Designing Innovative Reading Experiences for a Museum Exhibition

Rather than eliminating reading as many fear, digital technology actually facilitates a wide array of exciting and unusual reading experiences. A research team at Xerox PARC has created a museum exhibition that provides a glimpse into the future of reading forms and how we will interact with them.

Maribeth Back
Rich Gold
Anne Balsamo
Mark Chow
Matt Gorbet
Steve Harrison
Dale MacDonald
Scott Minneman
RED at Xerox Palo Alto Research Center

The Research in Experimental Documents (RED) group at Xerox Corporation's Palo Alto Research Center (PARC) is a small, multidisciplinary team that brings together researchers skilled in video production, mechanical engineering, interface design, architecture, cultural theory, sound engineering, cartooning, writing, lighting, programming, industrial design, and graphic arts to design and build real working objects and prototypes. It explores new document types and genres in emerging media through hands-on experimentation and technological innovation. At the same time, RED searches for projects that will have an impact on the real world, using public reaction to gain insight into the effectiveness of its projects. RED also observes itself, developing research and design methodologies that are particularly well suited to innovation through a process called "speculative design."

In 1998, the Tech Museum of Innovation in San Jose invited RED to develop an exhibit for its Center of the Edge Gallery. Located in the heart of Silicon Valley, the Tech Museum focuses on current-day technology rather than science. Most of the 250 exhibits in the museum's four major theme galleries are interactive and original or custom-made. Through fun, exploratory activities, visitors of all ages gain an insight into the process of innovation and the application of technology to industry and everyday life.

The Center of the Edge Gallery showcases cutting-edge technologies from the surrounding area's premier research laboratories, with exhibits that change two or three times each year. Interval Research Laboratory and AT&T Labs exhibited their work in the gallery in 1999. The RED group's exhibit, "XFR: Experiments in the Future of Reading," on display from 1 March through 4 September 2000, attracted more than 250,000 visitors. The XFR Web site is at http://www.thetech.org/xfr/.

For the exhibition, RED chose to address the relationship between reading and technology, in particular how digital technology affects nearly everything we read. Incorporating a range of research projects in development at Xerox PARC, the exhibit stimulates an awareness of the ubiquity of reading and its continued importance in the digital age. It also explores the range of exciting reading experiences made possible by new technology, from interactive readers to large-scale reading walls to dynamic narratives that change in response to reader input. Because the XFR show took place within the context of a modern technology museum, most of the exhibits are interactive and hands-on.

READING: AN ANCIENT TECHNOLOGY

More prevalent than the computer, electricity, or the automobile, reading remains central to our modern technological society. Reading is intrinsic to the ways we share knowledge, the ways we entertain ourselves, and how we manage our social, political, economic, and educational systems.

Reading continually adapts to technological and social change. Reading in the West once occurred primarily in public, performed aloud to groups—a practice that persists in several cultures today. Standing

0018-9162/01/$10.00 © 2001 IEEE

before his troops, Alexander the Great shocked them by reading a letter from his mother in silence. The soldiers had not known that such a thing was possible. Socrates condemned reading as a useless repetition of words without explanation. Until the advent of books, words created for the public appeared primarily on walls and monuments such as as those in the great European cathedrals, often in combination with images. Authorities during the Middle Ages considered the private, personal reading experience that we consider normal today to be unhealthy for the spirit. Instead, one person often read aloud to others—for example, during mealtime in monasteries.

Changes over time

As the practice of reading changes over time and across cultures, people's ideas about reading and writing also shift. Reading and writing are currently undergoing huge and often controversial upheavals.

The pervasiveness of digital technologies has transformed the creation of written language—its content, its genre, and even its physical embodiment. Even those who are still most comfortable composing longhand on paper usually write for the eventual computer-typeset page, which means that a computer-based transcribing and editing job lies ahead for someone. In most cases, only personal notes and letters are still handwritten, with home computers used increasingly for even these informal messages.

Electronic publishing

Several companies today offer e-books, handheld electronic devices with downloadable texts. Last year, an electronic publisher used the wireless application protocol (WAP) to make a 72-page novel, Sharon Hague's *The Faithfulness Myth*, available on a cellular phone in Wireless Markup Language (WML) format. Some cultural observers predict that as digital technology improves, we will access nearly everything we read through a single device, a process known as convergence. Whatever physical form that device takes—a PDA, a cell phone, an e-book, or some combination thereof—we will use it to read mail, books, magazines, and the latest news. The printed word will eventually disappear, the argument goes, to be replaced by electronic text (see http://www.wired.com/wired/6.07/ es_ebooks.html).

Far from limiting reading, however, digital technology makes reading more pervasive. The Internet has revolutionized communication, letting us read all kinds of text created by millions of people whose thoughts might otherwise never be recorded. In addition to books, magazines, and newspapers, we can now read clothing, electronic equipment, and even fresh fruit, all of which often bear labels and advertising (see http://www.parc.xerox.com/istl/members/nunberg/places3.html).

Physical form and interactive behaviors affect our interpretation of the things we read. Digital technologies do not restrict the physical form of reading devices; rather, they match it to the content of the text and thereby give it deeper meaning. The XFR show serves, in part, as RED's comment on the *anti*-convergent nature of text in the world. It is also an experiment in authoring form along with content, which allows ever more specific contextual interpretations of text and genre.

Digital technologies do not restrict the physical form of reading devices; rather, they match it to the content of the text and thereby give it deeper meaning.

REWORKING THE MUSEUM GENRE

RED approached the task of museum exhibit design as we do all our research: with deep attention to genre and a speculative gleam in our eyes. First, we identified a set of primary messages about reading and technology and decided to analyze the museum as the context within which to deliver these messages. We then spent time individually and as a group in science and technology museums, noticing subtleties in the exhibits' design and execution. We met with museum designers, consultants, and the staff of the Tech Museum itself, all the while developing opinions about what did and did not work. We also analyzed the exhibits already in place at the museum, knowing that our visitors would see the XFR show as part of the same journey on the same day.

We concluded that the show should feature hands-on, engaging interactivity. The exhibits would be experiential, with as little didactic content as possible. Because the museum's staff deemed the topic, reading, to be boring, we determined that the show must be, instead, riveting. In the museum world, prevailing opinion holds that visitors do not read and that a single exhibit can reasonably expect to receive only about 30 seconds of attention. RED deliberately set out to challenge this assumption.

The XFR show presented us with the opportunity to create not only the content, but also the entire form of the object that the reader perceives. We call this methodology "deep authoring" as it requires the author of a piece to create on several levels simultaneously. We used this method to author the physical form, interaction design, software architecture, and high-level content of the exhibits, with each aspect considered in the context of the others. Doing so offered the opportunity for deep engagement with visitors, communicating on several levels. Consequently, the visitor retention rate at the XFR show was considerably better than 30 seconds; at many exhibits, people lingered for five or ten minutes, often reading all of a piece's content.

In designing the physical form and spatial layout of XFR, we also sought to assuage the tension that arises when researchers expose their work to the general public, especially in a setting as demanding as a pub-

lic museum. By inviting visitors to assume the role of researchers, we encouraged them to consider unusual aspects of reading and to develop their own questions about the reading devices. The design metaphor of an idealized research lab captured the deep sense of possibility and of "inventing the future" that we find compelling in our own research (see the sidebar, "The Research Lab at Night"). RED also infused the design of the exhibits with a playful sense of exploration. We discovered that people will read at a museum when the activity, especially as it relates to technology, functions not just as the medium but as the topic itself: exhibit as signage.

THE EXHIBITS

The eleven exhibits on display at the XFR fall into three categories:

- *Augmented Books* expands the idea of the personal reader, the "book of the future."
- *Machine Reading* explores machines that do the active work of reading, then present the translation in sound or image.
- *Reading and the World* examines the history of reading, the varieties of its current proliferation, and experimentation in the world of book arts.

Augmented books

Augmented books experiment with different modalities, interfaces, and designs to discover how to reinforce the reader-author contract, adding depth without distraction. Examples include multiple modalities in the Listen Reader; alternative physical relationships to text in Tilty Tables and Walk-In Comix; and dynamic arrangements of text and images under personal control in the Speeder Reader, Fluid Reader, and Hyperbolic Reader.

Listen Reader. Interactive books often distract the reader rather than enhance the ability to read. The Listen Reader is an interactive book that heightens the experience of *multimodal* reading—reading that combines several sensory modalities such as sound, text, graphics, and tactile sensation—without interrupting the flow of the story. Sitting comfortably in a large chair with speakers mounted in it, the reader can, as Figure 1 shows, add sound effects and "conduct" background music much like a movie soundtrack.

By maintaining the look and feel of a real book, the Listen Reader also preserves the beauty of the book as token object. The design does not use an LCD or pixeled screen; instead, the Listen Reader prints images and text on special nontear, plastic paper. Digital technology is unobtrusively embedded in the pages and binding of the book, which is on a sturdy swing-arm table. Radio frequency identification tags sense what page the book is open to, while capacitive field sensors measure the proximity of the reader's hand to the pages. The Listen Reader sends information from these measurements to a computer that controls volume, pitch, and the sound samples associated with each page. Unexpectedly rich and evocative, the resulting deeply immersive reading experience provides the sense of a "magic" book (see http://www.parc.xerox.com/back/listen.html).

The Research Lab at Night

Steve Harrison and Maribeth Back
RED, Xerox PARC

One RED design tenet holds that physical form communicates meaning. At the XFR show, we wished to convey two main messages: Reading continues to be central to our culture, and understanding reading's many aspects is itself a kind of research investigation. We considered the first goal in laying out the various displays within the context of the gallery space. We chose the research lab's design metaphor with the second goal in mind.

We designed the XFR show specifically for the Tech Museum's Center of the Edge Gallery. Finished in dark purple, this 3,800-square-foot irregularly shaped gallery opens to the museum's atrium on one long side. The argument that the show makes about the ubiquity of reading depends on visitors' experiencing most of the exhibits, which we placed close to one another so that the similarity of materials and finishes would be mutually supportive. Because we considered the sequence of experience unimportant, we laid out the space to create a natural pull from front to back, encouraging visitors to circulate among all the exhibits. The configuration displayed a new world of reading, but one that logically extended today's world.

To reproduce the feeling of a research lab, we designed many of the exhibits to resemble laboratory benches. The signage system also used the same simple materials and finishes—unfinished aluminum extrusions held together with custom hardware and fill panels of translucent plastic or Formica-covered plywood. Using this system, we built most of the exhibition ourselves, using an outside fabrication company to build portions of only a few exhibits. We consciously avoided any theatrics in the displays that would suggest libraries, bookstores, or other traditional reading repositories.

We kept ambient lighting in the gallery low both as a practical matter—several exhibits use projectors—and to convey the feeling that scientists had gone home for the night, leaving their experiments running on the workbenches. This presentation drew attention to individual displays, encouraging visitors to look at and play with the many unusual devices and thereby share in the creative process of technology development.

Tilty Tables. A Tilty Table is a three-by-three-foot white square that rests on a metal podium. High-resolution video images fill the table's entire surface, giving it the appearance of a glowing screen. Pneumatic shock absorbers similar to those in cars let the reader tilt the table manually in all directions. As the reader tilts the table, an accelerometer sends information to a computer that controls an overhead video projector precisely aligned with the table. The images on the table surface change in direct response to the table's degree and direction of tilt.

A Tilty Table lets readers move through a large document, such as a blueprint or map, that would be both difficult and inconvenient to read if printed at full size. The table serves as a window through which the reader can view different parts of the document while lifting the table. Readers have the sensation of surfing or gliding across the table's images. In addition to making it possible to read extremely large documents in new ways, Tilty Tables explore alternative ways to use our bodies when reading and how doing so might affect the words' meaning. Standing and tilting a Tilty Table offers a significantly different reading experience than does sitting and turning a book's pages.

Walk-In Comix. Walk-In Comix delivers a short story in comic form, printed on a mazelike set of rooms and corridors as Figure 2 shows. The eight-foot-high walls, as well as parts of the ceiling and floor, display full-color graphic panels that users must stretch, bend, stand back from, and squint at closely to read. The plot and subplots of the story unfold in multiple directions, scales, and layers as visitors walk through the exhibit. Walk-In Comix explores the relationship between reading and architectural space. It questions how we might read differently and how writers would write differently if books were the size of houses and pages the size of walls (see http://www. parc.xerox. com/back/walkin.html).

Speeder Reader. People read printed words in *saccadic jumps*, a series of erratic eye motions around a page. The rapid serial visual presentation (RSVP) technique increases reading speed by lessening the need for such eye movements. Because words or short phrases continually flash in sequence in one spot, the reader doesn't need to move his or her eyes and refocus. People using this protocol can increase their reading speed from an average of 300 words per minute to as many as 2,000 words per minute. The problem with RSVP is that the reader, unable to shift between different texts, can easily lose track of what he or she is reading.

We designed the Speeder Reader, shown in Figure 3, to solve this problem. Similar in appearance to a car-driving video game, this device lets the reader press a gas pedal on the floor to control the speed at which words appear. On the screen where the car's front win-

Figure 1. The Listen Reader uses interactive sonic effects to explore the multimodal aspects of reading. Here, one child reads aloud from a Listen Reader while the others watch and help play music samples and other sounds.

Figure 2. Walk-In Comix is a graphic novel that tells the story of five teenagers who literally get lost in a world of text and can only find their way out by learning to read it. The exhibit's mazelike structure, which reflects the story's twists and turns, actually envelops the reader.

Figure 3. The Speeder Reader combines rapid serial visual presentation with a game-like racing interface to tell the story of a young girl's spaceship ride. A bright pool of tightly focused light draws attention to the speed pedal, which controls how fast words flash on the screen.

dow would be, sentences stream by, one word after another, at the rate of several hundred per minute. An onscreen speedometer indicates the "driver's" reading speed in words per minute. The steering wheel on the console lets the reader change lanes to reach a different word stream or story. A gearshift permits movement within each story by switching from one subheading to another.

The Speeder Reader merges the use of dynamic text with a familiar driving-control interface to give children a sense of excitement and fun while reading. At the same time, it offers adults a more intuitive interaction with RSVP's unusual text presentation (see http://www.parc.xerox.com/back/speeder.html).

Fluid Reader. Resembling a large touch-screen monitor tipped onto its side, the Fluid Reader displays an entire story, with small triangles next to some of the words. When the reader touches one of these triangles, the sentence breaks at that point, bends down, and grows a new ending; the old ending disappears. Many of these new sentence endings have small triangles that, in turn, lead to additional sentence extensions.

The Fluid Reader incorporates Fluid Documents technology, invented at Xerox PARC, which opens up text to reveal annotations and comments (see http://www.parc.xerox.com/istl/projects/fluid). Fluid text differs from hypertext in that the original text does not disappear from the screen; instead, it smoothly bends apart, then comes back together again on command. This capability lets the reader explore alternative readings within the same context. Unlike hypertext readers, in which the user determines how the story ends, the Fluid Reader provides a more contextualized narrative form. Similar to the way a good storyteller adapts to the audience, the Fluid Reader imparts deeper knowledge by adding new information in response to reader input.

Hyperbolic Reader. As Figure 4 shows, the Hyperbolic Reader consists of a long, octagonal box with a glowing screen at the end depicting a colorful graphical story. The story's structure is a tree with many branches. Each of the tree's nodes contains either a cartoon or speech bubble. Although parts of the tree can grow and shrink, the structure never changes. By pushing a joystick in front of the screen, you can control your place in the story, but you can't change it.

In a hyperbolic space, things get smaller as they move to the edge. The Hyperbolic Reader displays words and images at or near the center of the screen large enough to read clearly, while things near the edges remain visible but unreadable. As you move the trackball through this space of images and words, new parts of the cartoon world grow in size and move to the center while the rest shrinks and slides to the periphery.

Based on Inxight Corporation's (http://www.inxight.com) Hyperbolic Tree technology, originally developed at Xerox PARC, the Hyperbolic Reader explores different uses of two-dimensional space. Users can navigate conceptual space such as a descriptive passage, a narrative space such as a conversation, and actual physical space such as a house. The Hyperbolic Reader also examines the idea of narrative spaces that are neither linear, such as a comic book, nor discontinuous, such as hypertext.

Machine reading

In the two machine reading exhibits, a machine does the actual reading: A computer looks through a camera at text on paper, then translates what it has read into images or voice.

Glyph-O-Scope. Resembling a large microscope, the Glyph-O-Scope consists of a metal arm with a round lens view port mounted on it. On a workbench under the view port, you can place specially printed cards that show images and writing. Embedded in the images are slashes and back slashes almost too small to be seen by the naked eye. Invented at Xerox PARC, these DataGlyphs represent binary digital data (see http:

//www.xrce.xerox.com/showroom/techno/dataglyp.htm). A small camera inside the Glyph-O-Scope recognizes these marks, which a computer decodes into data. This data in turn tells the computer to project images directly onto the cards in very precise locations. While looking through the lens of the Glyph-O-Scope, which contains a half-silvered mirror, you can see the printed card and the superimposed computer-generated image at the same time. The image remains in place even if you turn or move the card.

The Glyph-O-Scope offers an exercise in computer-augmented reading, cryptography, and using hidden data. It also explores the possibilities of embedding digital "watermarks" in regular pieces of paper. A similar technique could be used to encode documents, blueprints, and photographs.

Reading Eye Dog. The Reading Eye Dog, shown in Figure 5, can read out loud books, newspapers, and other printed material placed on a stand in front of it. Two video cameras embedded in the metal dog's eyes capture an image of the material. A computer identifies which parts of the video image form text, and optical character recognition software determines the identity of each letter and puts the letters together to form words. Through a voice synthesizer, the dog speaks each word it has read or, if the dog does not know the word's pronunciation, spells it out. The user pats a button on the dog's shoulder to tell it when to start reading, processing, and speaking. LCD monitors on the front and back of the dog's body show the images the dog is "digesting" into shapes, letters, and words.

The Reading Eye Dog explores how new digital technologies can help visually impaired people read, just as guide dogs help the blind navigate the physical world. It also examines how the form of technology can affect our response to it, as the "Red Doggerel" sidebar describes. By shaping the reading device into a loveable companion, we made the exhibit alive, smart, and helpful.

Reading and the world

The WHYRL? exhibit highlights the place reading has in today's culture, the Reading Wall shows how reading has changed through the millennia, and the Book Artist's Studio shows how bookmakers continually develop and experiment with various forms of reading.

WHYRL? What Haven't You Read Lately? is a dynamic, captioned-photo essay about how language and text permeate the environment. The exhibit consists of two large, six-foot-high boxes with rear-screen projection systems. Each box holds a computer that contains more than a thousand photos stored as digital images. Photos, taken throughout the world, show text on everything from street signs to cereal

Figure 4. The Hyperbolic Reader tells the story of "Henry's World." Because the reading space is hyperbolic, words and images near the center appear larger than those near the edge. Although the story branches in several different directions, the reader can follow one pathway without losing sight of others.

Figure 5. The Reading Eye Dog uses optical character recognition software and a text-to-voice synthesizer to read out loud to visitors.

boxes to T-shirts. WHYRL? projects an image on the screen every few seconds in a meaningful but non-prescribed order.

Superimposed on these images, questions invite the viewer to think about how these words got there, who wrote them, and what their purpose might be. Above each box a sensor, similar to those used for burglar detection, determines a person's proximity to the screen. The computer uses an artificially intelligent program to choose which question to digitally superimpose on a given photo, based on the viewer's proximity. The closer the person gets to the box, the more personal the questions get. The exhibit invites the viewer to make sense of the juxtaposition of images and questions.

As an experiment in dynamic *epigraphic* (wall) reading, WHYRL? explores what happens when a reader's proximity to a wall changes the display. It also uses the photos to examine how to read writing taken out of context, how narratives form when such images appear one after another, and the role of image captioning.

Reading Wall. The Reading Wall consists of three massive, 16-foot-long panels that angle across the center of the exhibition space. Each wall displays a dense, printed collage of statements about the 25,000-year history of reading and writing. The exhibit's size serves as a dramatic metaphor of that long history. Large flat-screened color plasma displays mounted on a roller track on each wall can move back and forth. The displays roll directly over the printed collage, which forms a modern and expressive exercise in typographic design. As the monitor moves, it presents an electronic layer of information about key episodes in the history of reading and writing. The digital layer presents colorful photos, images, and additional information keyed precisely to the printed layer below it.

By laying out temporal information across physical space, the Reading Wall explores the possibilities of using wall writing to present complex information. It also experiments with the interplay between fixed, printed text and dynamic, digital text. Finally, the Reading Wall examines the tension between public reading in that everyone can see the wall, and private reading in that only one person can operate the moving lens.

Book Artist's Studio. Artistic innovations often become the norm. One way to anticipate reading's future is to observe bookmakers at work as they use state-of-the-art technology and equipment. The Book Artist's Studio provides a complete workshop in which artists who specialize in bookmaking demonstrate their use of both traditional handcrafting techniques and cutting-edge digital design

Red Doggerel

Mark Chow
RED, Xerox PARC

The ability to more easily create form along with content provides one example of how technology profoundly changes the nature of reading. Authors can now incorporate different fonts, graphics, layouts, and media in their work to change the reader's experience. For example, the shape of the children's book *Ellie Elephant*—an elephant with its trunk raised in happy greeting—communicates much of the book's message by itself, even before you open its pages.

The Reading Eye Dog, affectionately nicknamed RedDog, exemplifies a deeply authored form that began as a simple technology demonstration. We wanted to illustrate that a machine could read random pages of printed text aloud, a relatively straightforward task that involves combining optical character recognition (OCR) with speech synthesis. To keep the experience interactive and engaging, however, we clearly needed something more than a computer with a camera and speaker.

We considered a variety of forms—a black box reminiscent of HAL in *2001: A Space Odyssey*, a humanoid robot, or a mechanical Mother Goose—before settling on a robotic dog with a custom-machined headpiece. To match the look of other displays in the show, we constructed the dog out of 80/20 aluminum framing. We provided RedDog with reading material consistent with its whimsical appearance, including short, humorous poems about dogs and introductory text such as "Woof! I am a dog! Woof, Woof!" Because many children associate a synthesized voice with Stephen Hawking, we included a short biography of the famous physicist as well. For completeness, we added biographies of Ray Kurzweil, developer of font-independent OCR, and Alan Turing, who postulated reading machines nearly a half-century ago. We also interspersed famous quotes from history and technical explanations about how the reading by RedDog takes place, font recognition, and digital and optical resolution.

Like the rest of the XFR displays, RedDog gave us insight into how exciting and challenging it can be to create technology, genre, and content simultaneously. Visitors stayed longer than expected. Charmed by the incongruity of a robotic pet making utterances about serious topics, adults would linger just to hear what RedDog would say next. Intrigued by the dog, children would spend many minutes testing its reading abilities. Many people became curious about the technologies involved and would often propose alternative scenarios for RedDog such as "good for a children's hospital" or "just what my grandma needs."

tools. Eight artists from the San Francisco Center for the Book (http://www.sfcb.org) worked at the studio throughout the XFR exhibit. The working studio included high-end graphics software and hardware courtesy of Adobe Systems and Apple Computer, a high-quality Xerox color printer for printing pages, and a computer-controlled laser cutter from Universal Laser Systems that can cut paper into intricate shapes. The artists finished and bound their books by hand.

Visitors to the XFR frequently asked us when one or another of the exhibits will be available as a product. "Where can I get a RedDog?" they inquired. Although the XFR show did produce seven patents, we did not intend the reading experiences to serve as product prototypes or even predictions of what such products might look like. Rather, we designed these exhibits as tools to help us think about how reading might change and develop within our culture.

We continue to develop the XFR show, which will soon begin a three-year tour of museums and other venues. However, the show's original design does not provide for easy travel or adaptation to a variety of spaces. Thus, we must spend much time "hardening" the exhibits to meet the challenges of the road, in collaboration with a professional exhibit company.

Interviews and discussions with visitors indicate that the exhibit succeeded in its primary mission: It got people to consider the genesis of the text they read every day and to ask how technology might change what, where, and how they read. Informed by our experiences with XFR, we will continue our research into new genres and media forms. ✸

Acknowledgments

Jonathan Cohen, Maureen Stone, "Banny" Shilajeet Banerjee, Mark Meadows, Polle Zellweger, Jock Mackinlay, Bay-Wei Chang, Terry Murphy, and many others made significant contributions to XFR. Exhibition collaborators, sponsors, and supporters include the San Francisco Center for the Book, Chronicle Books, Atlantic Records, Apple Computer, Adobe Systems, and Universal Laser Systems.

Maribeth Back *designs, builds, and writes about new media genres and devices at Xerox PARC. Her research focuses on the interactions of technology, culture, and human perception. Her background is in audio engineering and professional theater; she received a DDes in advanced design studies from Harvard University's Graduate School of Design. Back is a member of the AES, ACM, and ICAD. Contact her at back@parc.xerox.com.*

Rich Gold *is an internationally known composer, cartoonist, and researcher who is currently the manager of the RED group at Xerox PARC. His research interests include ubiquitous computing, corporate identity within new genres, and "total writing." Gold is a Fellow at the World Economic Forum.*

Anne Balsamo *is a researcher and author at Xerox PARC. Her research interests include the relationship between culture and technology, the process and politics of the design of new media genres, and the relationship between new biotechnologies and gender identity. She received a PhD in mass communications and cultural studies from the University of Illinois.*

Mark Chow *is a video producer and educator at Xerox PARC. He received an SB in electrical engineering and architecture from the Massachusetts Institute of Technology and an MA in education from Stanford University. Chow is a member of the SMPTE and AES.*

Matt Gorbet *is a technology artist and researcher in San Francisco. His research interests include tangible interfaces and interactive environments. He received an MS from the MIT Media Laboratory's Media Arts and Sciences program. His online portfolio can be found at http://www.mgorbet.com.*

Steve Harrison *is an architect and current director of the Xerox PARC Artist-in-Residence (PAIR) program. His research explores next-generation multimedia communication and computing systems. He received an MA in architecture from the University of California, Berkeley. Harrison is a member of the ACM.*

Dale MacDonald *is a researcher, designer, and programmer of collaborative systems at Xerox PARC. He received an MFA in art practice from the University of California, Berkeley. MacDonald is currently president of the Asian American Dance Performances Board of Directors and a member of the ACM.*

Scott Minneman *is an architect and engineer at Xerox PARC. His research interests include interdisciplinary design, embedded systems, interactive video and robotics, and installation art. He received a PhD in mechanical engineering and design from Stanford University. Minneman is a member of the ACM.*