

Speeder Reader: An Experiment in the Future of Reading

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ABSTRACT

Speeder Reader is an interactive reading station built around two primary ideas: dynamic text (especially RSVP, that is, rapid serial visual presentation), and the interface metaphor of driving. As words flash one at a time on a screen in front of the reader, he or she controls the rate of speed of the words with a gas pedal (up to 1850 words per minute in the current instance). Text stream selection is performed with a steering wheel. Thus, one can “drive through a book.” We leverage people’s knowledge of the familiar activity of driving an automobile (or, in the case of children, operating a speed-racing video game) to allow comfortable and intuitive access to a possibly less familiar world of interactive text. We emphasize the power and ease of the familiar driving metaphor as a navigation device. *Speeder Reader* was first installed at the Tech Museum of Innovation in San Jose, California, as part of a larger exhibit on the impact of digital technologies on reading.

Keywords

Dynamic text, reading games, speed reading, Rapid Serial Visual Presentation (RSVP), interaction metaphors.

1. INTRODUCTION

Speeder Reader was originally designed as part of a six-month museum exhibit at the Tech Museum of Innovation in San Jose. The exhibit, titled *XFR: Experiments in the Future of Reading*, was designed and built by the RED (Research in Experimental Documents) group at Xerox PARC. It ran from March to September, 2000, with over 350,000 visitors during that time. In 2001 the *XFR* show began a three-year tour to other science and technology museums. The topic RED chose for the exhibition was reading and technology, and in particular how digital technology impacts nearly everything we read. The *XFR* exhibit presents a series of explorations in new ways of experiencing text, including new genres, new styles of interaction, and unusual media. Because the exhibit took place within the context of a modern

technology museum, the XFR exhibits are primarily interactive and hands-on, in keeping with many of the other exhibits.

1.1 The XFR exhibits

The *XFR* exhibits fall roughly into three categories: *augmented books*, *machine reading*, and *reading and the world*.

In *augmented books* we expanded on the idea of the personal reader, experimenting with different modalities, interfaces, and designs to discover how the reader/author contract can be reinforced to add depth without distraction. Some examples are alternative physical relationships to text, dynamic arrangements of text and images under personal control and exploration of how an added modality (sound, or auditory illustration) might affect the reader/author relationship.

The exhibits include a book that one plays like an instrument (*Listen Reader*), a drive-through book (*Speeder Reader*) and a life sized walk-through comic book (*WalkIn Comix*). *Machine reading* showed machines that did the actual reading of documents, through OCR (optical character recognition) or other visual analysis. These machines then interpreted the data they read into some other modality, such as speech or pictures. For example, a OCR-to-speech-synthesis system was installed in the form of a robotic dog (*RED the Reading Eye Dog*), which read aloud whatever was placed in front of it. *Reading and the world* allows visitors to examine the history of reading, the varieties of its current proliferation, and some experimental art in the world of book arts.

1.2 Analyzing the audience

The primary demographic we designed for was teens 10 to 14, although we tried to make sure that the exhibit language and presentation would be enjoyable and accessible for everyone, including younger children and adults. Though the topic of the exhibit is reading, many of the exhibits examine reading in conjunction with image or sound, providing some content for non-readers. The Tech gets about 700,000 visitors per year, representative of the general public

in San Jose, California. Many mixed-age family groups come through. Every morning and afternoon, waves of schoolchildren are delivered by the busload. After hours, the Tech is very often rented by Silicon Valley's high-tech companies for parties and receptions. This offers another interesting demographic: highly educated, technically savvy adults. We designed the exhibits to play on multiple levels: the 30-second "quick take" which is average in museum visitors, as well as a deeper level for visitors who became intrigued with the ideas and exhibits.

1.3 Museum visitor as researcher

The look and feel of the exhibit space aimed to reproduce the feeling of "the research center after dark," as though scientists have gone home for the evening, leaving their experiments running on their workbenches. The visitor could look at and play with the many unusual devices that the scientists have been working on. The visitor is encouraged to take on the role of the scientist/researcher, to consider unusual aspects of reading and develop their own questions about the reading devices. These exhibits were designed to encourage a playful sense of fun and exploration about reading. Signage for each exhibit features a provocative question and pointed out a few salient points about each reading experience. For example: "What if you had so many ideas they could fill a room?" or "What if you could walk right into the pages of a comic book?" For *Speeder Reader*, the question is, "What is it like to drive through a book?"

1.4 Messages of the XFR exhibit

Reading continually adapts to technological and cultural change. In some cultures reading is a social act, primarily performed in public; words are written on walls or in books that are read out loud. In other cultures, reading can also be private, a personal experience. The nature of that personal experience is always changing as well. Several companies now offer "e-books," hand-held electronic devices with downloadable texts. Cultural observers call this idea "convergence," where all text that one reads winds up being on one single hand-held device like a PDA, e-book, or cell phone. However, we observe that digital technologies, far from limiting the kinds of reading available in the world, actually enable text to migrate to even more objects and surfaces. In addition to books and magazines we read walls, clothing, electronic equipment. Even fresh fruit has labels and sometimes advertising on it. Digital technologies also enable the form of the reading device to match the type of the content of the text. A story about falling into a world of text is told on walls that surround the visitor with words; a story about travel is told on a device that looks like a vehicle. Thus, the XFR show is both a comment on the anti-convergent nature of text in the world, and an experiment in authoring form along with content.

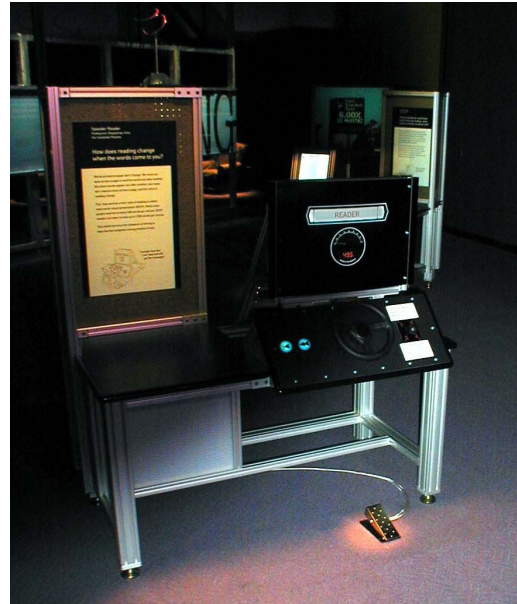


Figure 1. *Speeder Reader*, at the San Jose Tech Museum of Innovation, was one of eleven innovative reading experiences in "XFR: Experiments in the Future of Reading."

2.1 SPEEDER READER

One major point of the entire XFR exhibit is to associate a sense of excitement, fun, and personal control with the idea of reading. So, for *Speeder Reader*, we built a speed-racing interface onto speed-reading software. The exhibit, placed near the front of the gallery, attracted people (especially children) by its half-familiar game-like interface and brightly colored dynamic text.

2.2 Rapid Serial Visual Presentation (RSVP)

People read printed words on a page in "saccadic jumps," a series of somewhat erratic eye motions around a page. RSVP is a kind of dynamic typography wherein words or short phrases appear in sequence in one spot on a screen. As the words continually flash in one spot, the reader does not have to move his or her eyes, thus avoiding the saccadic jumps and eliminating the time used in moving and refocusing the eyes. With this protocol people have been known to increase their reading speed up to 2000 words per minutes (an average fast reader can read about 400-600 words per minute). RSVP (rapid serial visual presentation) was investigated in the 1980s as a presentation protocol for text [4]. It has been used in several products as a speed reading technology, and is sometimes used as a research tool by neurologists and perceptual psychologists. Other affordances of dynamic typography have been explored by a number

of people [3, 5, 6, 7]. In the final design of *Speeder Reader*, we were primarily interested in enabling the reader's words-per-minute speed. However, we did experiment with some more expressive mappings early on, with the idea that the reader could choose more or less graphically expressive typefaces. This is a promising path, but requires a longer learning period than most museum visitors will have.

2.3 The driving metaphor: navigation

One problem with RSVP text is how to browse it. How does one find different sections of content, play them at an appropriate speed, and replay them at will? *Speeder Reader's* interface allows personal control over all these parameters. The RSVP text is visible through a rectangular window in a specially designed monitor bezel (Fig. 1, 2). One navigates to different streams ("lanes") of text by turning the steering wheel, which moves the window to a different lane. A foot pedal ("gas" pedal) gives the user control over the speed of the text being displayed, up to 1850 words per minute. These are the two primary controllers, giving the user choice of text and control over speed of text. Several secondary controls allow a finer resolution of control. The stick shift can switch between different sections in the lane of text. A Cue button allows skipping backwards to set points in the text (beginning of last sentence, one button punch; beginning of last paragraph, two punches; preceding paragraphs, any additional punches beyond two). An accompanying Reset button starts the text over from the beginning.

2.4 Visual and physical design

Speeder Reader was built in 80/20, a type of aluminum framing often described as "an industrial-strength Erector set." Since we anticipated heavy use from enthusiastic pre-teens for six months straight, *Speeder Reader* was designed for ruggedness. We gave it a strong, four-legged "workbench" table, with the computer stored in a built-in box underneath and the signage attached along one corner. The game controller hardware was bolted onto 1-inch particle board covered with formica and cornered with soft black plastic.

Speeder Reader's visual presentation was multi-layered, in a deliberate attempt to blur the lines between the screen-based graphics and their physical surroundings. The graphics shown in Figure 2 were embedded behind four layers of thin materials with offset edges, to give a sense of depth similar to that in a dashboard.



Figure 2. Presentation graphics and physical overlay for *Speeder Reader*. Blue indicates the side-lit lasercut Lexan overlay; red and black, and the background to the text, are all screen display areas; white shows where physical layers of felt and black plastic (under the top-layer Lexan) block the rest of the computer monitor from view.

2.5 Authoring for *Speeder Reader*

Authoring *Speeder Reader* raised several points besides navigation:

Rhythm as punctuation: Content-appropriate rhythms can greatly increase both speed and comprehension in RSVP and other dynamic text. For example, titles or subheadings may be given greater temporal weight than normal text.

Type design: Appropriate typographical choices also aid in comprehension and speed. Characters may possess particular typographical characteristics; for example, sans serif fonts are more readily recognizable as they flash past; serifs seem to confuse the eye at high rates of speed. Or some words and phrases may be given more size or greater color contrast. Proper nouns, unusual words, and numbers are more difficult to recognize at high rates of speed; either type differentiation or timing differentiation can address this problem.

Narrative structure: We tried several different structures for the content. We settled on five lanes of text, with four subchapters in each lane (the four states defined by the gear shift). Each state in this content matrix contained approximately 1000 words, since we wanted people to be able to remain in each state long enough to get a feel for really reading in RSVP. So, the authoring task is a minimum of 20,000 words. We made a test model with dynamic use of rhythms, fonts and colors using several of Lewis Carroll's poems (*Jabberwocky*, *Father William*, *The Walrus and the Carpenter*, *Turtle Soup*). However, we wanted to tie the content of each of the XFR exhibits at least loosely to the physical form of the reading device. *Speeder Reader's* current content is a travel diary, a

fictional account of the travels of a young girl throughout the Solar System. As the girl visits each of five planets, she records salient facts and personal observations about it in her travel journal. Each lane features a different planet; each gear position is a new daily entry in her journal about that planet.

2.6 System design

All the devices, steering wheel, pedal, gearshift, and buttons are connected to an A/D converter which communicates with the host computer via serial line. A Java 2.0 program reads the serial information and converts it to actions in the program, thus affecting the text in response to user input. We use XML not only to specify the text, but also its layout and typographical qualities. Size, color, font, and background color of the text is determined in XML and is authored along with the content of each lane of text.

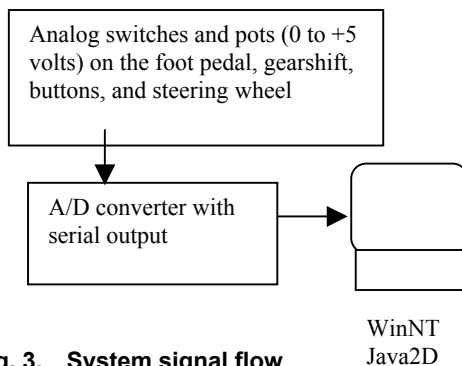


Fig. 3. System signal flow

3.1 Further iterations

Speeder Reader runs robustly and is popular with museum visitors. We are continuing our exploration of alternative content and iterations of the interface design. A Web-reader version of *Speeder Reader* is in development, as are some experiments with smaller, hand-held or embedded RSVP readers and RSVP readers as assistive devices.

As the XFR show left for its tour we found ourselves building demo versions of several of the pieces, including *Speeder Reader*. Since these demos were not necessarily constrained by the look and feel of the entire XFR show, we could iterate through some further design ideas. In the case of *Speeder Reader*, this meant embracing the video-game metaphor more fully, by moving the original hardware, software, and graphics into a video game housing. In the museum version, the “research lab at night” look and feel meant that *Speeder Reader* was installed in an aluminum framework meant to resemble a lab bench. Now, as a standalone object, the videogame form enhances the function of the driving metaphor: getting people to look for the interfaces they’d expect to see on a video driving game (such as the gas pedal).



Fig. 4. Iterating the physical form of *Speeder Reader*: the version shown at SIGGRAPH 2001 incorporated the original’s software, hardware, and content into a video game housing.

3.2 The AirBook

Another spinoff from *Speeder Reader* is a prototype we call the *AirBook*. It is an assistive reading device that combines dynamic text (especially RSVP) with force-free capacitive field sensors like the ones we used in the *Listen Reader*, another XFR reader, to create a simple, easily controlled assistive reading device. This reader is designed to assist people with visual disabilities (like dyslexia, loss of fine motor control or loss of contrast sensitivity) by giving them more control over font size and contrast. It’s also for people with upper-body disabilities, lack of fine muscle control, or severe arthritis, all of which can make the reading of standard paper books difficult. The force-free sensor system can be adjusted for large-scale motion or for tiny ranges of movement, and requires no pressure or fiddling with physical objects. The sensors read the proximity of a human limb, and adjust parameters on the text accordingly. For example, the reading device can be controlled with the motion of one finger if necessary, or adjusted to read the motion of an entire arm or leg.

Like *Speeder Reader* the *AirBook* emphasizes personal control; it is built upon the idea that both text and the device that is used to read it should be designed for the convenience of the reader, not constrained by issues like limited page space (which leads to small fonts) or the necessity to hold a book and turn its pages (which some people find difficult). The *AirBook* consists of a computer, a monitor and a tabletop interface which is two leather-covered sensor electrode plates (copper foil plates about four inches

square), mounted at a comfortable angle (about 30 degrees). The plates are connected to capacitive field sensors, which can track the proximity of anything conductive, including human hands and fingers. Although in this prototype the plates are surface-mounted to a table, they can also be mobile pads or small boxes that can be placed wherever is most convenient.

A reader sits at a table and controls the text as it appears on AirBook's computer screen by sliding her arms or hands along the stable table-mounted surface, until a comfortable reading speed is reached. Then no more motion is required, until the reader has finished. The range of motion and degree of control required is adjustable for the needs of each individual. Content can be anything that is parsable into XML format, including books, papers, or the Web.

4. CONCLUSION

Several of the XFR exhibits attracted groups of people as often as they did single individuals. It was not uncommon to find several children piled into one of the *Listen Reader* armchairs, for example, or to find clusters of children around *Speeder Reader*, *Fluid Fiction*, or the *Reading Eye Dog* (more details on these exhibits can be found at [1, 2, 8]).

All eleven of the XFR reading experiences were designed with the idea that form affects meaning, and in fact is inextricable from it. We found that by authoring the form as conscientiously as the content, we were able to achieve some unusual goals: getting people to read deeply in a museum setting, for example, and getting people to read socially, in groups, often aloud to each other. Interviews with visitors indicate that the exhibit succeeded in its primary mission: causing people to consider the origins of the text they read every day, and to ask themselves how it might be read differently.

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5. REFERENCES

- [1] Back, M., Cohen, J., Gold, R., Harrison, S. "Listen Reader: an electronically augmented

paper-based book." Proceedings of CHI 2001, ACM Press.

- [2] Back, M., Gold, R., Balsamo, A., Chow, M., Gorbet, M., Harrison, S., MacDonald, D., Minneman, S. "Reading the Future: designing innovative reading experiences for a museum exhibition." IEEE Computer, Vol. 34, No. 1. 2001.
- [3] Boguraev, B.K.B, Wong, Y.Y., Kennedy, C. Bellamy, R.K.E., Brawer, S. and Swartz, J. "Dynamic presentation of document content for rapid on-line skimming." AAAI Spring Symposium on Intelligent Text Summarisation, Stanford, CA, 1998.
- [4] C. Chao and J. Maeda. "Concrete Programming Paradigm for Kinetic Typography," IEEE Symposium on Visual Languages, Capri, Italy, 1997.
- [5] Ishizaki, Suguru. "Kinetic typography: Expressive writing beyond the smileys :-)" At the Vision Plus 3 Conference Monographs. July, 1997.
- [6] Potter, M. "Rapid serial visual presentation (RSVP): a method for studying language processing." Kieras and M. Just, New methods in reading comprehension research. Erlbaum, Hillsboro, NJ, 1984.
- [7] Wong, Y. Y. Temporal typography. characterization of time-varying typographic forms. Master's Thesis, MIT Media Lab, 1995.
- [8] See also <http://www.parc.xerox.com/xfr/> for more information on the XFR exhibits.