The Design Of Ethnographic Hypermedia

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ABSTRACT: Recent developments in computer hardware and software allow texts, documents and audiovisual materials to be stored as digital information and presented as integrated multimedia on computer screen. This paper considers the instructional opportunities of computer-based hypermedia for students of anthropology and the resources that hypermedia can provide to professional anthropologists. In an essay that appears earlier in this volume, I discuss the potential of hypermedia in ethnographic scholarship. The emphasis of the present essay is more pragmatic. It begins with an overview of the basic elements of hypermedia - databases, navigation tools and expert systems - and presents alternative uses to which they can be put. Despite the proliferation of Skinnerian models in computer-based instruction, a strikingly different educational philosophy may also be expressed (Delany and Landow 1991). This essay considers the benefits and hazards which the emerging "literary turn" in theory offers to the design of ethnographic hypermedia (Scholte 1987).

Specific design features of hypermedia are described through the presentation of one application, the author's work on the Ilparakuyo Maasai of Tanzania. Special emphasis is given to design-features of the program that integrate audiovisual field-recordings and texts. Maasai Interactive runs on Macintosh computer, is based on HyperCard 2.1 software, and will be distributed on CD-ROM.
I. Overview: Components and Problems

Because hypermedia is based on emerging technologies and is unfamiliar in most branches of research and instruction, it must overcome the skepticism of many users. Hypermedia's basic components (i.e., audiovisual and text databases, interactive search-and-navigation tools, and expert-system) have enormous educational potential. The essay first discusses these components. It then presents two alternative strategies of hypermedia-based instruction. Competing philosophies of education and of expertise lead to alternative designs. The essay concludes with a case study, the history, components and design of a particular project in ethnographic hypermedia, the author's CD-ROM based Maasai Interactive, currently in production.

Hypermedia's adolescence is precocious but troubled. Although computer applications can no more solve the epistemological problems of anthropology than can the media of which they are composed, they create an easy illusion of exhaustiveness and exactitude. In light of the diversity of anthropology's approaches and the complexity of its subject, caution with closure is advised. Some of the expertise that belongs in expert-system hypermedia should be used to resist over-simplification. Indeed, the resistance should not be difficult since hypermedia's power to annotate and qualify far surpasses that of ethnographic film. The power is sometimes abused, however, through the temptation of hypermedia to overwhelm its users with information-links and endless emendations. Maasai Interactive suggests a middle way. It offers a design by which scholarship is integrated into ethnographic film, neither undermining all perspective with a hyper-meteor shower of links and annotations nor promoting false insight with the illusion of closure.

a. Databases

Databases store information, navigation tools allow rapid access to it, and expert systems exemplify uses to which information can be put. Large, easily-searchable databases are therefore among the most important resources that computers offer the social sciences. In their more familiar incarnation as libraries, databases are a major component of anthropological research. Professionals and students must be familiar with a wide variety of library holdings. Like library bookshelves that hold texts, photographs, documents and audiovisuals, computer databases provide access to a variety of materials. Because databases make a large number of texts available at a single location, the computer screen, they save time spent searching through library shelves. Of particular use in the social sciences are CD-ROMs with specialized subject matter: these may contain texts that are too rare or arcane to warrant shelf-space in most libraries. CDs conveniently store materials that could otherwise be seen only through the help of inter-library loans or travel to non-circulating collections.

At present (1993), a single CD-ROM has the memory capacity to store about 640 megabytes of information. Although figures vary considerably (see II:d, below), this amount of memory permits one CD to hold more than 140,000 pages of text, or 8,000 6x7 cm. photographs of good resolution, or 15 hours of sound recordings at medium-resolution, or 90 minutes of video-and-sound at poor-resolution.

CD-ROMs and laserdiscs are currently the most popular technologies used in large hypermedia programs. Unlike floppy disks and hard-drives, CDs and laserdiscs can only be "read." That is, consumers cannot enter information onto them. Although this limitation is soon to be removed (Gussin 1993), alternative hypermedia configurations like Brown University's Intermedia already allow users to add to the database by networking with a mainframe computer.
The capacity to enlarge a database with new publications and even student papers increases its attractiveness and complexity. In the near future, comparatively inexpensive upgrades to writeable CD-ROMs will allow them to remain current with the disciplines they serve.

Many CD-based hypermedia packages include a floppy disk on which the user can store notes, the results of searches, records of progress through assigned audiovisuals and texts, and even course exams and papers.

b. Interactive Navigation and Search Tools

Among the principal attractions of hypermedia is the fact that it allows users to concentrate on intellectual relationships between multimedia documents by allowing users to study related documents together on one computer screen. A hypermedia document, a "collection of data that is related or linked to another body of information," is called a node (Seyer 1991:13). Designers of hypermedia are like the creators of hard-copy reference works, bibliographies and card catalogues: they are experts in the subjects covered by multimedia-nodes in their databases. Designer-experts know that certain relationships between documents will be of importance to many users, and they embody their expertise in the hypermedia program by making such relationships known. Designers create what are called permanent, electronic links between the related nodes of information. The existence of a link can be indicated on-screen in many ways, the most common of which is to place icons, called buttons, beside linked keywords in the documents. When hypermedia-users activate a link in a first node, by executing a mouse-click or keystroke, they are navigated to a second, linked node. The latter appears on screen beside the first or in its place. Hypermedia effortlessly crosses databases and thus make possible the integration of different media.

Electronic buttons were rarely employed in first-generation instructional media because these applications were generally based on Skinnnerian models of learning. Students' progress (or navigation) through a lesson plan was unalterably linear. Students' mastery of a subject was evaluated through responses to "objective" tests, whether multiple-choice, true-false or single-answer.

The concept of interactivity in computer applications developed historically as an alternative to the behaviorist dependence on linear instruction and belief that short answers to predetermined questions were the only viable measure of mastery. Interactivity in a hypermedia application is understood as a measure of the extent to which the application allows users to pursue many alternative, non-linear paths, either to predetermined instructional objectives or to the users' own research goals. The number and variety of links between different nodes in a hypermedia database are important criteria by which interactivity is assessed.

Permanen t links between related documents, and the buttons that indicate their existence, are created by designers and are therefore finite in number. Users of open-system hypermedia, however, may themselves independently uncover and explore many more relationships. Users may create their own temporary links between the nodes, and cause the linked documents to be presented together on screen. Users can discover new relationships and can temporarily link the related documents through hypermedia search tools. The sophistication and efficacy of these tools are further measures of interactivity in a hypermedia application.

Users' independent searches may begin with author-, title- or subject-queries, single words or phrases sought in the keyword-indices created for each database. When too many nodes are found to contain a keyword, irrelevant items, called false hits, may be eliminated through the use of Boolean, multiple-keyword, searches— and, or, not, nor and exclusive-or. Like a user's
search in a card catalogue, Boolean search-tools employ the users' own keywords. Unlike bibliographies and permanent links provided by experts, Boolean searches explore the users' assumptions and guesses of relevance. As such, Boolean searches allow users to make unprecedented discoveries about the relationships between multimedia nodes. Such searches may also be extended through the use of fuzzy-sets which locate the presence of keyword-synonyms and roots.5

All links which designers have placed in open-system hypermedia applications may be displayed simultaneously on screen with a graphic image called a web-view (Landow and Delany 1991) or browser (Seyer 1991:23). Web-views usually emphasize the reason that nodes have been linked (by identifying their shared properties) and web-views provide navigation to all nodes that are displayed. Individual documents are often linked to many others. Web-views therefore are non-hierarchical and can be displayed in many different transformations. Any one keyword or document may be depicted as the center point in a web of nodes to which it is related. Database index searches may also allow users to create their own web-views of found documents.

Another navigational tool, called the retrace function, presents users with a record of each information node that they have accessed since entering the hypermedia program. Neophyte users often fear becoming "lost in hyperspace," losing their bearings in vast databases and being unable to remember where they encountered information. The retrace tool provides a small web-view of the user's travels and offers the means to return to any node.

Finally, a few hypermedia applications include guided tours with proposed travel itineraries. As part of establishing their instructional objectives, tours familiarize users with the application's search-and-navigation options. Tours help users to gain the expertise that will permit them to leave the tour and begin their own independent scholarship.

c. First Generation Expert Systems

Computer programs that duplicate the performance of human experts in solving problems are called expert systems. The design of expert-system programs begins with the assumption that humans are successful at achieving particular goals because they have mastery over a spectrum of information and can retrieve necessary parts of it as needed. Databases and search-and-navigation tools are thus important components of the artificial intelligence that goes into expert-system design. These, combined with the computer's capacity to perform high-speed binary calculations, made possible the first generation of expert systems.

In medicine, available funding and the nature of the subject matter stimulated the creation of some of the earliest expert-system applications. Procedures employed by expert diagnosticians were analyzed and modeled, an activity which took thousands of hours to complete. Software and databases were then combined to duplicate expert diagnostic procedures. Expert-system applications of this type progress toward a correct diagnosis by eliminating incorrect binary alternatives or branches. The systems also contain feedback loops which catch misdiagnoses and correct them. Such models can be used as expert consultants to physicians.

Much of the same knowledge-base can also be used in the education of medical students. Very sophisticated expert systems have been designed to represent the reactions of patients, with specific medical problems, to tests and medications (e.g., Actronics 1993, DAROX 1992). The computer simulates a patient, presents his condition to a medical student, and responds as would the patient to whatever questions, tests or medications that the student suggests. If the student acts too slowly or prescribes improper treatment, the simulated-patient can "die."
In the social sciences, too, a number of applications simulate expert consultants who assist in the discovery and application of pertinent data. In one, the user plays the role of a United Nations representative who wishes to win ratification of a pollution-control treaty: this diplomat seeks information from many sources, including experts (Gamble and CBEL 1991). Similar programs insert users in the midst of historical dramas, make available advice, and offer realistic choices: alternate paths open before each decision, on the basis of which the user fares well or ill (True 1992, Collegium... 1992). These applications are fascinating and suggestive, but they leave much unsaid about expertise. To appreciate alternative models of expertise, one must understand the design-limitations of the first generation.

Keller (1987) makes a generalization about first-generation expert systems designs which well applies to the applications described above. The designs must meet three criteria: 1) the problem to be addressed by the simulated-expert requires a limited knowledge-base for its solution; 2) the data required for the solution of the problem contains no ambiguities; and, 3) the correct or best solution to the problem can be agreed upon by all experts. Keller's criteria have a strong behavioral accent, but expert system applications which are based on them do assist in the mastery of many kinds of expertise, such as the establishment of correct medical diagnoses or the comprehension of international diplomacy. The behaviorist interpretation of expertise that is exemplified in these applications is also valued in a number of contemporary social scientific paradigms. The latter, too, can boast of their own achievements, however reductive their philosophy of knowledge and expertise may be.

Limitations of the behaviorist interpretation of expertise are not difficult to identify. Experts in the social sciences cannot often satisfy Keller's first criterion for a closed knowledge-base. Anthropologists must weigh many theoretical approaches and recognize countless influences on the phenomena they study. Their knowledge-bases must always be open systems. Keller's second criterion, to avoid unquantifiable ambiguities, is also often impossible to meet: the data required in many social scientific analyses is partial, contextual, impressionistic, and ideological. The reality of such data may depend on nothing but belief, but it has profound social consequences. Finally, the third criterion is more wishful than accurate. Few conclusions in the social sciences are considered to be "correct" by all experts. Many paradigms are mutually-hostile. Even within a single paradigm, experts often select conclusions because they are appropriate in a given context, at a given time, rather than because they are correct in an absolute sense. Surprisingly, there is no denial, even from strong proponents, that the behaviorist model of expertise falls short of the human original. Expertise includes such imponderables as style, grace and creativity, behaviors which at least presently defy computer simulation (Bateson 1972).

d. Alternative Expertise

Computer-based hypermedia can reflect many different educational philosophies (Gagné 1987). The open-system design (mentioned in section 1:b, above) represents a philosophical break with the behaviorist assumptions of first-generation expert systems. Behaviorist simulations keep the hierarchical logic of their search-and-navigation trees transparent to the user. Open-system hypermedia is anti-hierarchical, specializing in the exhibition of all possible web-views. Open systems lay bare their nodes and webs, emphasize historical and intellectual movements, point out the common problems and competitive approaches of many scholars in one discipline. To those who can comprehend, web-views represent the paradigmatic knowledge-base of disciplinary expertise.
Open-system hypermedia also de-emphasizes the authority of the individual expert (including the designer), and thereby helps to redefine the scholar's task and self-conception. Scholars, offered a textbook without a binding, are urged to conceive of their works as merged with those of others. Hypermedia readers become more "writerly" (Barthes 1978: 4-6). The distinction between author/authority and reader/recipient becomes less tenable (cf. Landow 1992).

Open-system hypermedia does not offer over-simple answers or single destinations, but it may be accused of proliferating overwhelming opportunities. Open-system designers justify this *embarras de riches* on the grounds that paradigmatic alternatives are the warp and weft of expertise in the postmodern age: documents exist in anti-sequential, decentered, authorless space. As Landow and Delany (1991:6) quip, "Hypertext creates an almost embarrassingly literal embodiment" of postmodern critical concepts.

Unlike its behaviorist forebears, open-system hypermedia is rarely oriented to lesson plans or problem-solving role play. Its alternate vision of expertise is communicated largely in its designers' selection of database entries and in the links that designers create between them (Rada 1991:145). If an open-system application indiscriminately adds and automatically indexes new documents, the guidance that would otherwise be available from an expert designer will be diminished (cf., Yankelovich, et al. 1985, Yankelovich 1991). Many of Brown University's Intermedia applications (discussed at length, below, in I Ie) are acephalous: users are frequently left to their own devices. They must contend unguided with ambiguities, undifferentiated paths and textual contradictions. Yet the dangers of open-system hypermedia also exist in any library, and libraries have been judged worthy of the risk.

Like other technologies, hypermedia leaves unkept modernism's promise of redemption (Angus 1989:96). Paradigms struggle within it. Although the expertise in open systems does not aspire to the false optimism of behaviorism, it may add to the fragmentation of postmodern scholarship.

The second section of this essay proposes a middle way for hypermedia. It suggests that, by providing some guidance, open-system hypermedia need not overwhelm its users. Guided tours and recommended pathways can assist the first-time user through the maze of juxtaposed multimedia. The tour guide proposes optional interpretations, softening blows which sometimes lurk in texts. At the same time, *Maasai Interactive* is left open for independent scholarship. Search-and-navigation tools allow users to quit the tour and begin to emulate the expert tour-guide's method.

e. Difficulties: Financial, Technical, "Spiritual"

No overview of hypermedia for potential designers would be complete without mention of its unique combination of liabilities. From a funding agent's point of view, hypermedia is new and largely untested. It is expensive, requiring a considerable amount of labor to create. The computers that hypermedia needs to function are rather costly and sometimes unavailable. More than this, many hypermedia applications which present themselves as serious interactive learning tools are little more than video games or computerized Skinner Boxes: these multimedia toys give legitimate efforts a bad name, increasing the difficulty of convincing funding agencies that investment in such projects will benefit scholarship. Funding agencies regard hypermedia with suspicion and, with important exceptions, are reluctant to invest funds in its development. Hypermedia's conceptual and technical advancements are thus principally the innovations of commercial vendors.

Hypermedia's usefulness for instruction is also lessened by a number of technical problems related to the computer screen. Rada (1991) lists several. He begins with a discussion of
experiments that contrast student work on a small screen with work on a screen that was almost 50% larger. He writes:

the larger screen consistently supported better reading and writing behavior (Hansen and Haas, 1988), but was not as good as paper. Text on computer screens can take 30 per cent longer to read than text on paper with roughly equal comprehension (Shneiderman and Kearsley, 1989). If the studies include the confusion over page-turning commands and anxieties that some users have in reading from a computer, then the time required to read a text on the computer can double relative to the time required to read the same text on paper [Rada1991: 13].

In addition to these problems, a few people aver that texts reproduced on computer screen are completely impossible to read. Although this is an exaggeration, it is true that computer-born texts cannot, currently, without great expense, be carried around like a paperback and perused in any convenient location.11

Hypermedia also entails what might be called "spiritual" difficulties. Computer searches and electronic media cannot always improve on the services provided by the library. As access to library books becomes increasingly limited, replaced by the CD and electronic text, advantages of browsing in the vicinity of a favorite catalogue number will be lost. Users of electronic media are deprived of a perspective on antiquity and humanity that is preserved in dusty stacks. Users who compose their texts on computer screen also lose perspective: every draft of an electronic text appears perfect, no matter how rough it is. Reworking clean drafts gives time for insight and reflection. Reworking text on paper leaves a trace of history (c.f., Lyman 1984, Garson 1989).

Despite hypermedia's many problems - despite even the fear that it seeks someday to make academic teaching obsolete - hypermedia presents an ideal to anthropology that is difficult to ignore. It promises to integrate, for the first time, all of the teaching tools that anthropologists use to pass their discipline to the future. The thought that this ideal might be reached makes the limitations of earlier media less easy to reconcile.

II. Maasai Interactive: A Case Study in Ethnographic Hypermedia

Like any work in hypermedia, Maasai Interactive [henceforward, MI] was shaped by its financial history, its particular mix of audiovisual recordings, and its platform and authoring system - in this case, Macintosh and HyperCard. The project, too, must conform to the memory limitations of its medium, a single CD-ROM. In the following, I describe how these factors influenced the development and shape of MI. I then discuss the project's screen design, its databases, navigation tools and expert system.

a. Financial History

The tape recordings and photographs used in MI were made as the audiovisual component to a text-based dissertation in cultural anthropology (Biella 1984, 1988). Funding for the 1980 fieldwork, the filmmaking, the processing, and the translations was provided by Temple University and my family. Eleven years later, I approached Apple Computer with a proposal to apply the material to hypermedia. I received one of Apple's grants to individuals, a powerful Macintosh IIci and an image-scanning device. Other efforts to raise hypermedia post-production funds have, thus far, failed.12

Figure 1 estimates the man-weeks and cash expenses (past and anticipated) used in the creation of MI.13 I do not translate weeks into dollars because of the common failing of
The production of hypermedia is extremely labor-intensive. Assistants can perform many essential functions, but Project Directors can expect to be busier than if they were writing a book. Yet the interpretation of Figure 1 requires the following caveats, important to those who would use its data to estimate the costs of their own hypermedia productions. First, Figure 1 cites a total of 70 weeks of my time as Project Director consumed in the creation of MJ. A full third of that time contributed equally to the creation of my dissertation and several publications. Thus, anthropologists who undertake hypermedia projects need not be so consumed by them that they are prevented from performing other professional activities. Had labor for this project been funded even at a moderate level, its cost would have exceeded $100,000. Instead, my own work was complemented by the unpaid contributions of many others—colleagues, students, and family. The project is still incomplete. Another six months of my time and that of two assistants are still required to fine-tune the programming, enter and synchronize seven hours of Kiswahili and Olmaa recordings to English translations, and complete the writing of what will be about three hundred pages of guided tours, annotations and Help-screens.

An expert would have required much less time to program MJ than I. In the future, the hardware and software needed for ethnographic hypermedia will be standardized and improved to a point where ethnographers can produce works without having to master a programming language or create their own applications. Most of the technology required is already available on college campuses. To an even greater extent, the expenses in the future will be the makers’ own time.

As a consequence of declining costs, the external funds required to produce and distribute a major work in hypermedia will come more closely to resemble those required for the anthropological mediators to complete projects even if they are paid poorly, or not at all.

<table>
<thead>
<tr>
<th>TIME AND EXPENSE CATEGORIES</th>
<th>Project Director (weeks)</th>
<th>Others (weeks)</th>
<th>Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIELDWORK</strong></td>
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<td>Cash</td>
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<td>Labor</td>
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<td>In-kind</td>
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<tr>
<td>Pre-departure</td>
<td>3</td>
<td>1</td>
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<tr>
<td>Field period</td>
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<td>12</td>
<td></td>
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<tr>
<td>Expenses</td>
<td></td>
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</tr>
<tr>
<td>Transportation</td>
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<tr>
<td>Per diem</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Film and tape stock</td>
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<td></td>
<td>$3,000</td>
</tr>
<tr>
<td>Cameras, recorder</td>
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<td></td>
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<td><strong>AUDIO-VISUAL PREPARATION</strong></td>
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<tr>
<td>Labor</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Darkroom</td>
<td></td>
<td></td>
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<tr>
<td><strong>TRANSLATION / TRANSCRIPTION</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>6</td>
<td></td>
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<tr>
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<td>Writing</td>
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<tr>
<td>Programming &amp; design</td>
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<td>Ethnographic &amp; hypermedia consultations</td>
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<td>Digitization &amp; correction of texts, photos, sound</td>
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<td>17</td>
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<tr>
<td>Sound-to-translation synchronization</td>
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<td>Proof reading</td>
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<td>Expenses</td>
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<td>Computer hardware</td>
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<td>CD pre-mastering and mastering</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td>70 wks.</td>
<td>60 wks. $20,500</td>
<td>$8,500.13</td>
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</table>

FIGURE 1. Labor-time and expenses in production of the Maasai Interactive CD.
publication of a book (tens of thousands of dollars) than those funds needed for the production and distribution of a major anthropological film or video (hundreds of thousands). Scholars who choose to work in hypermedia will therefore become less dependent on external funding than ethnographic filmmakers, and they will proliferate. Like authors of unsolicited journal-manuscripts, hypermedia-makers will be free to innovate, sometimes faltering, sometimes achieving unexpected and important results. Hypermedia authors will not need to satisfy the understandable expectations of granting agencies that the projects they fund should be quite likely to achieve success, or that they should represent approved theoretical paradigms. If the rate of ethnographic hypermedia failures will be high because of the absence of censure and funding-oversight, so too will the number of unfunded, successful projects increase.

b. Audiovisual Mix

Maasai Interactive's 20 hours of sound recordings and 7,000 still photographs were produced over a period of thirty days in the field. Because the original material was shot in black-and-white and was neither video nor 16mm, its transformation to hypermedia was simple. At present, the computer-memory required for even moderately-long, color motion pictures exceeds the capability of educational-media technology. As shown below, however, thousands of black-and-white still photographs and many hours of sound may be stored on a single CD-ROM. MI is thus able to include a high percentage of the original recordings made in the field. This availability is useful for a number of reasons, particularly because it offers visual scholars a larger sample of activities. 17

In the field, sequences of still photographs from single camera positions were taken along with uninterrupted sound recordings (Biella 1984, 1988). Almost none of the photographs have precise sync-points with the sound track. Lack of sync influences the annotations that I give the audiovisuals. Instead of discussing kinesics and image-sound synchronization, I concentrate on the ethnographic implications of utterances, on relationships discernible from still photographs, and on unfolding group dynamics. In retrospect, I believe that I would not have proceeded in MI very differently if I had had moving pictures as a database, since kinesics are not of special interest to me. Nevertheless, the fact that the images do not move and have few sync-points is an important limitation of my data. It will prevent some analyses from being made.

The lack of sync-points between picture and sound also effects the screen design of the audiovisual files. To avoid giving the impression of picture-sound synchronization, I allow two different photographs visible on screen at any given moment. Both were taken at approximately the same time as the sound that is being heard or being read in translation.

c. Platform and Authoring System

A high priority of MI was for it to be reasonably easy to use. Before I began working, I compared Macintosh and IBM. I found the former to be more intuitive to use and more attractive stylistically.

I was drawn to Macintosh in part because of HyperCard, its omnipresent hypermedia program. The user's control of HyperCard is largely dependent on buttons so that little memorization of commands is required. I sought an application that would not soon become obsolete, and Apple Corporation has guaranteed that it will support and upgrade HyperCard for many years. I was also attracted to HyperCard because I anticipated having difficulty learning computer programming. HyperTalk, HyperCard's programming language, is comparatively easy for the neophyte to master.

Unlike dedicated database applications, HyperCard is comparatively slow in database searches; it is comparatively
unsophisticated in word-processing. Yet its combination of adequacies makes it versatile and viable.

d. Memory Assignment

<table>
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<th>Number / type of units</th>
<th>Per unit (KB)</th>
<th>Memory used (MB)</th>
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</thead>
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<tr>
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<tr>
<td>Simple Player™</td>
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<td>TEXT INFORMATION</td>
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<tr>
<td>Textbook/Guided tour of machine-readable text</td>
<td>2000 pages</td>
<td>3</td>
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<td>Other works by Biella</td>
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<tr>
<td>Transcribed translations of field recordings</td>
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<tr>
<td>Annotations on the translations of field recordings</td>
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<tr>
<td>Ethnographic and historical essays by others in the field</td>
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<tr>
<td>PHOTOGRAPHS</td>
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<tr>
<td>(Black and white)</td>
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<tr>
<td>75-dpi resolution</td>
<td>2000 pictures</td>
<td>75</td>
<td>150.0</td>
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<tr>
<td>300-dpi resolution</td>
<td>175 pictures</td>
<td>1350</td>
<td>236.3</td>
</tr>
<tr>
<td>SOUND RECORDINGS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-bit resolution</td>
<td>450 minutes</td>
<td>478</td>
<td>215.1</td>
</tr>
<tr>
<td>22-bit resolution</td>
<td>30 minutes</td>
<td>657</td>
<td>19.7</td>
</tr>
<tr>
<td>VIDEOS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3, 20-second movies</td>
<td>3500</td>
<td>3.500</td>
<td>10.5</td>
</tr>
<tr>
<td>TOTAL MEMORY REQUIREMENT</td>
<td></td>
<td></td>
<td>638.5 MB</td>
</tr>
</tbody>
</table>

**FIGURE 2.** Assignment of CD-ROM memory in the design of Maasai Interactive. (Numbers reflect 1993 compression sofware and technologies as well as qualitative decisions [see

As discussed in section II: a, above, a storage medium commonly used in hypermedia is CD-ROM. A single disk has the capacity to store some 640 megabytes of information, whether audio, text, still photographs or video. The designer of a hypermedia program must assign fractions of this total capacity to the different media.

Figure 2 shows how I plan to share the available memory of the MI CD. (The figures given here reflect 1993 compression technologies which will soon be obsolete.)

Authoring systems. HyperCard 2.1 will be included in MI by agreement with Software Licensing at Apple Computer. HyperCard provides a combination of tools—search functions, simple word processing, linking capabilities, and the ability to display photographs and videos. The Simple Player program will also be included by agreement: it plays sync-sound videos on-screen. Having few videos, MI uses Simple Player primarily for its capacity to reproduce sound: audio recordings are linked, with accuracy of a tenth of a second, to textual translations.

Text information. The computer memory requirement for storage of a single page of text is very low. Some hypermedia projects, like MacFarlane's (1990) on the Naga of the Assam-Burma border, store 10,000 pages of text. MI, however, includes only about 2,000 pages. My reason for not including more is not the shortage of memory. Rather, I stop at that point for three practical reasons. First, I own the copyright to only half of the textual material that will be included in MI. Acquiring copyright clearance and paying copyright fees for even a thousand pages is daunting. Second, in order to enter journal or other textual materials onto a CD, it is necessary first to scan each page digitally into a computer. The scanned texts are imperfect and must be proof-read, a very time-consuming proposition. Third, a thousand pages of previously-published ethnographic texts, in addition to another thousand of my own writings and the translations of fifteen hours of sound, will provide sufficient
FIGURE 3. Resolution of photographs on computer screen. The upper-left image reflects the average quality of most photographs in *Maasai Interactive*. The upper-right image is a 400% magnification of the photograph if it is scanned at 75-dpi. The lower-right image is a magnification of the photograph if scanned at 300-dpi.

material to demonstrate possibilities of hypermedia, and will serve the project’s needs.

**Photographs.** All of *M1*’s photographs are black-and-white and therefore have only one-third the memory requirement of color. Photographs may be stored in memory at different degrees of resolution (or dots-per-inch), and at different enlargements. Almost all of the photographs are stored at a fairly low resolution, 75-dpi at an enlargement of 3” by 3.5.” At this size, images appear on the computer screen roughly as sharp as the upper-left photograph in Figure 3 (though they are almost twice as large). Because the memory consumed by photographs at 75-dpi is relatively low, a single CD could store more than 8,000. I have elected to include 2,000.

HyperCard allows users to magnify photographs that are on screen. This is an attractive option, both for the users’ pleasure and curiosity as well as for some kinds of research.

Unfortunately, pictures stored at 75-dpi cannot be magnified and retain clarity. The upper-right image of Figure 3 demonstrates the decrease in sharpness that comes from a 75-dpi photograph when enlarged to 400%. Because I do wish some pictures to be enlarged, I decided to store 175 of the most interesting photographs at 300-dpi. These images can be enlarged significantly while still remaining relatively sharp, as shown in the lower-right image of Figure 3. This decision has two drawbacks. First, because the higher-resolution images contain so much more information, they come up on the computer screen much more slowly than do the others. On my system, they need as long as eighteen seconds, eight times longer than the other photographs, to appear. Second, images stored at 300-dpi consume sixteen-times the memory needed for storage at 75-dpi.

The memory-consumption of photographs may be reduced by using Apple’s QuickTime compression program. I decided against this option, however, because decompression of the photographs takes an unacceptably long period of time.

**Sound recordings.** The *M1* CD includes eight hours of original sound recordings. (These eight and seven additional hours of the recordings are translated and included as text.) Like photographs, sound may be stored at different levels of resolution, with correspondingly different consumption of memory. For purposes that I envision, sound recordings of conversations will be reproduced with adequate clarity when stored at 16-bit quality. Thirty minutes of songs are stored at the highest quality.

**Videos.** No video was shot in the fieldwork period, but the project was influenced by several films, portions of which will be stored as QuickTime movies and quoted in *M1*. Because the memory consumed by video is so high, only three 20-second clips are included.
e. Screen Design

A goal of MI is to provide a prototype and demonstration of ethnographic hypermedia. MI is intended to be used as a textbook, with assigned readings and exercises, as well as a resource for scholars and students of scholarship in visual anthropology. As designer, I put into the program as many options as I could imagine for others to build on. The shell of MI—its files and navigation tools without data—will, I hope, be licensed and adopted by future hypermedia-makers, including those who work with video, as a platform for their own audiovisual presentations and analyses.

Much of the philosophy of open-system hypermedia scholarship that is embedded in MI is expressed by Landow (1991) and Landow and Delany (1991). They are major contributors to Intermedia, the most impressive example of hypermedia that I have seen by far. Despite my extensive agreement with these scholars, the screen design of MI and that of Intermedia also clearly reflect our philosophical differences, in very different styles and solutions to shared problems. A contrast of the two designs brings out trenchant features of hypermedia production.

Intermedia presents its users with a multi-layered, multi-windowed screen. Intermedia users can gain access to linked texts in several ways, including the two ways represented in Figure 4, a sample screen. Users can call up—make visible on-screen—any document in Intermedia's database by selecting from the complete list of texts in a web-view, shown at the lower-right of Figure 4. Alternately, users can take advantage of the arrow-shaped icons, imbedded above keywords in Intermedia texts, which indicate the existence of a link to another, related, text. Users click on the icon in the one to call up the other. The new text-window then appears, outlined in gray, covering all or part of the previous window.

Intermedia has one basic screen: metaphorically, it is a single location to which all documents are brought and held in place. Many texts are made simultaneously visible through the image of overlapping, or juxtaposed, text-windows. Often, only one document is completely visible: it lies on top of a three-dimensional pile as the current active text, the center of attention. Any other text that is visible on screen need only be clicked to be brought to the forefront.

The design of MI suggests a different metaphor: the computer window is the vehicle for travel to many locations—different files or “screens” —each of which is purposed to feature one particular document. The main text featured in any screen always appears in the upper-left and is flanked by three other quadrants. The latter provide linked Commentaries and
Contrasting Texts about the main text, as well as a space for the user to keep a travel itinerary and take notes.

Figure 5 represents the Document-view of a typical Scenes window from MI's audiovisual database. (Scenes windows also support alternative Summary-and-links views, not unlike that depicted in Figure 6, discussed below.) The Document-view always reserves the upper-left quadrant of the screen for the main text, the English translations of the scene. As the user scrolls through that text field, photographs to the right of the screen, originally taken as the sound recording was being made, shift correspondingly.

The main-text quadrant of Figure 5 contains the translation of Scene 5, Rivals' Dispute, and a QuickTime control-bar that plays the scene's original audio recording. As conversations in Kiswahili and Olmaa are reproduced over a speaker or headphones, contiguous phrases of the translation in the main text are successively highlighted, providing a moving subtitle across the totality of the textual translation.

Data-windows which present sync-sound videos instead of still photographs and sounds also employ a control-bar to provide random access to QuickTime movies. Movies occupy the same location as the photograph in Figure 5, the upper-right quadrant of audiovisual screens. Translations flow as brief subtitles below the movie as well as in the main text.

The audio control-bar at the top of the main text, and the field scroll-bar along the right boundary of the main text, are electronically synchronized: in response to random-access scrolling of either control, sound recordings and their textual translations always remain in sync.

Nominally, the main-text quadrant of a data-screen is the current center of attention, analogous to Intermedia's uppermost document. Attention may wander, however. Figure 5 represents a moment when the user has stopped playback of the audio with a mouse-click on the asterisk for main-text footnote #56. The mouse-click calls up, in the lower-left quadrant of the
Both the upper and lower quadrants on the right of the standard MI screen serve multiple, but interrelated, purposes. Both upper and lower quadrants can display photograph sequences that unfold with the progress of the sound recordings and translations.

In the screen depicted in Figure 5, a photograph, #28.17, occupies the upper-right quadrant. (A QuickTime movie could also appear here.) The same quadrant is available to display Contrasting Texts which pertain to the subject of the scene, such as Beidelman’s (1961) study of Ilparakuyo dispute settlement from the late-1950s. I have selected Contrasting Texts to be linked to main texts for many different reasons determined in the course of writing the textbook and guided tours. As will be seen, users themselves can take advantage of the open-system component to discover, create and pursue any number of text-links as well.

The lower-right quadrant also can present one of two fields which list the user’s specific travel agenda and research notes. The user’s travel itinerary, called the Review field, may be created either by the author, as a part of an assigned guided tour in the textbook component of MI, or by the user as part of independent research. The second field that can appear in the lower-right quadrant is shown in Figure 5, and is reserved for the user’s Notes field. Notes may be typed by the user, as shown, or may be quotations, copied with a copy-and-paste button, from any text files — main, Commentary or Contrasting. Unlike the content of other text fields, the content of the Review field and of Notes always travel to each screen with the user, as he or she navigates anywhere. The user therefore cannot become lost in the databases because the itinerary is always at hand. Notes are always available to be added to, used as contrast to main texts, or deleted. As mentioned, in the audiovisual database, the user may elect to allow the lower-right quadrant to be occupied by photographs that are choreographed with the audio and the main text.

To summarize, the design of information screens varies significantly among different hypermedia applications. Alternative styles affect the way that study and independent research are conceived and conducted. Brown University’s Intermedia screen creates a metaphor of many over-lapping windows which together offer a wealth of alternative texts. The proliferation of alternatives, however, makes the texts difficult to prioritize and their relationships difficult to grasp. The difficulties are not accidental by-products of design. Rather, they correspond clearly to the vision of text, scholarship and authorship proposed by designers Landow and Delany. As will be seen, it is a vision with which MI parts company.

The notion of an individual, discrete work becomes increasingly undermined and untenable within [hypermedia], as it already has within much contemporary critical theory. The reader is now faced by a kind of textual randomness. The writer, conversely, loses certain basic controls over his text; the text appears to break down, to fragment and atomize into constituent elements (the lexia or block of text), and these reading units take on a life of their own as they become more self-contained because less dependent on what comes before or after in a linear succession (Landow and Delany 1991:9-10).

In contrast to Intermedia’s vision of endless windows, out of which the hapless writerly-reader may sometimes be tempted to leap, the screen design of MI presents a rather sedate metaphor. Like Intermedia, MI offers powerful tools for undirected sampling and open-system research (described below), but the application is equally committed to non-random, non-broken readings and analyses. The four quadrants of the standard screen formalize this commitment. Every main text is linked to three other kinds of documents, each of which contextualizes and interprets the first. Thus, contrary to Landow and Delany, the consequence of exposure to hypermedia is not
necessarily a growing conviction of textual "randomness" and incorrigible "fragmentation," words which suggest to me, bafflement. Hypermedia links in the MI design are intended to lend at least a moderate sense of comprehension - by the interpretations they provide of texts' and audiovisuals' constituent elements (or lexia), of texts' intellectual predecessors, contemporaries and descendants, and of their competitors in alternative paratradigms.22

f. Databases

MI is composed of four principal databases: Audiovisuals, Texts, Graphics and Glossary. Each database includes indices to its holdings as well as numerous data-screens. The databases serve users of MI in two principal ways. First, they are windows of information to which users are guided in the textbook-and-tour components of the program. Databases provide the raw material for examples of, and assigned exercises in, audiovisual scholarship. Second, MI's databases make available a moderately large collection of graphic documents, recordings, and texts. Experts and students of visual anthropology alike can use the databases to conduct open-system research that is entirely independent of the guided tours.

Audiovisual database. This database includes, first, a selection of 2,000 still photographs taken from the original 7,000 that were shot in the field; second, 8 hours of sound recordings, and 15 hours of textual translations which were culled from the 20 hours originally recorded; and third, annotations, keyword-lists and summaries that I have prepared for the above materials.

The Audiovisual database has three special indices described in the Search-and-Navigation Tools section (II:8, below), and two varieties of data-screen. One variety of screen presents Scenes, a view of which has been seen in Figure 5. The second presents People: Figure 6 is an example. It shows the summary, links and index fields for Katao ole Koisenge, a man who figures prominently in the recordings. In Figure 6, as in all People screens, the main text in the upper-left quadrant describes the person, with particular emphasis on scenes in which he or she appears.

MI has forty-three scenes. Katao appears or is discussed in the eight which are listed in the lower-left quadrant of Figure 6. There, the name of each scene is a link: a mouse-click on any item in the field navigates the user to that scene's window.

The Keywords field, in the center of Figure 6, is a compilation of search-terms culled from scenes in which Katao appears. In
this field, scene numbers follow each search-term keywords list. Here, the items are not links to scenes (since the field to the left provides that function), but may be copied into the user’s notes for later reference and navigation ideas. The Keywords field is important, also, because it is scanned whenever a user performs an Audiovisual-database keyword search.

The next field in Figure 6, Photos, provides linked access to every photograph in which Katao appears. A mouse-click on any location-code number in the field causes that photograph to appear on the screen.

The lower-left quadrant of Katao’s People screen is the portion of the database’s Main Kinship Index which represents Katao and his immediate family. Numbered circles and triangles in the diagram are links which may be used either to call to this window a photograph of the person represented in the diagram, or to navigate the user to that person’s window. A mouse-click in the “Go to Main Diagram” button takes the user to the complete Main Kinship Index. It provides links to all thirty of the Ilparakuyo who were filmed sufficiently often to warrant their own People screens.

Finally, the upper-right quadrant of Figure 6 displays photographs. The photographs may be of Katao, called up by a user from the Photos field, or may be of his kin, called up from the Kinship Diagram. The tiny arrows to the right of the photograph, and the slide-buttons in the upper-right, permit users to change the enlargement and placement of photographs.

The Summary-and-link view depicted in Figure 6 provides access to the major nodes of information in MI that relate directly to Katao, to windows of other scenes, to keywords and to photos. Although a sample screen-view is not included in this essay, Scenes windows also have Summary-and-link views that are analogous to that of Figure 6. Like it, Scenes windows can also display links to related people, keywords and photos. From the Summary-and-link view of a scene, users may either click open the Document-view, shown in Figure 5, or may simply browse through the summary.

Texts database. More than thirty essays by other anthropologists and historians of East Africa are contained in the Texts database, along with my own field notes, dissertation and publications about filming the Ilparakuyo. Like the other databases in MI, Texts are itinerary stops on the guided tours. In addition, they provide one of several kinds of available data which users may review for their independent research. In both cases, the texts enrich the audiovisuals, giving both a sense of the ethnographic interpretations that informed our field recordings and a background in scholarship for the users’ own interpretations.

Figure 7 represents the Document-view for the Texts window of Beideman’s (1961) “Beer Drinking and Cattle Theft in Ukaguru.” The essay concerns Ilparakuyo-cultivator dispute settlement, and provides pertinent background information to the events that transpire in many scenes. The “Text” button in the lower-left corner of the screen is blackened (or highlighted) to indicate that the main text of the window is visible. As before, in Figure 7 the upper-left quadrant holds the main text. The quadrant would be enlarged, and more main text seen, if the user were to close the Commentary field with a click on the “Comment” button at the bottom of the screen.

Figure 7, however, represents a moment in time when the user is studying the Commentary. The user has followed instructions in the Commentary field by highlighting what is currently its lowest line. This line, which reads: “<Set the scroll of field 2 to 6752>” is HyperTalk programming code. It is active text, which means that when the line of text is clicked, it instructs the computer to perform an action. Here, a click causes a particular paragraph of the main text to be brought into view. When a Commentary refers to several quotations in a main text, separate lines of programming code are inserted
Every chapter in the MI textbook constitutes a different guided tour, and more than one tour may have reason to return to a single main text with different Commentaries. Each chapter's Commentaries contain their own code to call up different quotations from the text. Accessing quotations with active-text in the Commentary leaves the entire original essay unchanged: out-of-context quotation is quite impossible.

Commentaries in the Audiovisual database make references to and provide access to specific quotations from Scenes in the same way. When the user clicks on the active line of code in an audiovisual Commentary, the English translation of the recording is scrolled to the required location. The QuickTime audio track scrolls appropriately forward or back, and photographs shift synchronously. As with Texts, quotations from Audiovisuals are precise, repeatable, and do not require fragmentation of the original.

The Commentary field is MI's most powerful tool for the scholarly integration of audiovisual data and textual analysis. It has the precision of the film director's hand, calling forth an instant or span of recordings. It also has the reflectivity of the scholar's colloquy - seeking input from informed contrasting texts, returning to the multimedia data when necessary.

It should also be noted that the lower-left quadrant, depicted in Figure 7, stores two additional types of information which are not shown. The first, footnotes, has been discussed, for Figure 5, with respect to my annotations of audiovisual windows. In Text database windows, the footnotes which appear in this quadrant were written by the author of the main text. They are called up as a result of a click on an asterisk in the main text, or a click on the "Fn" button at the bottom of the screen. Similarly, a mouse-click on a bibliographic citation in the main text, or on the "Ct" button below, will call up citations.

The lower-right quadrant may display either the user's Notes field, as shown in Figure 5, or the Review field, shown in Figure 7. A pocket-sized itinerary and navigation tool, the Review field leads users to the windows it names and discourages users from becoming lost. The "Review" button is highlighted, in Figure 7, as an indication and result of the fact that field has been made visible. With each arrival to a window named in the Review field's itinerary, a black dot appears to the left of the name.

Contrasting Texts are located in the upper-right quadrant of Text and Audiovisual screens. In Figure 7, the user juxtaposes data in a main text with that of another source. Beideman's early ethnographic description of Ilparakuyo is here contrasted...
with Scene 24, a beer feast that was filmed some twenty years later. The omega symbol, "Ω," which appears on the button for Contrasting Texts at the bottom of the screen, is highlighted to indicate the visibility of its field. "Ω" represents resistance in electronics, and seems a fitting icon for the sometimes dissident function served by Contrasting Texts.

Graphics database. Figure 8 depicts a normal Document-plus-index window from the Graphics database. The map represented here is the most detailed in the MI collection. Locations of 1,100 place-names in Tanzania have been identified and logged for it. When the user clicks on a place-name in the index field to the left of the screen, the map scrolls to the proper region and displays the location. A wider view of Tanzania, with fewer visual distinctions, can be called up with a mouse-click on the close-up map in Figure 8.

Users may store a link for this map (or for any graphic or photograph) in the Review field, and may call it up when prompted to do so by a question raised in a text or audiovisual document. From any screen, the user may also search any of the place-names in the Glossary or Maps Index.

Other graphics in the database include early ethnographic photographs of Ilparakuyo and Maasai, QuickTime movies, historical and ethnographic maps, and sketches of the region and neighborhood where filming and fieldwork took place. All maps have place-name keywords and provide search-and-navigation tools like those described for Figure 8.

Glossary database. The Glossary is among the few windows in MI that may be brought to hover above main texts like a ghost from Intermedia. Accessed through the “Search” button at the top of every window, the Glossary permits users to look up the names of people and places that are mentioned in texts or transcripts, as well find as words in Kiswahili and Olmaa that have been left untranslated. Once a person- or place-name is found in the Glossary, the user may select either to return to the main text which initiated the search or follow up by visiting the appropriate People or Map window from which the Glossary entry was derived. Because the Glossary floats over the text while it is being used, it does not of require the user to navigate to a entirely different window. The user’s concentration is less likely to be broken from the subject that initiated the search.

Search-and-Navigation Tools

Users of MI navigate through its databases in two capacities, either as students, whose intention is to follow guided tours and the arguments proposed in Commentaries, or as independent scholars, whose agendas require them to follow
less-trodden paths, to research the ethnographic data relatively unguided. In both capacities, users are aided by search-and-navigation tools that MI provides. This section discusses tools.

**The Review Field.** On first encounter with MI, users are urged to become students, to follow, at least briefly, predetermined paths and links with guided tours created by the designer. The tours introduce students to database-holdings and instruct students in independent search-and-navigation tools. The tours then begin their principal work, to offer audiovisually-integrated course material, the textbook-long introduction to Ilparakuyo ethnography, fieldwork and filmmaking. In these excursions, the student-users' guide-bus is a single navigation tool, the Review field: it leads users through assigned explorations and follows them to every stop en route. A sample Review field may be seen in Figure 7.

When a student-user begins a new chapter of MI, the travel itinerary and links for the new chapter's guided tour must be loaded as lines of active text into the Review field. The tour's Commentaries and Contrasting Texts, as well as the location codes of the data-screen windows in which they are to appear, must also be loaded into the computer's random-access memory for use as needed.

To begin a tour, student-users navigate first to a region of MI called Overview and Assignments where they can load the desired chapter into memory. Users then mouse-click on the first destination that is named in the newly-formed Review-field itinerary. Instantly transported, users see the appropriate data-window open to its Summary-and-links view (as in Figure 6). After getting their bearings and perhaps reading the screen-summary, users call up the main text and Commentary which comprise the window's Document-view (as in Figure 7). This is done by activating the screen's "Text" and "Commentary" buttons with mouse-clicks. Users then follow the Commentary's various instructions for reading, listening or viewing. They may copy audiovisual links as well as quotations from the several text fields and paste into their notes, and type their comments there as part of the tour's exercises in scholarship. When a Commentary ends, users are asked to navigate to the next window that is indicated on the Review-field itinerary.

**Keywords, Indices and Boolean Search Tools.** In guided tours, users follow well-traveled links between documents. MI's independent search-and-navigation tools permit scholars to make their own unprecedented discoveries about documents and to create their own temporary or permanent links. Single-term keyword searches can be conducted from any window of MI. The user need only type a search-term into the field located the top of the screen (as in Figure 8). Then, with a mouse-click on the Search button, users initiate an electronic search in the current window or in any desired database.

Search-results - the names and location-codes of audiovisuals and data-windows that are discovered by a search - are automatically entered into the Review field. There they remain, temporarily or permanently, as links to the discovered documents. The user may scroll through the Review field at any time to find the search-results, and may activate links to visit the documents. Photographs or QuickTime movies, with location-codes stored in the Review field, may be called up in any screen for comparison and contrast with the documents found there.

All of the databases in MI also have their own Main Index screens. In such screens, users may gain an overview of the database by scrolling through various summary-fields which itemize holdings. The Main Index screens to the two largest databases, Audiovisuals and Texts, allow users to conduct Boolean, multiple-keyword searches on the holdings. Figure 9 is a view of the Main Index to the Audiovisual database. Four summary-fields serve this window, Scenes, Photos, People and Keywords. (Only the first two fields are visible in the current view of Figure 9.) Figure 9 represents the results of a Boolean "not" search that has been conducted in the database's Scenes
The principal browsing tool is the multi-button Navigation palette with added subdirectories. The latter permit almost instantaneous access to any data-screen in the entire program. As seen in Figure 10, the palette is made visible with a click on the "North-East-South-West" button at the bottom of the screen. In the palette, the user clicks on any database name—here, Scenes—to call up its respective subdirectory, the complete list of its data-windows. In Figure 10, the user is shown considering selection the data-window, Scenes 5, Rivals' Dispute, from the Scenes subdirectory. If the selection is completed, the user will be navigated to the screen shown in Figure 5.

Browsers may also wish to explore the Summary-and-link views of Text, Scene, and People data-windows. (Figure 6 is an example of the latter.) The summary-fields itemize holdings and give links to related documents. The pursuit of these links provides opportunities to discover new relationships. Similarly, the Kinship Diagram (of which a portion is shown in Figure 6) and a similar Age-Set Diagram (not shown) provide different views of the People database, giving a graphic representation of human relationships as well as navigation to each screen.

A user may realize the importance of a screen only after departing it. To recover the missing name, the user may call up the Retrace screen which provides lists of all previous visits to windows in MI.

Annotation-links. Lastly, independent scholars may find one more source of navigational inspiration in Annotations to the Scenes windows. There, thousands of cross-referenced,
active-text footnotes lie dormant. In Figure 5, for example, the annotations in the lower-left quadrant make reference to two other moments stored in the Audiovisual database. A click on either of these footnote asterisks will call up its respective, cross-referenced English translation. This, along with its synchronized QuickTime audio track, will be placed, next to the main text, in the Contrasting Text field for concurrent evaluation.

h. Expert Systems and Expertise

Maasai Interactive is among the first ethnographic hypermedia projects which goes beyond a compilation of databases to the design of an expert system. Existing models of hypermediated-expertise in other disciplines range philosophically from multiple-choice, behaviorist oversimplifications to the postmodern, wide-open "dociverse." MI's vision of expertise seeks a middle way between the illusion of analytical closure and the unpleasantness of analytical chaos.

In recognition that beginning scholars require examples and a modicum of tender loving care, MI's expert system first adopts the form of a guided tour. It leads users on narrated journeys through the databases - the audiovisuals, texts and graphics - and provides users with combinations of all three for consideration on a single screen. Different aspects of Ilparakuyo culture, political economy and history are brought to the fore in the juxtaposition of recordings, ethnographic texts and Commentaries. Ethnographic knowledge is queried in tours which consider the epistemological status of photographs, audio tracks and translations, and their pertinence to fieldwork in general.

As users become more familiar with the search-and-navigation capabilities of MI, they are assigned exercises in controlled audiovisual research. They are led, through predetermined bibliographic- and keyword-searches, to find ethnographic texts in the database which shed light on specific ethnographic recordings. Users then become increasingly capable of conducting independent scholarship, and are required to integrate outside theoretical and ethnographic materials. These exercises are the model for future uses to which MI can be put.

Maasai Interactive's expert system design encourages efforts to interpret film and audio from alternative perspectives. Its text-based Commentary field and guided tour calls up precise instants in ethnographic recordings and subjects them to repeated scrutiny. The tour also introduces contrasting texts and contrasting media into the debate. These are cued appropriately for use with the main text, but both are also complete and available for scrutiny themselves.

Hypermedia shapes users' philosophical approach to learning and it effects what users learn. The medium, however, is not the entire message. Particularly important messages can even transcend the vagaries of alternative expert-system designs. On rare occasions, messages that people want to send cause the boundaries of existing media to be transformed. The development of hypermedia closes the era when ethnographic recordings and anthropological analyses could not be integrated intelligibly and repeatably. The integration is the work of scholarship in hypermedia, the foundation of a new expertise in social science.

NOTES

1 I would like to thank Dr. John Finch, Assistant Director of the ITEC Center at Temple University, for his critical attention to a draft of this essay, and for his good will while revealing to me the mysteries of repeat-loop computer programming. I also want to thank Apple Computer, Inc. and Karl Kinscherf for the media grant which provided the Macintosh computer and scanner used in production of Maasai Interactive.

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Computer-based works like *Maasai interactive* received the name *hypermedia* from Nelson (1981) because their capacity to integrate media goes beyond that which was possible in the pre-computer era. Such works are also called *courseware* because they serve as tutorials in academic courses while containing a software component.

In this essay, I follow current usage by treating the word *hypermedia* as singular. I observe an equally inelegant tradition by referring to the people who work with hypermedia as *users*.

A megabyte is a thousand kilobytes, a million bytes. The figure of 640 MB for the memory capacity of a CD-ROM allows room for the additional 10 MB of memory required by the CD for its own purposes - desktop file, volume directory, allocation table and other items important to the orderly functioning of the CD but transparent to the user.

Within a few years, blue-light lasers are anticipated to allow storage of two gigabytes (2,000 MB) of information on a single CD (Gussin 1993).

Unlike CD-ROM-dependent hypermedia, applications which are networked to a mainframe computer can be designed to allow users to create *permanent* buttons and links that are available to all future users. As Yankelovich (1991) points out, however, it is naive to expect the average user to undertake the trouble required for the task. Brown University's *Intermedia* system therefore introduced a Document Search tool: "Every time a new document is created and saved, the text of the document becomes automatically indexed without any user intervention" (Yankelovich 1991:135).

A useful discussion of information-retrieval strategies is presented by Woodhead (1990). He writes that, on one hand, synonym and other generalizing searches locate a high percentage of all relevant items in a database; unfortunately, they also suggest many items that are irrelevant. In such searches, the user is required to weed through the mass of unwanted texts. Strict, term-based searches, on the other hand, rarely turn up items that are irrelevant, but they also miss many items that would be of use. Woodhead adds, "In some cases Boolean combinations can increase recall measure, e.g. by use of alternatives [synonyms], and in other cases they can increase precision, e.g. by use of AND to conjoin restrictive criteria" (1990:44).

Unlike the software cited in this essay, most computer-based teaching materials for the social sciences are databases, not expert systems. The most famous of these is Harvard's *Perseus Project*, about classical Greece.

Keller (1987:34) readily admits that the simulations of expertise that are attainable through his model and criteria are not complete. He argues only that simulations can assist, and partially train, experts.

Keller (1987:xx) suggests that each advancement in artificial intelligence is welcomed by a public that quickly ceases to be impressed. If calculators, word processors and databases once appeared to simulate aspects of phenomenally-capable human beings, the people now no longer seem as capable. Machine replications of other aspects of intelligence will no doubt further cheapen the coin of human expertise.

Some *Intermedia* files, like Landow's Dickens Web (Landow 1992:96) include graphic concept maps as well as many expert introductions which function as guided tours. The present essay emphasizes the aspect of *Intermedia* which is more aequphalous and chaotic than a guided tour would be.

The Annenberg Foundation, for example, contributed more than a million dollars to the development of Brown University's Institute for Research in Information and Scholarship (IRIS), which created *Intermedia*, the UNIX-based network frequently discussed in the text (George P. Landow, personal communication, February 1993). Another major foundation grant is described in footnote 12.

Some scholars prefer to read in bed: others orient themselves to working in the tub! Like the limitations of memory that prevent films from being stored on disk, the difficulty of reading from computer screens and the difficulty of carrying a computer on the bus are understood by the industry to require attention. Such problems are slowly being corrected.

Wenner-Gren rejected funding for *Maasai interactive* and several branches of the National Science Foundation responded negatively to queries because the project, a prototype in educational media, had no research component. The Rockefeller, Ford, Kellogg, MacCary and Annenburg Foundations responded to queries by stating that hypermedia production was not within their current funding priorities. The disinterest expressed by funding agencies may be superseded, however, if hypermedia production is linked to one of the foundation's priorities. An example is Rockefeller's recent support for a hypermedia project which received funding because it gave exposure to minority filmmakers (Abrash and Egan 1992).
Photographic and sound equipment, as well as a fine darkroom, were loaned by Temple University. Macintosh computer equipment and a scanner were provided by a grant from Apple Computer, Inc.

Like anthropologists who become filmmakers, those who turn to hypermedia must dedicate themselves to many activities which have little to do with the normal practices of the discipline. Weeks spent meditating on screen design are not spent teaching, conducting fieldwork, reading journals or publishing. The production of educational software, like the production of ethnographic films, is not part of the normal progress toward tenure. Yet in the future, hypermedia-making is more likely than filmmaking to be recognized as legitimate, because academic anthropology favors text.

Richard Cross, a Pulitzer-nominee since killed on photo-assignment in Honduras, was project photographer. The consulting anthropologist, Peter Rigby, an member of the Ilparakuyo family on whom the work concentrates. He has published extensively on Maasai, Ilparakuyo and his own adoptive Ilparakuyo family (Rigby 1985, 1992). Fifteen hours of sound recordings were translated by an Olparakuoni sociologist, Melkior Matwi, who worked with me in the United States for a period of six weeks.

In the early design of Maasai Interactive, I was assisted greatly by the incisive wit of Laura Kunreuther. Scott Kecken also helped enormously by scanning hundreds of photographs and maps and by suggesting many improvements in the graphic layout. Finally, my ever-generous mother, Anne Biella, dedicated a month to scanning and correcting documents in the Texts database.

When I began work on the project, I could find no software applications which would serve my purpose. I concluded that I had to create my own shell and became a student of HyperCard's HyperTalk computer language. (Friedel primarily on Goodman [1988] and Apple Computer, Inc., ed. [1990] as teachers.) At least two months passed before I had an inkling of what one might be able to accomplish. After six months, I was able to write scripts that functioned much more rapidly than my earlier attempts. After a year, I could identify elegant scripting.

I discuss advantages of including uncensored field recordings in my earlier essay in this volume. Howard (1988:308) points out that the cost of incorporating large amounts of text into ethnographic hypermedia will be so low "that we will not have to exclude such a large segment of what we learned in the field to accommodate cost-conscious publishers." Accommodating time-conscious users is a problem that will always remain.

CD-ROMs are capable of storing texts simply as bitmap-images of the pages. The acquisition-time for bitmap storage is comparatively brief, but words stored as bitmap-images are not machine-readable. That is, they cannot be copied and pasted, as text, into other texts, and they cannot be searched with Boolean tools. Hypertext-makers are therefore forced to transform hard-copy works in print into machine-readable, machine-searchable, electronic text. To do so, a page of text is first digitized by a machine called an optical scanner. Software then evaluates the digitized result: it makes an hypothesis about which alpha-numeric character was signified by every ink-mark that was scanned from the page. Erroneous hypotheses are often made, sometimes resulting in a page of text that contains hundreds of errors. For the most part, however, scanning errors are usually limited to five or ten per page.

Spell-checking computer programs, while helpful in correcting scanning errors, cannot be relied on to catch them all. Such errors sometimes transform one word into another one that is also spelled correctly and which therefore is not flagged by a spell-check program. Frequently, indigenous names and non-English words, which proliferate in ethnographic texts, are considered by the spell-check program to be spelling errors. Each foreign word must be added to the spell-check dictionary as a correct, properly-spelled word. Proofreaders of electronic texts are therefore forced to work in the traditional clumsy way, comparing original with computer copy to check each unfamiliar word.

Anyone who considers scanning several thousand pages of text should investigate all available programs thoroughly. We use OmniPage which scans, hypothesizes alpha-numeric equivalents, and exports the hypothesized characters into MicroSoft Word on any other word-processing application. There, spell-checking procedures are conducted as usual. Using this method, I could not scan and correct a 20-page article in less than two hours. Scanning and proof-reading hours are often boring and always exacting.

Scans made from enlarged photocopies of text always give better results than scans from the original smaller pages. In poorly printed texts, occasionally, even enlarged photocopies cannot correct for a major problem, the filling-in of the lower-case letter 'e.' In such texts, so many words with 'e' are rendered incorrectly that retyping the entire article becomes the only viable acquisition technique.

A potential confusion lies in the fact that, regardless of the dots-per-inch-of-photograph stored in memory, Macintosh screens cannot reproduce images more sharply than 75 dots-per-inch-of-screen. Thus,
two reproductions of the same photograph, made at a given enlargement but stored in memory at, say, 75-dpi and 300-dpi respectively, would appear identical on-screen when shown at the original enlargement. Only if the two reproductions were magnified above that enlargement would the major qualitative differences shown in Figure 3 become apparent.

Hypermedia designers will soon be able to place footnote asterisks within QuickTime movies. The asterisks, sometimes called micons or moving icons, are presently available for movies created and played back in the MacroMind Director application.

The formal arrangement of data in regular quadrants and screens is almost universal in hypermedia applications: *Maasai Interactive* follows the precedent. Intermedia’s preference for scattered document-windows is an exception to the rule.

One of Landow’s “rules” for hypermedia-makers is that links should only be created if they “condition the reader to expect purposeful, important relationships between linked materials” (1991:83). This implies that links contribute to the user’s recognition of order, the opposite of randomness. Ramey argues in a follow-up that enlargement within the system is almost the system described by Brown, et al. (1990).

Howard (1988) discusses the use of kinship diagrams in hypermedia applications, at length.

Search components of *Maasai Interactive*’s expert system resemble the system described by Brown, et al. (1990).

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