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Stories as Dynamic Adaptive Environments

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Stories are invitations to understand ourselves, our community, and the world around us. During a live conversation or performance, an active feedback loop exists between an audience and a teller of tales. The greatest benefit of the feedback loop is that it allows for personalization and individual learning. In computational modes of storytelling, the designer can promote feedback as a natural extension of the story situation by careful development of the story modules, by attention to the voice of the audience, and by introducing visible content frameworks. In some experimental works, strategies of "narrative guidance" and "society of audience" are juxtaposed in order to insure a more cohesive story experience.

We live in an age where what is new and innovative tends to obscure connection and continuity. Nonetheless, the age old principles of human storytelling remain essential to the ways in which we humans grow in our understanding of the world and of our own experience in that world. If we look at story across a range of invention—spoken language, performance, written language, print, movies, and television—we discover that new technologies have successively traded the dynamics of interaction with a teller for increased audience size and cultural longevity. What distinguishes the computational media from past forms of mass media is the potential of introducing audience feedback and personalization into the experience.

The behavior of a dynamic, machine-based system is governed by complex instruction sets that are authored by many people and contained within a box called a computer. Unlike the literary and graphic traditions, which focus on intuition and subjective craft, computing is a young science that takes most of its cues from mathematics, particularly the mathematics of transformation. While progress in building more flexible media-capable hardware and software has increased dramatically over the past decade, new story forms that are both engaging and sensual are just beginning to emerge.

Interactive media—as I understand the term today—implies that, in collusion with the viewer, the computer is exerting some dynamic control over run-time sequencing of the media content.

A Trail of Bread Crumbs

Few people would question that the Bible contains powerful stories that have provided generations of readers with a measure of our own morality and mortality. How can media make these stories more accessible and compelling? Attempts to transcode biblical stories into motion pictures often fail because the cinematographic representation does not transport the audience back in time. In movies, any flaw in continuity or cohesion due to an inappropriate detail in the set, the cast, the performance, the direction, or the editing, encroaches on the viewer's suspension of disbelief. In contrast to the movies, missionaries on radio and television work in a less error prone lecture format. However, while the translation from family elder or pulpit to a one-way television channel extends the potential for audience numbers, it lacks the personalization and feedback that live discussion enjoys.

The discussion style associated with the teaching of biblical texts suggests a very compelling but technically difficult model for new technology. However, the idea of actively associating ideas and leaving a trail which someone else can share has been a goal of hypertext systems for many years. It is in fact plausible that the Old Testament, while not explicitly discussed by Vannevar Bush, Douglas Englebart or Ted Nelson, did provide the tradition on which hypertext was modeled. In fact, Vannevar Bush's vision of hypertext (Bush, 1945) included the notion of "memory traces," traces which illuminated both the history of a single scholar's exploration, and the collaborative path of many scholars, through a library. The astronomical growth of material available on the World Wide Web attests to the powerful backbone of a standard file address protocol and the hypertext link. As individual researchers browse electronic materials, they can perform the function of an editor: evaluating the relative value of materials; discarding the irrelevant; collecting and connecting the relevant; attaching informed commentary to selected materials.

In addition, the Bible provided the computational community an exemplary non-linear text. Few people read the Bible from first page to last, without pausing. Rather, individual scholars, at every level of knowledge, take particular themes or stories and deconstruct them in order to understand their symbolism and extract their lessons. In a recent conversation with my sister Suzy Brooke, who has spent many hours reading and studying the Bible, we discussed trails formed by two themes of particular interest to her. The first concerns the theme of leadership and the separation of the stories of leadership from the exposition of laws in the Old Testament. Her trail began in Exodus where Moses looks up from his work, tending sheep, to

discover a burning bush. As Moses approaches the burning bush, God reveals himself to Moses, the shepherd, commanding him: "Don't come any closer. Take off your sandals—the ground where you are standing is holy" (Exodus 3.5 Contemporary English Version).

Suzy paused to explain that shoes were, at the time, a rare article of clothing and connoted human authority. She suggested that by taking the shoes off, Moses is putting aside personal selfhood, and accepting God whose name is "I AM THAT I AM" (Exodus 3.14). Now barefoot, Moses can walk with those he will lead without flaunting authority. Most of us will find this lesson compelling at some level. But it is the expert, the scholar who can lead us along the leadership trail. Suzy's bread crumb trail takes us through many scenes which allude to the difficulty of moving a generation out of slavery into freedom. Skipping Numbers and Deuteronomy, we arrive at Joshua who is able to make progress in the Law. What interests Suzy, as she moves into Kings, is how the notion of healing begins to emerge in parallel with governance by Law.

Current Technology and Non-Linear Storytelling

How well does current technology support non-linear storytelling? In the CD-ROM version of *Society of Mind*, we are introduced to Marvin Minsky as a lecturer as well as a seminal writer on the subject of how we think (Minsky, 1994). *Society of Mind* is formatted as an augmented book, replete with indexes and video lecture segments. The Minsky cut-out, who talks to us as we request his presence, helps make many of the ideas of *Society of Mind* more accessible. The navigation is consistent and fun, which makes our exploration enjoyable. However, what the experience of *Society of Mind* lacks is the society of audience, people gathering together to share insights which have awakened their thinking.

Bush's concept of hypertext included a human dynamic that is not fully functional in *Society of Mind* or in most CD-ROM titles. The concept of memory traces requires that the machine be cognizant of the bread crumb trail and, over time, make inferences linking it dynamically to other trails. The ultimate goal of the dynamic process, which allows us to explore, learn, edit, talk, test, and explore some more, is emergent knowledge. The bread crumb trail is built out of what others give us by way of knowledge and connections. It was this richness that Vannevar Bush felt could be captured by electronic hypertext.

Today, a vision of content links has been augmented by the programming of "social agents" which can search for similarity between large feature sets and generate on-the-fly a composite path, based on the exploratory roamings of many individuals. Agent-makers might choose to extract feature sets that reflect a specific special-interest community, as in *Firefly*, a commercial version of HOMR or Helpful On-Line Music Recommendations

(http://ringo.media.mit.edu/ringo/ringo.html). Under this approach, trends discovered within a community are repackaged as editoral expertise, which can be used to steer individuals through the larger information space. As the source and scope of the editorial voice changes, the development of social and intellectual groups may also evolve.

Bush recognized that a trail of bread crumbs served a powerful editorial function, and that a system could leverage common knowledge in order to grow new knowledge. Thus the electronic medium can be used to shape new societies, societies of people who have shared not only a text but the process of understanding that text.

Out of the Box into a Theatrical Space

What other forms might a transcoding of biblical stories take? One possibility would be to develop adaptive models of stories within the context of immersive participatory environments—both in the box and out of the box. Here I will review some story models we have built that include facilities for inter-player communication, and a clear and unique sense of navigating through place.

Two years ago, Larry Friedlander and I attacked the problem of creating a responsive physical environment (Davenport & Friedlander, 1995). In a collaboration with 20 Massachusetts Institute of Technology (MIT) students, we mounted a show entitled "The Wheel of Life." The audience experienced the environment as either "explorers" or "guides." The central idea was to create a collaborative interchange between the two players. In 13 weeks of rapid development and prototyping, we evolved three worlds: Water, Earth, and Air.

"Water" was instantiated in a 40-foot-high fishbowl-shaped translucent scrim on which images were rear-projected. (See Figure 1) By entering the space, an explorer initialized the story. Flung to the bottom of the sea by an enormous hand, the explorer found himself surrounded by singing fish, including a huge muslin-covered-rebar walk-in whale with a brilliant pink mouth. A guide encouraged the explorer to strike up a conversation with the whale using a compendium of visual and whispered cues. If the explorer could get the whale to sing, he was rewarded with a joyful rite of passage.

The story of "Earth" was inspired by Percy Bysshe Shelley's poem "Ozymandias." The "lone and level sands" were contained in a large rectangular enclosure replete with broken columns, an arch, and the ruins of a wall. Sensors detected and indicated the movements of the explorer. As the explorers entered this space, they were advised that through a process of discovery they could help restore these wastelands to life. Explorers were led from task area to task area by emphatic changes in the lighting and messages from a guide. In one interaction, the guide triggered short snippets of poetry, such as "it is the East and Juliet is the sun," which played in
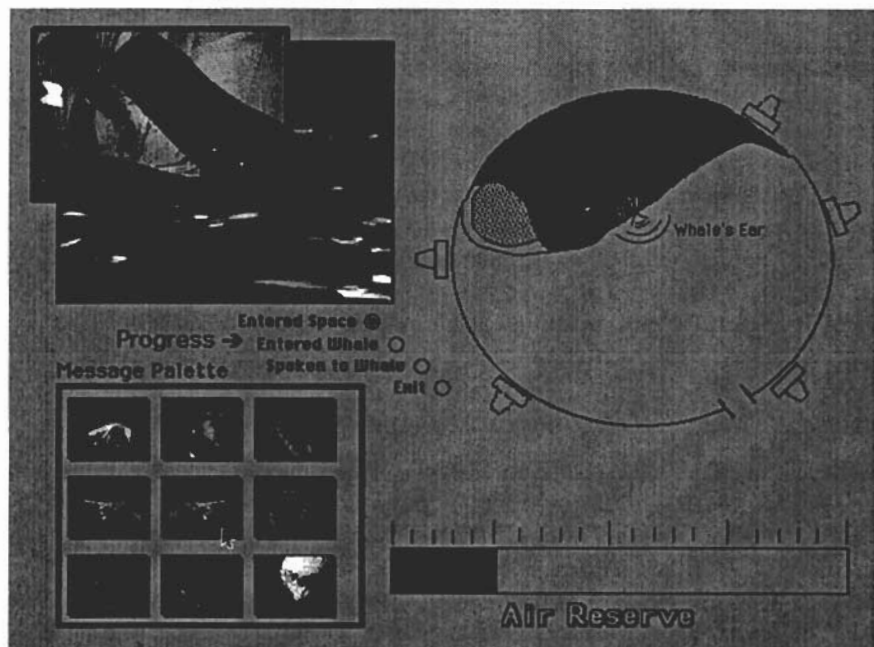
Figure 1: **Details from the virtual reality experience, "Water," in which the player questions a whale for clues. The images are rear-projected on a translucent scrim.**

small monitors buried within the columns of the arch. If the explorers deduced that these were disguised instructions to stand on the designated points of a pressure-sensitive compass set into the floor, their insight was rewarded.

The experience of "Air" took place in a large inflatable mylar spaceship that was caught in a red nebula. Five rag-tag crew members were distributed around the circumference of the ship. An explorer was encouraged to awaken them from their trance-like red state into their active blue state. Unless the explorer could transform all, the ship did not stand a chance of surviving. In order to free the crew, the explorer had to discover pressure sensitive spots in front of the monitors and had to activate these sensors in the correct order. True to an MIT fantasy, the guide had to master the concept of a video game before providing useful information to the explorer.

When one creates an unusual story, one learns a lot about what did not work. For instance, it was more difficult than we had expected for some explorers to situate the story—a small percentage of disoriented explorers never quite "got it." Temporally, because of the demands of audience size and throughput, we had to limit visitors to 10-minute explorations of each of the three "worlds," rather than letting them take whatever amount of time

they wished. Structurally, all of the interactions were simple and task-ori-
ented, and therefore lacked some of the magic that complex rule-based
transformations or other heuristics might have been able to provide. None-
theless, on the whole "The Wheel of Life" was very well-received. The im-
mersive participatory environment was lively and fun, and it inspired many
researchers to explore content in a new way.

Transformational stories require us to understand the psychology of
the audience. Why should I want to become involved in an interactive story?
Certainly not in order to click buttons, select icons, read menus or scroll
bars. Rather, I choose to participate in an interactive story to have an experi-
ence. The interface must be an integral narrative element of the story.

Two More Stories

The problem of creating an engaging experience in which the viewer
can participate has other pitfalls. In particular, the first person role of
"viewer as pilot" must be resolved against available limits in the story plane.
Recently at MIT, we created two stories to learn more about how we can
balance story, system, and audience control.

In *Dogmatic*, a virtual reality piece by Tinsley Galyean, a viewer is
free to look around a space from a given position in the story space (Blum-
berg & Galyean, 1995). The story consists of five scenes. To insure that the
viewer acknowledges the plot point in each scene, the story is based around
what we call a directable character. In this case, a dog is the directable char-
acter and is also the antagonist; the audience is the protagonist. The idea
behind a directable character is that it can operate on high level behaviors.
Therefore, if a story requires the participant to look in a particular direction,
the story could send a directive to the dog to stand in front of you and bark
for example. Throughout this noire story, the viewer feels that they are in
control, until they are not any more! (See Figure 2)

Lurker suggests another model for dynamic storytelling. It runs on the
World Wide Web, and was designed with two objectives in mind (Morgen-
roth & Davenport, 1995). The first requires that the story promote a style of
"thinking" in the minds of the participants; the second, that the story be
experienced by a community of participants. Six audience members are cho-
sen to participate each time the game is played. Each player receives e-mail
and takes on another identity: a rat or a monkey, for example. Each player
and all the characters in the story have home pages on the Web. The *Lurker*
story involves the disappearance of one member of the hacker community;
as a lurker, you, the audience, receive a call to arms to help the hackers find
the lost member of their group. As the story evolves, the lurkers are faced
with challenges that engage them in conversations with their fellow voyag-
ers.

The "society of audience" model provides a particularly promising avenue for exploration because it takes advantage not only of a new distribution channel but also of new ways of community building. The separation between fictional characters and audience in *Lurker* makes the interaction between real characters feel intimate and immediate; however, the separation must be conceptually structured or it could trigger some confusion on the part of the audience.

The Look and Feel of Things to Come

In thinking about transcoding biblical stories, one needs to consider that the new medium is as much graphical as it is informational. While I cannot go into the developments with regard to relational grammars and automatic layout here, I can say that work in these fields has evolved in the past few years and is important in the creation of dynamic stories.

In the world of infinite zoom, an effect inspired by Charles Eames and Philip Morrison in *The Powers of Ten* and implemented by Muriel Cooper and her students in the Visible Language Workshop at MIT, any piece of information has a home if you know its spatial relationship to other points of interest (Morrison, Morrison, and Eames, 1982). A modeled world could be all-encompassing and arranged as a stack or as a set of conceptual relationships, again a bread crumb trail.

When mapped to diverse texts, libraries, or cinematic story elements, dynamic graphical cues will become part of the language of interactive story. As we wander through the woods and fields in our first person reverie, spatial metaphor allows us to visualize the trace of our wandering, creating thereby a tool for non-linear access to a larger, more consequent story base.
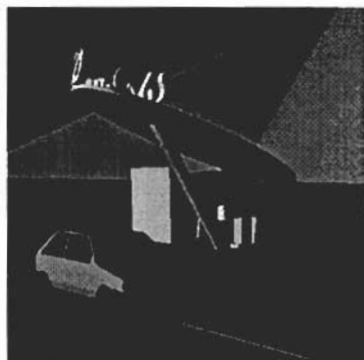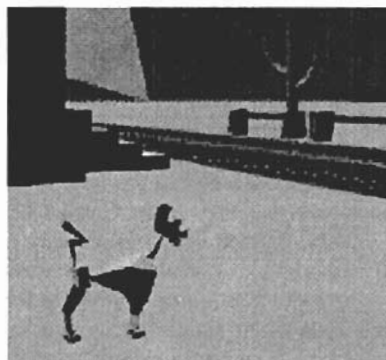
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Figure 2: **Scenes from the virtual reality experience, "Dogmatic," with the directable character of the dog.**

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