identifying the core task may make it clear that this is not a problem that calls for a computer at all. Maybe the fundamental design problem is in the social, political, or information structure itself, and the computer will not solve the problem, only distract from it. Maybe the computer will even make the problem worse. For example, suppose that in a large liberal arts university, students are extremely bright and motivated, but 20 percent of the freshman class is getting poor grades in a required course. This course is taught by lecture; students can be seen at all the lectures, their eyes glazed over, and some of them asleep in their seats. Suppose that money becomes available to the university to offer computer-based education, and the instructor of

this required course secures some of the funds. His plan is to put his lectures on digital video and make them available from a web page in all student dormitory rooms. This plan presents itself as a simple design problem: make a web page that students can find with clear links to digital video. But if the underlying problem is how to improve student performance in the course, this is not a satisfactory solution. If the lectures in this course are not effective in person they are unlikely to be more effective when seen remotely. The digital design is doomed to failure because it is not an appropriate response to the presenting problem of the high failure rate. The same logic holds if the presenting problem is a failing newspaper or an unpopular television program. Adding "interactive" bells and whistles for their own sake will not make for a successful application, and such projects undermine confidence in the medium and in the work of interactive designers.

As the designers of interactive artifacts we are engaged in a collective task of inventing a new medium of representation. We cannot be satisfied with just reproducing older information formats in digital form, settling for mere **remediation** of the textbook, the lecture, the broadcast TV show, the paper newspaper. We have to think more radically. But we cannot redesign the world with every object we make. We have to accept the creative boundaries of the project at hand, such as resistant power structures, technophile or technophobe collaborators, preexisting platform commitments, and limited resources. Yet even on the most constrained project, the fully professional designer can make decisions based on the larger collective task. We can always do a better job with the immediate task by seeing it as a single step toward the development a future, more radical version. We can think of this future artifact as the endpoint of a collective journey, providing an orientation point, a general direction in which we are moving in the company of the larger body of designers, each of us at our pace and from our own starting point.

Orientation toward the core need and toward development of the affordances of the digital medium (as we will be discussing in chapter 2) can guide us even in creatively constrained projects. In the case of the boring college lectures, for example, we can design the underlying data structure so that it supports a more active learning style. Following good information design principles, we can semantically segment the lectures, labeling all segments that contain live demonstrations in a similar way so that they can be accessed by those students who will find them more effective than the whiteboard parts of the lecture. We can look for ways to link our project with those of other designers exploring more participatory learning tools. We can also steer the general design process in the direction of collective change by raising questions that orient the team toward the core human tasks and the expressive opportunities of the medium, preparing the way for more original projects in the future. Even if we use only a limited range of the representational power of the computer, we can remain fully professional by cultivating an awareness of wider possibilities, and doing our best

to orient the current project toward the collective goal of an increasingly mature medium.

DESIGN EXPLORATIONS: EXPLORING DESIGN IN A NEW MEDIUM

Increasing Awareness of Design Choices that Shape Everyday Experience

- In a familiar environment, such as a room in your own home, look at three or more manufactured objects and identify the design decisions that went into producing each one, including size, materials, color, shape; placement of buttons, functions of buttons; relationship to human senses such as softness/roughness, retention of heat or cold; relationship to other objects, such as size of shelves or counters the object sits on, size and shape of any of its own container compartments (e.g., pockets on an apron, oven size in an appliance), need for electrical or other energy source, and portability (e.g., can it fit inside a pocketbook? A car trunk? Can it be carried from floor to floor?). What trade-offs were made in designing it (e.g., capacity versus portability, pleasing appearance versus cost)?
- Choose a household object, such as a microwave oven or media-recording device or clock radio, that has been confusing to you or to someone you know. What design choices led to this confusion? Do you know of similar devices that employed alternate strategies for the same feature? How would you redesign the device to make it less confusing?
- Compare two cell phones that have different approaches to providing a keyboard for dialing a telephone number. What requirements and constraints were common to both design teams? What different choices did they make? What similar or different trade-offs did they make in order to fulfill the requirements within the constraints? How would you justify both design paths?

Increasing Awareness of the Cultural Traditions behind Familiar Media Conventions

- Take an aspect of a commonly used medium and trace its form back to a design innovation or design choice of at least a hundred years earlier. Report your findings in a brief essay, slide presentation, or interactive artifact. You may come up with your own example or choose one of the following:
  - The forms of printed letters (i.e., A a, B b . . .)
  - The arrangement of keys on a keyboard (e.g., QWERTY, telephone pad)
  - The image of a file folder in a computer operating-system interface.
- Choose a website you are very familiar with. What features and functions does it have that resemble older media? Does it have conventions in common with a pamphlet, newspaper, television show, social experience, or other nondigital cultural form (e.g., captioned images, headlines, list of contents, opening credits, rituals for greeting other people)? How are these conventions changed in digital form? What aspects of

the site are unique to digital media? What computational inscription and transmission technologies (e.g., mouse, links, HTML code) make them possible?

Differentiating Layers of Media Innovation

• Make a chart similar to table 1.1 for movies. What inscription and transmission code changes of the twentieth century changed the format of movies? What stable formats were important to the film industry as a business? What innovations in the technologies of inscription and transmission were important to the development of film art?

• Make a chart similar to table 1.1 for video games. Indicate important innovations in input and output (inscription) devices. What are some important innovations for mapping actions with the game controller to complex actions, like fancy fighting moves, on the screen (we can think of coordinated keystrokes as similar to Morse code, a symbolic transmission code for sending a message from the player to screen display)? Indicate important platforms and representational genres. What relationships do you see between changes to the inscription and transmission layers and changes in representation?

• Make a chart similar to table 1.1 for Internet-based formats and genres. What other inscription and transmission technologies can you identify? What formats and platforms have disappeared in the past five years? Which have lasted longer than five years? What are the most recent examples of a stable platform for building applications at the level of representation? What codes do they share? What genres have been built on top of these platforms (e.g., podcasts, blogs)? What conventions do they have in common? How have the underlying technologies shaped the level of representation?

Increasing Awareness of the Cultural Values Reflected in Design Decisions

• Choose a digital or mechanical artifact you use regularly and identify the cultural values that have shaped it. Does the design incorporate assumptions about privacy, space, leisure time, or other aspects of life that might vary across societies or groups? Does the artifact include features that reflect historical values, such as stricter gender roles? What activities does the artifact assume to be the most valuable? What related activities does it ignore or support less completely? How would the design be different if it came from a different cultural context?

• Microsoft and Apple make operating systems that have very similar functions, but users identify themselves with either the Windows or Mac similarly to the way sports fans identify with teams. Look at the advertising campaigns for Apple and Microsoft products. What values do each of these companies emphasize in their approach to potential customers? Do the designs of the Mac and PC systems reflect these different corporate values?

• Choose an artifact that you would like to see redesigned for a different demographic group. Identify the differences in experiences, expectations, and values between the two groups. How does the artifact reflect its current user group? How would it change to appeal to the new group? What features would remain the same across user groups? (Examples: How would you redesign a miniaturized music player so that it would be usable by the elderly? How would you redesign a shooting game so that it would appeal to pacifists or a cooperative game so that it would encourage competition?)

Increasing Awareness of Media-Specific Conventions

• Compare any two platforms for listening to recorded music (e.g., vinyl records and cassette tapes or CDs and MP3 players) or for watching television programs (e.g., digital recorder; broadcast, cable, satellite, computer, or mobile device; DVD player). What features and conventions do the two systems have in common? What features and conventions differ? How does the experience of the user change with the change in delivery medium? Consider capacity, playing time, ways of acquiring the music, portability, ability to share, privacy, noise, and so on. What conventions remain the same across platforms? What new conventions (e.g., for labeling, playing, storing, advertising, purchasing) were invented to take advantage of the affordances of new delivery formats?

• Compare a paper newspaper to a web-based news site of the same newspaper on the same day. What purpose do headlines serve in the paper version? Do headlines change in any way when they move from paper to the web? What is on the masthead of the paper newspaper? Where is the same information presented or the same functions served on the website? What new conventions exist on the website that do not exist in the paper version? What purpose does the menu bar serve? How was this purpose served in the paper version?

• Make a two-column table, similar to table 1.2, listing at least five inscription methods you have used in the past week and the task you performed with each of them. How appropriate is each method for its task? How are the specific affordances that made them appropriate?

Table 1.2
Inscription Methods

Task	Performed With
Bank withdrawal	ATM kiosk keyboard
Shopping list	Pen and paper
Appointment calendar	PDA stylus on screen
Slide presentation	Laser pointer and projection

Now invent an **algorithm** for randomizing the two columns in relation to one another and execute it. (For example, you sort the items in one of the columns alphabetically while leaving the other column as is.) You now have new pairings (such as a PDA stylus for making a bank withdrawal). How would you perform each of these tasks with the mismatched inscription system? How would the experience change? What would be the challenges for accomplishing the task? Would there be any advantage in the new system or any opportunity for an innovative approach to a familiar task?

• One of the marks of an immature medium is the need for the interactor to have to pay attention to transmission codes (e.g., telephone numbers) rather than the representational layer (e.g., names of contacts). For a week, write down every time you are confronted with a code that is meaningful to a computer but not to you as a human being. How would you redesign the system so that interactors did not need to focus on the transmission code?

Orienting Design toward the Underlying Human Needs, Not the Legacy Media Conventions

• Telephones have been in use for a century and a half, but have changed tremendously in the past twenty years. What core human needs do they serve? How were these needs met before the invention of telephony? What communication conventions and rituals made the land-based original telephone system coherent (e.g., assigning of telephone numbers, invention of the dial, ringing, new greeting rituals, human operators)? How did mobile phones incorporate these older conventions? What new conventions and social rituals have been invented for the new devices (e.g., dialing by hyperlink, custom ringtones for different callers, texting)? What needs have been met by these new features that were not met by predigital telephones?

• Identify the core human needs or activities served by one of the following: Google, Amazon.com, eBay, iTunes (or choose another widely used digital environment such as an instant messaging or social networking site). How were the same needs met before the invention of writing? How were they met before the invention of the computer? How has the activity remained the same and how has it changed as a result of the switch to the digital framework?

• Choose an example of a device or application that you find poorly designed. Analyze its design objectives in terms of core human needs. What design elements prevent it from serving those needs appropriately? Why do you think the design team made those unfortunate choices? What did they value more than the needs that you expected them to address? What other media artifacts serve these needs? Do they offer other conventions that might have been applied here? How would you redesign the artifact so that it better served the core needs?