User Interface for the National Digital Library Program
Needs Assessment Report

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Submitted by: Human-Computer Interaction Laboratory, University of Maryland at College Park

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Gary Marchionini, Principal Investigator
Catherine Plaisant, Co-Principal Investigator

Table of Contents

Executive Summary

Understanding and assessing user needs is the first step in interface design, and this report is one of the first milestones in the overall design effort. This assessment provides an informed basis for the interface design and evaluation to be done in the months to come. It was prepared under the Library's contract with the Human-Computer Interaction Laboratory (HCIL) at the University of Maryland's to work together to design an interface for the Library's National Digital Library (NDL) Program.

In order to determine user needs, HCIL conducted a survey of nine reading rooms with special emphasis on the Special Collections from which the content of the NDL will be drawn. HCIL also used questionnaires to reach remote audiences who may typify NDL users accessing the Library via the Internet. They also analyzed many of the documents available in the Reading Rooms, such as finding aids, other handouts, and user studies. This assessment took place during the period September 1995 to January 1996.

The reading room interviews used a protocol to elicit data about:

- <u>content</u> (what materials are housed in the reading room, what indexes or finding aids exist, and which materials were scheduled for inclusion or possible inclusion in the NDL),
- <u>users</u> (the types of users who typically used the reading room, what types of information needs they brought to the Library, what levels of searching skill they typically have, how these users might benefit from the NDL, and what new users might be attracted by the NDL), and
- <u>strategies</u> (how users conduct searches, what types of search tools are available in the reading room, and how the reading room staff assist users).

The results illustrate the need for content-specific search strategies as well as pose a set of design challenges across all the collections:

- serving a wide range of users
- serving a wide variety of information needs
- helping users distinguish primary and secondary materials (including multiple layers of each)
- helping users make links among items across different collections and reading rooms
- capturing the essential elements of the reference interview so that users can find what they need without human intervention
- communicating to the user what items are NOT in the NDL and give pointers to external resources
- creating an interface that is accessible by users with state-of-the-market technology
- developing new techniques to search for multimedia objects and to integrate those techniques into the interface (e.g., visual and audio query languages)

Because K-12 teachers and students are featured prominently in plans for the NDL, a limited survey of two groups of educators was conducted. The first group was a set of 24 teachers who participated in NDL orientation sessions. The second group of educators was the set of 27 school library media specialist supervisors in the state of Maryland. Teachers and school library media specialists were unified in their desire to use primary materials for educational purposes and in demanding a system that could be used in school and home, and is easy to learn and use. There is a wide range of equipment available in these schools and many have some type of online capacity in the building but few have it in classrooms. This is problematic as significant numbers of workstations in these schools will not be capable of taking full advantage of the NDL.

The task of assessing the needs of the general citizen was addressed by surveying parents and workers in a day care center in Flint, Michigan. Results show that computer usage is pervasive with well over half of respondents in this survey using computers in a variety of settings multiple times each week and that almost one-third have some type of online access. Although one-third of the respondents had heard of the World Wide Web (WWW), only nine (11%) had actually used it. The general populace shows interest in computers and the information resources networks offer but have limited first-hand experience with the WWW. These results reinforce the theme of diversity in users, needs, and computational settings and suggest that the NDL must be purposefully introduced to potential users.

Documents represent an institution's expression of procedures, policies, and responses to user needs. The number and range of handouts in reading rooms illustrate user needs that are so pervasive that special publications or finding aids are created and similar documents will be needed for the NDL. The surveys illustrated the problems users have with computer systems in general and with conducting effective searches in electronic systems. In addition to reinforcing the importance of computer experience, these findings illustrate: the need for crisp and intuitive dynamics between screens/windows so that users can focus on different levels of representation easily or possibly juxtapose them; judicious use of any scrolling functions; and the need for clear yet powerful search articulation and results display. Email questions were mainly system-related or reference-related and some form of human response to user electronic requests will be required as NDL usage grows. The quantity and diversity of these documents indicate the complex nature of the individual reading rooms, and project the complexity of the aggregate NDL.

The needs assessment results have several implications for the design of the NDL interface:

- Serving users ranging from school children through seasoned scholars, including those with special needs, implies an interface that supports a range of information-seeking strategies from easily-navigable selections to complex queries.
- The lack of human intermediaries requires that the interface provide significant help, tutorials or tours, and last resort communications.
- Serving a range of user platforms implies multiple interfaces to provide a default lowest-common denominator interface (e.g., low-speed, all text) as well as a graphical interface that takes advantage of visualization techniques.
- The interface must provide clear delineations within the NDL as well as among the larger collections of the physical Library of Congress and the entire Internet.
- The interface must help users distinguish secondary and primary materials.
- The interface must also distinguish and rapidly display texts, graphics, and sounds to facilitate browsing, as well as find ways to support non-textual search for non-print media.
- The interface must also allow users to search across collections or not; and if they choose to limit searching to a collection, provide clear linkages to other collections.

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1. Introduction

This report is part of the Human-Computer Interaction Laboratory (HCIL) at the University of Maryland's contract to work with the Library of Congress (LC) to design an interface for the Library's National Digital Library Program. Understanding and assessing user needs is the first step in interface design and this report is one of the first milestones in the overall design effort. The report presents HCIL's efforts to understand the needs of the many users currently doing research in the Library, including LC staff. The report also investigates the projected needs of potential users of the Library of Congress National Digital Library (NDL).

The purpose of this assessment is to provide an informed basis for the interface design and evaluation to be done in the months and years to come. To this end, we visited and interviewed staff in nine of the Library's 22 Reading Rooms (RR), conducted three written surveys of potential users, and analyzed various Library documents. This investigation took place during the period September 1995 to January 1996.

1.1. LC Context for the Needs Assessment

The Library of Congress has taken a leadership role in the development of a National Digital Library. LC's role in this effort is articulated in the document *The National Digital Library Program--A Library for All Americans*.

"The core of the digital library will consist of historical collections, extensive bodies of primary-source materials. Contemporary materials will also be important. At the Library of Congress, two hundred Americana collections have been selected for digitization: unique documents, photographs, sound recordings, printed matter, and motion pictures that represent the nation's memory. The Library's American Memory pilot (1990-1994) established the value of historical collections to the field of education and to the public at large. Evaluations in 44 sites across the United States indicated that primary-source materials can be an important tool for educational use. During the pilot, a strong demand for computer access to the collections was expressed by users at every level.

To facilitate the conversion of Library of Congress historical collections, the Library has initiated a National Digital Library Program to oversee the challenging work of digitizing manuscripts, rare books, glass negatives, and older sound recordings and motion pictures. The success of this national effort requires the cooperation of other research institutions and libraries. At the end of the five-year launch period, 5 million items from the collections of the Library of Congress and other institutional partners will have been made accessible via computers."

As part of this initiative, the NDL Program has planned activities for preparing, digitizing, archiving, and providing access to these historical and contemporary materials and for managing the overall project and collaboration with other institutional partners. The challenges of providing access are addressed by efforts to develop an easy to use yet powerful human-computer interface. To this end, LC contracted with the HCIL, a leading interface design laboratory with a history of library-specific projects to work with LC staff over a 20 month period to develop a design plan, and build and test prototype interfaces. To guide the development of the interface, a user needs assessment was undertaken to determine what tasks and search strategies users bring to the Library today, what new types of users, tasks, and strategies the NDL will attract, and how these user needs may best be served by the NDL interface.

1.2. Needs Assessment Perspective

Needs assessment has many manifestations ranging from general market research to specific recommendations for conducting reference interviews. The focus in this study was on people's information needs. There is a long history of studies of what types of information needs people bring to libraries (e.g, Krikelas, 1983; Marchant, 1991; Paisley, 1980; and Wilson, 1981). Dervin & Nilan's (1986) review of the information needs literature dichotomizes system-oriented and user-oriented approaches to determining information needs. They criticize the system-oriented approach as too narrow to actually identify user needs and propose an approach that attempts to directly assess people's information needs. This approach is increasingly adopted by practicing software designers. Hartson & Hix (1993) offer many practical suggestions for assessing the tasks that users bring to computer systems and Shneiderman (1992) provides a rationale for mapping user tasks and needs onto the syntax and semantics of interface designs. Marchionini (1995) provides a framework for considering users, tasks, and information need settings onto interface designs and this framework was used in the needs assessment.

The primary principle of the current needs assessment is to be user-centered--with the intention of focusing on user characteristics and the information-seeking tasks they bring to the Library. This principle is tempered by the realization that the NDL is evolving from an existing system. Thus, the needs assessment was conducted so that is was primarily user-centered but wide enough in scope to capture and incorporate institutional factors.

1.3. Needs Assessment Problems.

One of the problems associated with assessing information needs is to distinguish the global needs of user communities from the specific needs of a single user. Clearly, determination of global needs best informs system design. However, the process of determining global needs is done by aggregating and synthesizing the articulated needs of individual users. Given that the assessment was user oriented, individuals and small groups were the units of data collection. However, the institution and its existing systems as manifested in documents, policies, and practices were analyzed for design decisions impact.

A second problem associated with assessing information needs is that there are multiple levels of an individual user's need. Three decades ago, Taylor (1962) referred to these levels as visceral, conscious (but unverbalized), formalized, and compromised. For the practical purposes of this assessment, we are concerned mainly with the formalized and compromised levels of need since they are most accessible and addressable without human intermediation. Formalized needs are operationalized as natural language expressions (either verbally or textually) from participants in the investigation. Compromised needs are constrained by a system or an intermediary and are operationalized as responses to closed form questionnaire scales, and interviewees' statements about user needs based on past experiences.

1.4. Needs Assessment Objective.

The objective of this work is practical: to determine the perceived needs of different users and user communities in order to inform the design process. Three general user communities were considered at the beginning of the project and others emerged as the needs assessment progressed. The three original groups were:

•LC staff. This community is characterized as experts in both library system and content, as heavy users of the existing systems, as knowledgeable about articulated (formalized) user needs, and able to devote short (usually less than two hours) amounts of time to individual's needs.

•Scholars and other visitors to LC. This community is characterized as having high levels of domain expertise and knowledge of library systems. They are also able to devote large but specific amounts of time (days or weeks) to their individual information needs.

•Visitors/Prospective users. This community is characterized as having varied levels of domain expertise and low levels of library systems knowledge. They are able to devote only short periods of time to their information needs or explorations.

2. Procedure

The procedure for conducting the needs assessment had three components: Selected LC Reading Rooms were visited and staff hosts were interviewed; Written questionnaires were created and distributed to important prospective user communities; and LC documents were examined.

2.1. Reading Room Visits and Interviews.

This was considered to be the most informative component of the assessment since the librarians in the reading rooms are not only themselves important users of the existing system but also have extensive knowledge about current user needs at LC. In addition, many of these staff members will be either directly or indirectly involved in the development and maintenance of the NDL and have stakeholder needs that must be captured. HCIL developed an interview/discussion framework (See Appendix A) for use in the visits. This framework was presented at a meeting with Dr. Sarah Thomas and other LC staff on September 29, 1995. Based on discussions at that meeting, it was decided to simplify the protocol by eliminating specific questions about expected impact of the NDL on work and service at LC. Based on this meeting, visits to nine readings rooms were scheduled. Table 1 lists the reading rooms, dates, and participants.

For each visit, HCIL staff took notes according to three elements of the protocol and added a fourth generic note category. These elements were:

> •Content: What materials are housed in the reading room, what indexes or finding aids exist, and which materials were scheduled for inclusion or possible inclusion in the NDL.
>
> •Users: The types of users who typically used the reading room, what types of information needs they brought to the Library, what levels of searching skill they typically have, how these users might benefit from the NDL, and what new users might be attracted by the NDL.
>
> •Strategies: How do users conduct searches, what types of search tools are available in the reading room, and how does the reading room staff assist users.
>
> •Other: Any notes on interface implications, additional notes specific to that reading room

Table 1. Reading Room Visits and Interview Schedule

When:	Where & Who

October 26:	1. Newspaper & Current Periodical Reading Room: Georgia Higley, Maryle Ashley, Catherine Plaisant, Gary Marchionini
	2. Prints and Photographs Reading Room: Barbara Natanson, Maryle Ashley, Catherine Plaisant, Gary Marchionini
October 27:	3. Performing Arts Reading Room: Walter Zvonchenko, Maryle Ashley, Catherine Plaisant, Anita Komlódi
November 6:	4. Manuscripts Division: Ernest Emrich, Catherine Plaisant, Gary Marchionini, Anita Komlódi
	5. Main Reading Room: Lois Korzendorfer, Catherine Plaisant, Gary Marchionini, Anita Komlódi
December 18:	6. Geography and Map Reading Room: Betsy Mangan, Gary Fitzpatrick, Kathryn Engstrom, Catherine Plaisant, Gary Marchionini
December 21:	7. Local History and Genealogy Reading Room: Ann Toohey, Catherine Plaisant, Gary Marchionini, Anita Komlódi
	8. Law Library: Keith Ann Stiverson, Nick Kozura, Catherine Plaisant, Gary Marchionini, Anita Komlódi
	9. Folklife Center: Stephanie Hall, Catherine Plaisant, Gary Marchionini, Anita Komlódi

Upon return to campus, these notes were transcribed by one HCIL visitor and sent via email to the other HCIL members who participated in the visit. These HCIL members augmented and edited the electronic notes based on their own written notes and the final electronic version was sent for comment (member checking) via email to the reading room staff who had hosted the visit. After staff had made comments, corrections, or addition, a final set of notes was prepared. The nine sets of final notes are found in Appendix B.

2.2. Questionnaires for Potential Users.

Because K-12 teachers and students are featured prominently in plans for the NDL, a limited survey of educators was conducted. Rather than an expensive and time-consuming random sample, we took advantage of existing contacts to survey a convenience sample of educators. There were two groups so selected.

The first group was a set of 24 teachers who participated in NDL orientation sessions led by Martha Dexter as part of LC's Kellogg Foundation Educational Outreach Project. A questionnaire was developed, reviewed by the LC Interface Design Working Group and students in Marchionini's graduate level Research Methods course at the University of Maryland, and mailed with a cover letter to these teachers in early November, 1995. The questionnaire is included in Appendix C.

The second group of educators was the set of 27 school library media specialist supervisors in the state of Maryland. A questionnaire was developed, reviewed by school library media professors and students in Marchionini's graduate level

Research Methods course at the University of Maryland. Addresses were obtained from Professor James Liesener, Coordinator of the School Library Media Program at the University of Maryland and the questionnaires were mailed with a cover letter to these supervisors in November, 1995. The questionnaire is included in Appendix C

The difficult task of assessing the needs of the general citizen was addressed by two graduate students under the direction of Gary Marchionini. Juliet Conlan and Stacey Finley were able to secure the cooperation of the director of a day care center in Flint, Michigan who agreed to distribute, collect, and return questionnaires from parents and workers at the day care facility. This facility is a cooperative of the UAW and General Motors and serves a large and diverse community of blue collar and white collar workers. A questionnaire was developed and pilot tested with graduate students at the University of Maryland. After revision, the questionnaire was sent to the day care center in late October, 1995. The questionnaire is included in Appendix C

2.3. Document Analysis.

Documents represent an institution's expression of procedures, policies, and responses to user needs. Three types of LC documents were examined as part of the needs assessment to better understand user and system needs:

•Reading Room handouts and brochures. During reading room visits, many handouts were obtained and these handouts reinforced the notes taken during visits in that in some cases they illustrate user needs that are so pervasive that special publications or finding aids are created.

•User study reports prepared by LC staff. One extensive report is the *American Memory User Evaluation 1991-1993 Site Summaries addendum* prepared by the American Memory user Evaluation Team. This report summarizes user experiences at 44 sites to the Macintosh and IBM based American Memory systems. One section in each of the site summaries addresses Macintosh system features and in some cases IBM system prototype features. These comments mainly address interface issues. Another report examined was the *P&P World Wide Web Public User Interviews* Report (conducted May 10-23, 1995). This report summarizes a user study conducted to determine how successfully P&P's researchers could use its digital collections using the existing American Memory interface and browser capabilities in a reading room context. Ten users conducted two assigned and one personal search using the WebExplorer client at a P&P workstation. Many interface issues were identified in this report.

•User email commentaries or inquiries about the NDL, including staff responses. Beth Davis-Brown selected a representative sample of 20 messages from her logged messages along with brief categorical commentary on the type of need the message represented.

3. Results

Results are organized by component and subdivided within components as appropriate.

3.1. Reading Room Visits and Interviews

3.1.1. Content

The NDL is not an academic exercise that begins with well-articulated user needs and then adds content that is tailored and organized to meet those needs. Instead it is a large, real-world effort that is rooted in a complex cultural context. Content for the NDL is selected based on a variety of economic, legal, social, and political exigencies. As the digitization plan takes shape, we can anticipate that materials added to the NDL will be as varied as the holdings of the Library itself. This implies that interfaces to the NDL must be driven by content decisions as well as users' needs. The following list summarizes discussions about content at the nine reading rooms visited and includes special interface challenges related to these materials (see Appendix B for the complete set of notes). Content challenges across the collections follow the list.

<u>American Folklife Center Reading Room</u> . The collection is largely uncataloged, much of it is unpublished. Originally consiting of folk songs, it now includes cultural documentation in various media. Most collections are multi-format, most include recorded sound. Permissions were obtained for WPA California Folk Music Collection (sound, photos, field notes). Autograph album collection (Duncan Emrich) next for addition to NDL. Anthologies are good candidates for eventual digitization since they are integrated wholes. Others include: J.D. Robb Spanish materials; Sonkin collection (Oakies in California, migrant workers), Zora-Neal-Hurston collection with finding aid. Internet is an advantage since fieldnotes and recordings can be linked together virtually rather than located in physically different places in the RR.

Special interface challenges: audio access (searching as well as download times); showing between to multi-format items (i.e., a sound track and textual fieldnotes).

<u>Geography and Map Reading Room</u> . Items for NDL include: panoramic maps (cataloged), county atlases (cataloged), railroad maps, East European maps (not cataloged, heavily used by genealogists), Civil War maps, Sanborn fire insurance maps (about 700,000 items), and selected maps of American history (e.g., early atlases).

Special interface challenges: user specification of areas/regions on maps; place name ambiguity

<u>Law Library</u>. For NDL: early Congressional materials; Congressional Globe; link to GLIN system.

Local History and Genealogy Reading Room . Part of LC Kellogg project is to select biographies, autobiographies, and local histories related to Michigan, Minnesota, and Wisconsin for scanning and link to related materials in other reading rooms.

Special interface challenges: identifying and representing links among separate items; distinguishing documents that help one do genealogical research from the primary materials.

Main Reading Room . Contains mostly copyrighted books and indexes so not a part of NDL, although most typical users expect that basic reference materials will be part of the NDL (see questionnaire analyses).

Manuscript Reading Room . Items for NDL include: Washington, Lincoln, Jefferson, papers; WPA life histories; Whitman notebooks; Margaret Mead collection; some finding aids for other collections. Finding aids vary in detail.

Special interface challenges: Mainly text (will full-text search be available and how to specify limits within a manuscript, across a collection, etc.); distinguishing finding aids levels and primary material

Newspaper and Current Periodical Reading Room . For NDL: Pulp Fiction collection. Series records now in MUMS, text on microfilm, covers may be added to NDL.

Special interface challenges: need for linkages from browsable covers to bibliographic records and microfilm text available at LC.

Performing Arts Reading Room . Much of the collection is not cataloged and much of it is copyrighted so not available to NDL. To be added: selected nineteenth century sheet music; English & Irish broadsides; images of manuscript notes (Federal Theater Project); and photo negatives of sets, posters, costumes, etc (IBM Project).

Prints and Photographs Reading Room . Includes about 13.5 million items, about half processed & physically available at LC. Mainly historical items; long list of items for NDL. An important component of the NDL in terms of number of items digitized or scheduled for digitization. Likely to become increasingly important as multiple media become more expected as part of scholarly work. Currently 36 card catalogs give different entry points to different collections; One-box is an attempt to integrate recently produced catalog records for images in various collections, some cataloged at the item level and others cataloged at a group level; some item records have accompanying videodisc images that display automatically, other records have no accompanying records.

Special interface challenges: image searching (including displaying series of related images and images in challenging formats such as panoramas and oversized posters); possible use of P&P thesaurus; enabling researchers to absorb enough of the context for historical images and captions (why images were made) to deal sensitively with content that might otherwise be deemed offensive.

General content interface challenges. There are a variety of materials that will become part of the NDL. Not only do the materials vary by topic, size, and format, but also by degree of cataloging. Some materials are cataloged at the item level, some are cataloged only at the collection level, and some are uncataloged. This state of affairs presents huge challenges to LC staff as they work to serve user needs and challenges to users who are trying to find information in the NDL. It is highly unlikely that new cataloging efforts can be undertaken to catalog those items not currently cataloged (e.g., in Geography and Map Reading Room alone, only about one-quarter million items are cataloged out of 4 million.) or that catalog records for specific items in collections cataloged at the aggregate level can be created, or that existing catalog records can be edited to reflect any special requirements of the NDL (e.g., geo-referencing for maps). Thus, the first challenge is to develop a conceptual interface design--an organizational framework with appropriate rules for applying the framework. This framework must characterize for users the granularity, size, and nature of objects in the NDL. This challenge cuts across all the reading rooms and has several facets. The interface must communicate to the user the following:

•What is contained in the entire NDL

•The level of representation for a displayed object (bibliographic record to collection, series, or item)

•The alternative levels of representation available for a displayed object (bibliographic record only, thumbnail or other extract, primary object)

•The nature of a displayed object (secondary or primary; format(s); concomitant or linked objects)

This challenge must be met within the current levels of indexing. However, just as the Library takes advantage of user browsing behavior in uncataloged collections or in collections that are described only at a group level to create records subsequently for individual items selected by patrons and therefore presumed to be "high demand" (e.g., photographs found and copied by patrons in Prints and Photographs), the NDL presents an opportunity to add additional cataloging information to items that users find while browsing the digital collection. Another element of this challenge is to integrate searching of catalog records with searching of SGML finding aids.

A second challenge is to communicate to the user what items are NOT in the NDL. At one level this places the NDL within the context of the entire LC itself (e.g., copyrighted materials, 3-D objects, etc.), and in the context of the world of information available in other institutions and on the entire Internet. On another level this assists users in planning for visits or becoming aware of related information at LC or other institutions.

A third challenge is to support users in the NDL without human intervention. Although some level of reference service will be necessary in the NDL, every patron cannot expect the level of human support current visitors to LC need, receive, and expect.

A fourth challenge is to create an interface that is accessible to user with state-of-the-market technology. The interface (and underlying retrieval system) cannot be based on assumptions about state-of-the-art hardware (e.g., in 1995 terms: 20" high-resolution displays, very high-speed connections, huge RAMs, specialized I/O devices) or software (e.g., the latest operating system or web browser)[1]. Just as the overall system must leverage compression/decompression and advanced retrieval algorithms, the interface must inform the user about temporal demands for data transfer, provide posting information about result set sizes, and provide some level of explanation for ranked results. In addition, the interface must be "growable" to keep pace with the evolution of hardware and software.

A fifth challenge is to invent new techniques to search for multimedia objects and to integrate those techniques into the interface (e.g., visual and audio query languages).

Together with the specific interface challenges listed in the reading room summaries above, the NDL content begins to define both a development and a research agenda for digital library interface design. All the challenges will be addressed as some level in the months ahead, yet all will remain long-term problems for the research and development efforts at LC for many years to come.

3.1.2. Users and Strategies.

The Library of Congress is mandated to first serve Congress and its staff. It is a library of last resort for other citizens in that its collections are so large and specialized that only well-prepared researchers can take full advantage of the Library. Although many casual visitors come to LC to see and experience it as an institution, it is a research library and operates to serve those prepared to work in a complex and scholarly environment (e.g., citizens under the age of 16 are not permitted to use the Library). The NDL is a fundamental change in the service mission of LC in that a much broader user community is addressed. The following list summarizes discussions about users and their search strategies in the nine reading rooms and highlights specific interface challenges to serve these users. User challenges that cut across all collections follow the list.

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1 A more parsimonious position is to assume a state-of-the-installed-base which seems entirely too constraining for an evolving, forward-looking project like the NDL.

American Folklife Center Reading Room . Users come for various reasons and include: anthropologists, musicologists, publishers representatives, and amateur researchers (e.g., someone who wants to know how to play a specific instrument or a song that grandpa used to play). Users rely heavily on reference librarians.

There are more than 250 finding and reference aids. Important search entry points include: ethnic group, performer, instrument, language, format, chronology, geography, and genre.

Geography and Map Reading Room . One-third of users (estimate) are looking for genealogical information (e.g., the village grandpa lived). Estimate one-forth of users are contractors looking for environmental information. Estimate one-tenth of users are picture researchers looking for maps for books or other publications. Important note: before moving downtown, about one-third of the users were Civil War researchers; digital access may bring many of these users back. Specialized maps are often sought (e.g., railroads, land use, hot topics). Users rely heavily on reference librarians to get started (due to combination of size and nature of collection, and users are often not cartographically nor geographically literate)

Adequate-level cataloging will be done for uncataloged material. All finding aids use similar entry points: area (hierarchical), time, subject (hierarchical). Area is by far the most important access point.

Special Interface challenges: specifying areas; awareness of the potentially huge files to transfer and display.

Law Library . Primary users are Congressional staff. Other users come from the Supreme Court, other government agencies (including state, local, and foreign), other law libraries, and local law firms. Historians and Congressional staff will benefit from NDL historical and foreign law materials.

People in the wrong place are directed to their local libraries; there are good law materials on the Internet so an analogous strategy can be used in NDL. Novices pointed to law encyclopedias. Main entry points are time, country, type of material (law, court decision).

Special Interface challenges: determining when to point users elsewhere.

Local History and Genealogy Reading Room . Currently 300-600 visitors sign guest book per month; many are retirement age. They come for various reasons but mainly in two classes: prepared and unprepared. At least half are in the prepared group (knowledgeable about sources, tools, etc.) and some come in groups. In addition to genealogical information, users seek other historical information (e.g., about citizens involved in health-related investigations, art work provenance; etc.).

Unprepared are directed to books and materials on how to do genealogical or historical research (many as handouts that will be available in electronic form). Family name is the key entry point, with geography and time also used.

Main Reading Room . Huge variety of users; many college students. Significant reference by mail (1000+ per year). In the RR, 30-40 questions per hour answered (many procedural in nature).

Since this is the entry point to LC for most patrons, there used to be a mandatory orientation station (should there be an analog in NDL?). The main information-seeking strategy is to ask a librarian.

Manuscript Reading Room . 80-90% are academics visiting for a few days to more than a month. Scholars are interested in all aspects and time period of American history and culture. Many non-academic researchers visit the reading room seeking material related to the U.S. Civil War, local history, or genealogy.

When visiting, part of the entry registration process is a reference interview with a librarian. Most users have to work through multiple levels of guides to get to primary materials and are heavily dependent on librarian assistance. Finding aids often point to a container and/or a microfilm reel number. Collections are rarely described at the item level. Entry points are mainly name of person, some subject access that point to finding aids. Finding aids exist for about two-thirds of the collections and include: provenance, general information, bibliographic notes, scope and content, series description, container list.

Special Interface challenges: Helping NDL users quickly understand that few of the primary materials are online and that there are many levels of search to work through.

Newspaper and Current Periodical Reading Room . Many users are first-time visitors to LC, about 20% are regular users who come for sustained scholarly visits. Many users have business or social science backgrounds, many interested in genealogy.

Reference interviews are important and often refer users to other RRs. The main entry point is title. Other entry points include: history or other index (e.g., a book on a specific newspaper, NY Times Index), geography, and chronology. Since much of collection is copyrighted, finding aids and a few specialized items (e.g., Pulp Fiction covers) will be in NDL. Holdings information is as important as pointer information (many people call to make sure that an item found in the bibliographic record (to a series) actually contained in the collection.

Special Interface challenges: Helping NDL users quickly understand that few of the primary materials are online.

Performing Arts Reading Room . Equal number of serious researchers and general public. Much of the collection is copyrighted. Example requests include: performers looking for specific arrangements; many known item searches.

Most users require librarian assistance. Entry points in catalog (not comprehensive for all items) include: composer, title (piece or collection) and instrument. Copyright files of LC may be useful finding aid.

Special Interface challenges: identifying copyrighted materials (so patrons do not find pointers to them and expect they can come and copy them at LC).

Prints and Photographs Reading Room . Only a small portion of users are scholars. Many users looking for items for commercial products (books, CD-ROMs, etc.); others are researching local or family history, are engaged in historical preservation efforts, are seeking documentation for hobbies such as model building, or are interested in purchasing reproductions for wall decorations. About half of all mail requests are known item searches. Different collections have different catalogs but searching is heavily dependent on browsing at item and sometimes the collection level. Some typical entry points for the many different catalogs include: name, topic (controlled vocabulary for some; some specialized topic numbers), geography and chronology.

Special Interface challenges: patrons lack of knowledge about media (e.g., how pictures were produced at different times); supporting specialized exhibits/publications.

General User Interface challenges There are many interface challenges posed by the assessment of users and the strategies now used in the reading rooms. The most fundamental challenge is: How to serve a wide range of users who will visit the NDL? This general problem has several facets.

- The entire range of the U.S. citizenry:
  - Users of different ages
  - Users with the entire range of education level
  - Users with a range of cultural and ethnic perspectives
  - Users with special physical and cognitive needs
  - Users who vary in their experience with computer technology

- The entire range of experience specific to their visit to the NDL:
  - Users who vary in experience in the domain of the information problem they bring to the NDL
  - Users who vary in their experience with libraries and research collections

In addition to the challenge of individual user characteristics, the interface must support a wide variety of information needs that users bring to the NDL. Because we are focused on formalized and compromised needs, we use the term task in the following. From a user's need perspective, these tasks vary on five non-orthogonal dimensions.

- •complexity
  - the number of concepts involved
  - how abstract are the concepts
- •specificity (ranging from a particular fact to interpretations)
- •quantity (the amount of information required or expected to meet the need)
- •criticality (how important it is to the user to meet the need)
- •timeliness (how long users are willing to spend or expect to spend in meeting the need.

The NDL interface must help users easily communicate some of these characteristics of their task to the system.

Other general challenges echo the content challenges above.

- •The interface should help users distinguish primary and secondary materials (including multiple layers of each).
- •The interface should help users make links among items across different collections and reading rooms.
- •The interface must capture the essential elements of the reference interview so that users can find what they need without human intervention.

3.2. Questionnaire Results

3.2.1. Teachers and School Library Media Specialists

Responses from the teachers and school library media specialists were very similar and provide insight into the great diversity of technology penetration in U.S. schools. Thirteen of the 24 questionnaires (54%) sent to teachers were returned and eleven of the 27 questionnaires (41%) sent to school library media specialist supervisors in the state of Maryland were returned. The raw data is summarized in Table 2. The data for the two groups show very similar patterns. For preferred information-seeking patterns, both groups report using all the strategies often. Both

groups are similarly generous in estimating students' use of the entire variety of information-seeking strategies. Likewise, teachers and school library media specialists were unified in demanding a system that could be used in school and home, and is easy to learn and use. There was less unanimity within or across the groups about the need for access to large amounts of primary materials. Even less agreement was reported for the need for access to multimedia materials, perhaps reflecting concerns about the computing infrastructure in schools today. Both groups were far more concerned about professional use of the NDL than they were about personal uses.

Although both groups rated primary documents as important, teachers were more uniformly consensual in rating them as extremely important. Teachers rated finding aids as somewhat less important than school library media specialists (most of whom are trained as librarians). It is interesting to note that teachers rated teacher guides as somewhat less important than did the school library media specialists.

The most substantive results from the questionnaires come from the open-ended responses. There is a wide range of equipment available in these schools; IBM compatibles range from older 286 models to newer Windows-based machines, and although most Apple products are some level of Macintosh machine, there are still Apple II class machines in use. This wide range of equipment is problematic as significant numbers of workstations in these schools will not be capable of using the NDL. It was somewhat surprising that all but two respondents said that there is some kind of Internet access in their schools, most often in the school library media center. Perhaps even more surprising, eight of the thirteen teachers and six of the eleven school library media specialist supervisors reported having Internet access at home. Although Internet access was not defined as an IP-capable connection, some type of remote access capabilities is available either in school or at home to most of this very select group of educators.

The final open-ended question asked what types of materials respondents would find most useful for themselves or their teachers. Not surprisingly, the teachers were more verbose in describing specific materials they could use in class, in many cases citing very specific NDL collections that presumably they had encountered in their LC training. The following lists paraphrase teacher and school library media specialist supervisor suggestions respectively.

Teacher suggestions :

- •link LC to archives, Smithsonian, etc.
- •include photos (thematic) Depression (WPA), American Indian, Black studies, popular culture, World War I; in 5 years--multimedia, film/sound, oral histories from Depression, Japanese American relocation, famous Americans
- •World history primary sources are very scarce--we would love more sources

from ancient to modern periods; also sound, images all would be welcome additions to current history courses

•Any topic, all media; students' selection of topics for research is only limited to their knowledge & imagination--the range is good

•Ease of access is vital; for grades 5-8 images of the past & current interest linked to curriculum & interesting primary sources and documents; sounds of historical events and music

•Major American figures from all areas of life--pictures, writing, inventions, etc.); Major events in US history (Civil War photos, maps, etc,); Life in other times (Edison film of NY harbor, sharecroppers, immigrants, farm life, etc.); (most of our schools have Apple IIe, except my school with Mac lc..this is a real problem)

•Revolution (French, American, etc); racism (e.g., holocaust), women's history, industrialism, Depression, wars, art, architecture, music, oral history

•Documents that helped shape our nation

•Photos, letters, personal items (diaries)

•Collections used in the following areas of geography: North America (land forms, climates, pictures); U.S. cities (pictures over time); U.S. rivers and waterways (pictures, text, historical to present), map collections (historical, N. America, U.S., S. America)

•Primary sources on American history--19th century

•Primary sources-especially media, also short synopses of important events, people linked to media (e.g., a person whose papers could be accessed.)

School Library Media Specialist Supervisor suggestions :

•Research topics, full-text journal articles, want graphics

•History, especially American, text, sound, images

•All academic areas, technology (e.g., history of), careers, speeches, biographical info, current topics, art & music

•Social studies, American history documents, text, visual, census statistics

•Source information on specific subject area topics, teaching strategies & techniques for given objectives/outcomes

•Want information that is useful to students. Topical areas would be: current events, science, social studies, language arts; need texts

•Download public domain information; indexes, finding guides, etc.

•Depends on whether search was for personal, professional, or students; lesson plans for all subjects areas; support materials for lessons (text, sound, images); text will accompany images (that can be printed and used away from terminal); social science pictures; science pictures with sound; literary texts

•Schools already have Internet access to LC--any expansion of full-text access would be useful; Increased access to photo collections desirable.

3.2.2. Day Care Center

The results of the day care center questionnaire stand in somewhat sharp contrast to the school-based data (See Appendix D for a summary of the raw data). Figures 1 and 2 illustrate that about two-thirds of the respondents were female and the largest number were in the 23-41 age group (another large group was composed of high school students who worked at the center). This distribution is representative of working parents with day-care age children.

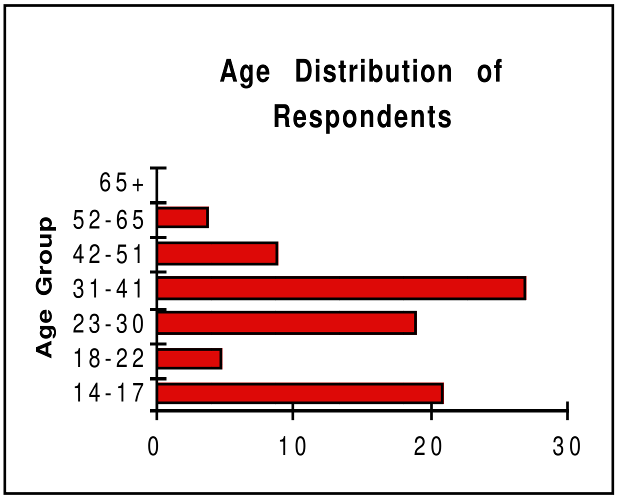


Figure 1. Age Distribution (N=85)

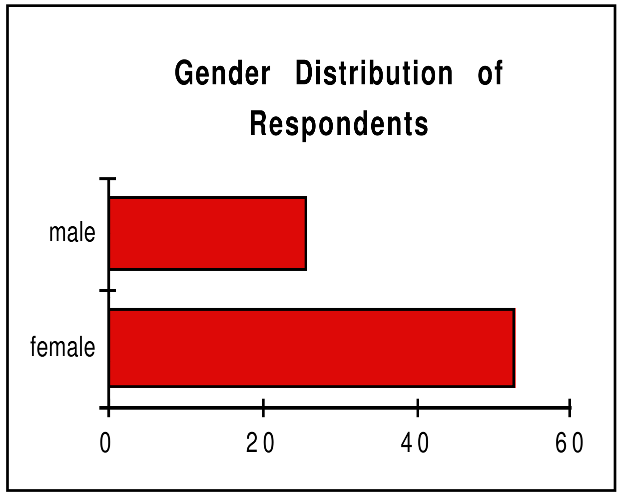


Figure 2. Gender Distribution (N=79)

Figures 3 and 4 illustrate that although there is a wide range of educational completion levels, most respondents are interested in learning more about computers.

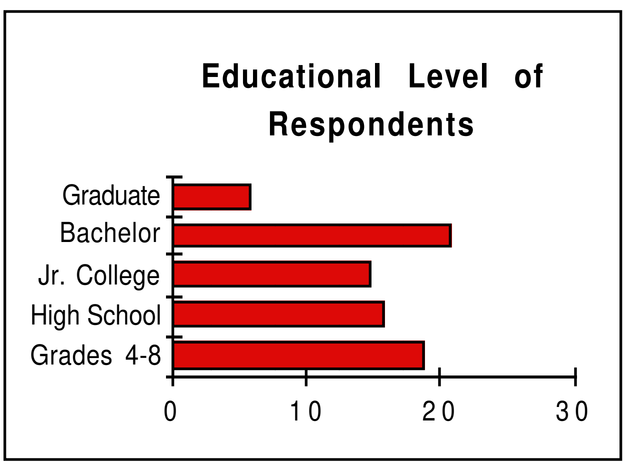


Figure 3. Educational Level (N=77)

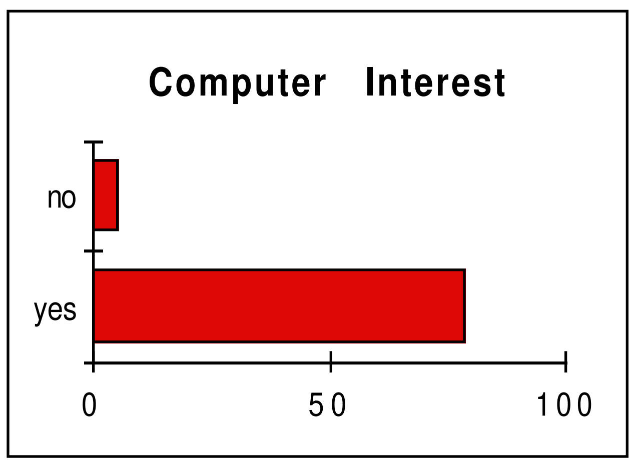
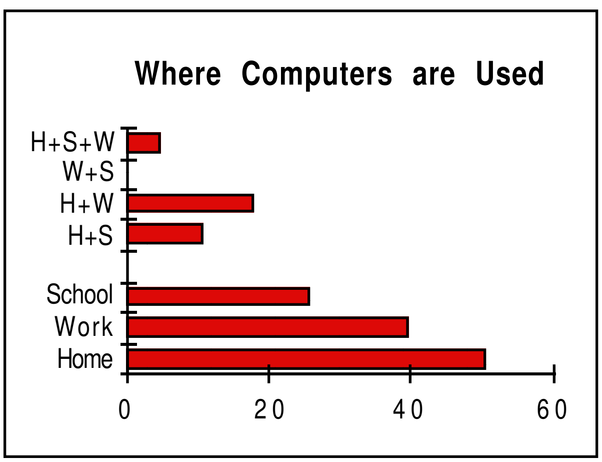


Figure 4. Interest in Learning more about Computers (N=85)

Note that all those respondents who marked grade 4-8 as highest completion were current high school students. Thus, all the adult respondents reported at least a high school completion rate.

The responses to computer usage questions illustrate the gap between interest to learn and actual experience. Figure 5 shows where respondents access computers. Ten participants did not respond to this question. As they were asked to check all that apply, the total number of responses was 117. It is interesting to note that 51 respondents reported using a computer at home (60%), a figure that exceeds national survey data on home computer penetration nationally (e.g., 37% of U.S. homes had computers in early 1995, *Communications of the ACM*, May, 1995, p. 9). Forty respondents (47%) reported using computers at work. Twelve of the 18 (67%) high school student respondents reported using computers at school. Eighteen respondents (21%) reported using computers both at home and work; eleven (13%) reported using computers both at home and school; no respondent reported using computers at work and school; and five respondents (6%) reported using computers in all three locations.

Figure 6 depicts how often respondents use computers. Twenty-nine (35%) of the respondents reported using computers on a daily basis; 20 (24%) reported using computers several times a week; 15 (18%) reported using computers several times a month; 14 (16%) reported using computers once in a while, and seven (8%) did not respond to this question. Seventeen respondents selected reasons for not using computers, with access (6 respondents) and knowledge (5 respondents) the most frequent selections. Twenty-five (29%) of the respondents reported having access to some online service. These data suggest that computer usage is pervasive with well over half of the respondents in this survey using computers in a variety of settings multiple times per week and that almost one-third have some type of online access.



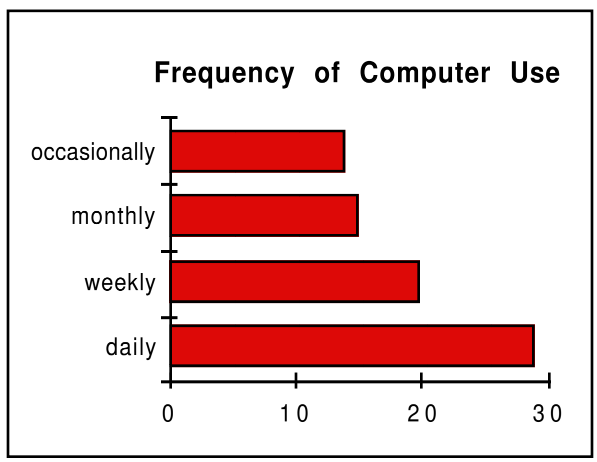


Figure 5. Where Computers are Used. Figure 6. Frequency of Computer Use

A very different portrait emerges from the responses related to the World Wide Web (WWW). Although 32 (38%) of the respondents had heard of the WWW (see Figure 7), only nine (11%) had actually used it (see Figure 8). Of those who did use it, only three were high school students so the adult users are beginning to use the WWW. Although this very low penetration of the WWW suggests that NDL access today would reach a small portion of these citizens, the facts that almost one-third now have some online access and over half are regular computer users suggest that WWW access will follow quickly as the NDL continues to evolve.

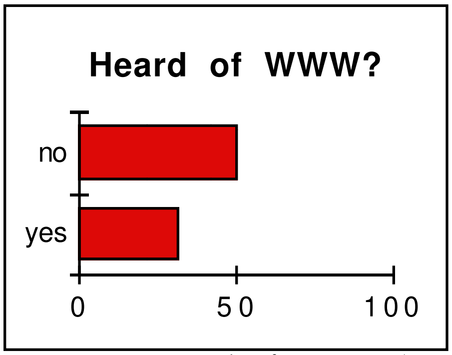


Figure 7. Heard of WWW (N=83).

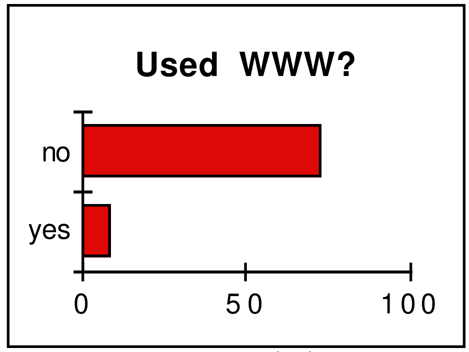


Figure 8. Used the WWW (N=82).

The questionnaire was designed to determine the basic library use facility of the respondents. The results (see Figure 9) illustrate that most respondents (50=59%) of the respondents use the library on occasion (less than several times a month). In response to the question about what reasons they do use libraries, responses varied across the categories, with school (40=47%) and reference (38=45%) garnering the

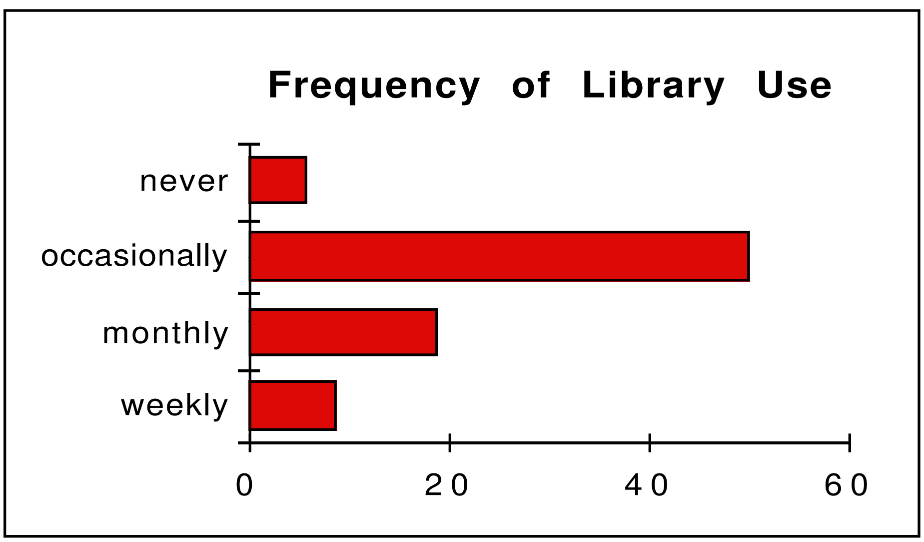


Figure 9. Frequency of Library Use (N=84)

most frequent usages (see Figure 10). It is interesting that 33 respondents (39%) selected leisure reading as a usage. Of all these usages, perhaps leisure reading is least likely to be affected by NDL availability.

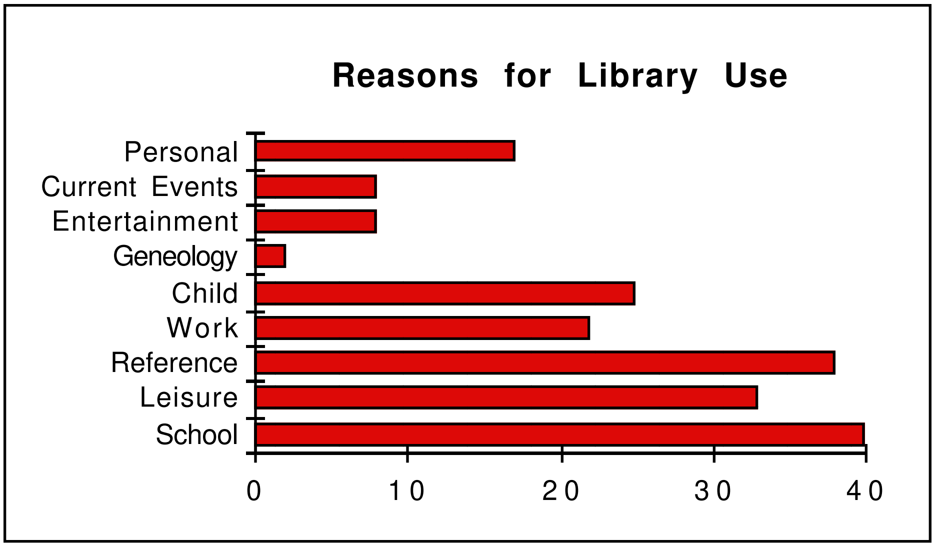


Figure 10. Reasons for Library Use.

The main objective of the questionnaire was to determine what needs exist or may evolve for the NDL. This was also the most difficult objective to achieve since subjects were asked to articulate needs related to a new entity about which they knew very little if anything. Thirty-six (42%) of the respondents said they expected to use the NDL for the same reasons they currently use libraries, however, the fact that 41 (48%) selected don't know illustrates the lack of knowledge about the NDL. To address the difficulty of eliciting information about an unknown entity, the questionnaire was designed to be open ended in this section. Although, we recognized that this would make responses more difficult and many participants would skip these questions, we wanted to provide the broadest possible scope of responses. For the question about what reasons subjects would like to use the NDL, most respondents (54=64%) wrote nothing or NA/none. Several of the respondents made generic comments about easy, fast access to information or about gaining more information or knowledge. A few made general comments about using for school and a few noted the importance for children. Five respondents gave specific information topics or types of information (World War II, genealogy, history from a different perspective, educational materials for teachers, and maps and photographs). Two respondents noted that they would use the NDL to find information not available in their local libraries. Thus, only a small number of respondents were able to give any reasons beyond generic library use for the NDL. See Appendix D for compilations of actual responses.

The question about search strategy was not answered by 53 subjects (62%). Most who did respond noted subject (11), author (5), or some combination of subject/author/title (11). Three listed browsing and a two others noted that it depended on need and by some known piece of information. Thus, the respondents mainly expected to use the NDL as they do finding aids in physical libraries. To the question about other preferable ways to find information, 10 wrote something about computers or other electronic tools (CD-ROM) and three listed a librarian.

To the question asking if they thought they could find information easier if were available electronically, 71 (84%) replied yes, two (2%) replied no, and 10 (12%) replied maybe. Clearly, these respondents felt confident about their ability to use computers to find information.

Participants were asked to speculate on advantages and disadvantages that might be expected with NDL use. Faster and easier access to information was given as an example in the questionnaire item. Forty-seven (55%) of the respondents indicated one or both of these reasons. Two of those respondents also noted that there could be more information, another noted that it would be faster since they could send information to their local printer, and another noted that there could also be many more cross references. Twenty-two (26%) gave no response. Five respondents said there would be more information; six said they could do work from home or work; two noted that they could find information beyond that available in their local libraries; two thought that they could get more precise (exactly what I want) information; and one noted that it would have no advantages since the computers in libraries were too confusing to use already.

The disadvantage question gave "slower more difficult access to information" as an example. Six respondents noted that access might be slower; seven said that it might be difficult to use the technology, three noted generic difficulty, and three noted difficulty related to finding information. Forty-five (53%) of the respondents did not answer or said no disadvantages. Two respondents were concerned with access to terminals; five noted potential problems with technology failure; three noted concerns about system overload (busy lines); one noted potential information overload; one was concerned that not everything needed would be available; three were concerned about costs; one noted that no librarian would be available to help; and one thought the entire idea was a waste of tax dollars.

The final open-ended question asked participants to list ways that they might use NDL materials. Thirty-eight (45%) of the respondents did not write anything or wrote NA. Fifteen (18%) specifically noted school work or projects; seven (8%) noted to help children (one said younger brother); eight (9%) said reports, presentations, or projects; and four said for general reference. The remaining responses related to some sort of personal knowledge: five noted general personal information; Five noted travel or vacation information; three noted general knowledge acquisition; two said knowledge of history; two said genealogy; and one each noted music/literature, multiple sclerosis, and art inspiration. One other respondent said for entertainment, and one said "just like a library."

Although it was difficult for the respondents to speculate about the pros and cons of the NDL they knew little about, the comments given do cover the commonly expressed advantages of digital libraries and provide a wide range of concerns about technical and intellectual challenges to the NDL.

3.2.3. Summary of Questionnaire Analyses.

The general populace shows interest in computers and the information resources networks offer but have limited first-hand experience with the WWW. Home access is high with some sort of online access becoming more common. Schools use a wide range of computers and many have some type of online capacity in the building but few have it in classrooms.

The day care results show that few respondents gave specific reasons for using the NDL and cited no specific collections. The media specialists gave some specific reasons but no specific collections. The teacher respondents who had participated in LC training cited specific materials. These results reinforce the theme of diversity in users, needs, and computational settings and suggest that the NDL must be purposefully introduced to potential users.

3.3. LC Document Analysis

3.3.1. Reading Room Handouts.

The first documents examined were those available in the reading rooms as handouts for visitors. There is a rich set of knowledge captured in these handouts and the NDL interface must provide some of their functionality.

- •Some of the handouts relate to physical space and working hours--functions less critical in the NDL.
- •Others provide descriptions of the collection and policies for using the collection and are clearly applicable to the NDL. A challenge is finding ways to integrate the many individual RR descriptions into a common introduction for the integrated NDL.
- •Documents that help users actually use the collection or conduct research in the field will also be as valuable for NDL users as they currently are for LC RR users.
- •Finally, the reading rooms have created specialized documents related to particular user needs or hot topics. The existence of these documents illustrate the need for some similar service in the NDL interface.

All these documents reinforce the complex nature of the individual reading rooms, let alone the complexity of the aggregate LC. Early versions of the interface can simply point to electronic versions for these documents, eventually specialized electronic versions will emerge and be integrated into the system help and guided tour components.

3.3.2. LC User Studies.

The two LC user studies offer a rich set of specific interface recommendations. Some of the impressions and commentary at the American Memory sites strictly reflect individual preferences, however some trends were common across many sites, for example:

- •students preferred buttons to pull-down menus,
- •there were many instances of poor understanding of search strategy (e.g, misunderstanding Boolean AND, lack of systematic reformulations or use of results),
- •complaints about time to use the system (both physical access due to a single workstation and response time),
- •teachers noted that linkages between the primary material and their curricula would be beneficial (a common use for the content and system was as an enrichment adjunct rather than an integral part of the course), and
- •several noted that it is essential that materials can be printed and/or saved to disk.

The P&P WWW Public User Interviews identified a variety of navigational problems, for example:

- •basic graphical user interface literacy (e.g., knowing how to use a mouse, how to scroll, using pull-down menus),
- •moving among levels of representation (e.g., among full image, thumbnail, and brief display), and
- •losing buttons after scrolling.

The search strategy problems identified included:

- •confusion regarding relevance ranking of results
- •need for easy-to-use alphabetical subject headings (system had them available and scrolling required),
- •limiting hit lists to 100 and converse of too many to look through
- •need for posting data after all moves.

Both of these sets of results highlight challenges for the NDL interface. In addition to reinforcing the importance of computer experience, these findings illustrate: the need for crisp and intuitive dynamics between screens/windows so that users can focus on different levels of representation easily or possibly juxtapose them; judicious use of any scrolling functions; and the need for clear yet powerful search articulation and results display.

3.3.3. Email messages.
The sample of electronic mail messages answered by Beth Davis-Brown provide an interesting mosaic of users who are actually using the infant NDL and the types of information needs and problems they bring to the Library. Based upon a content analysis of user messages, Davis-Brown's responses, and her brief classificatory commentary for the exchanges, the messages fall into three broad categories: system, user needs, and miscellaneous.

The system category includes the following types of messages:

- •praise (compliments about the NDL)
- •crashes (complaints or inquiries about server or telecommunications problems)
- •technical questions or suggestions (difficulty launching video players on client, suggestions for alternative data formats)
- •suggestions to add:
  - content (add specific collections)
  - indexes or services (one interesting request was for a zipped index of the NDL that could be downloaded and used locally to save connect charges)
- •corrections (e.g., mislabeled photograph).

The user needs category includes the following types of messages:

- •reference questions (e.g., census data for NY state 1600-1900 and how to find it)
- •requests for special collections (e.g., HABS drawings of historic buildings, America eats collection, Walker Evans and Marion Post-Wolcott photographic negatives, etc.)
- •requests for specialized services (e.g., photograph copy requests online)
- •requests for help (some in Locis or another service; some need help in using the system--e.g., “Where is the search function?”; some have done searches and want help in narrowing; others confused about what to ask, where the mail is going).

The miscellaneous category includes the following types of messages:

- •contributions of two types
  - specific items (e.g., want to donate a photograph)
  - URLs (requesting LC to link to their web sites)
- •job seeking (to work on NDL)
- •general communication (some users reply with thanks and commentary to a reply to their earlier message--want to maintain dialogue).

Taken together, these documents capture a wide range of knowledge about the LC, the users who use it, and the types of information needs they bring to it. The existing documents must be captured and integrated into the NDL. Analysis of future email will surely contribute important data as the system evolves and new, systematically scheduled user studies are highly recommended.

4. Conclusions and Recommendations

4.1. User Type/Task Taxonomy.

A central theme emerging from this investigation is diversity. There were wide ranges in users, the tasks they bring to the NDL as manifestations of their needs, the technological settings they work in, and in the wide variety of content that makes up the NDL. To integrate the results from the different components of the investigation it is useful to revisit the nature of users and needs in light of the types of user communities identified before data collection began. It seems clear that the three communities (LC staff, current scholars, and prospective NDL users) are too broad to capture the diversity or to fully guide the interface design.

A more fine-grained classification is possible by combining the analytical framework of users and tasks (Marchionini, 1995) with the empirical data from this investigation. The analytical framework crosses users, tasks, and the personal situation that motivates the search.

Users have a host of individual characteristics, preferences, and experiences which are not orthogonal:

- •personal attributes (physical, cognitive, social),
- •experience in the domain of knowledge related to the information need, and
- •experience in using library systems and research techniques.

Five non-orthogonal dimensions of the information seeking task are:

- •complexity (both the number of facets involved and the level of abstraction),
- •specificity (how confident the user is to determine the accuracy and completeness of results),
- •quantity (the amount of information expected),
- •criticality (how important it is that the need be met), and
- •timeliness (how much time the user is willing or expects to invest).

Analytically, we would define scales for each dimension (e.g., low, average, high) and populate the resulting matrix with examples or cases. Assuming three points per dimension, we would have 27 cells for user characteristics and 243 cells for tasks. Crossing the two matrices would yield 6561 cells to fill. Adding the many types of motivations and situations that contextualize specific instances of information seeking similarly expands the theoretical possibilities. Clearly, this approach is a) impractical due to the large number of variations for which interface features are considered, and b) minimal and simplistic on the user characteristics side.

A more realistic approach is to collapse some of the dimensions in light of the empirical evidence collected in the reading rooms, surveys, and document examinations. Based on the evidence, factors that characterize users are:

•motivation (the personal situation that brings users to the Library)
•domain knowledge (related to the particular need)
•library system knowledge
•focus (a combination of complexity, quantity, and specificity) and
•time allocated (combining timeliness and criticality).

These factors are applied to the different types of users and user needs described in the reading room visits. Such an approach yields then nine user classes listed in Table 2. These classes are not exhaustive, nor are they mutually exclusive. Moreover, any individual belongs to a class for each information need (i.e., in different visits or sessions users may fall into different classes). It is highly likely that this taxonomy will change as the NDL evolves since it is rooted in data that come from a mix of current users of the physical LC, early adopters of the nascent implementation, and non-users asked to speculate about using it.

Such a taxonomy will be useful to the interface design in three ways. First, it will guide the development of features that substitute for the reference interview. Since a human resource will not be readily available, the system must provide ways for users to articulate specific needs (e.g., queries) as well as contextual information (e.g., granularity and scope of need). A set of user templates varying according to the parameters above may be helpful in meeting this fundamental interface design challenge. Second, the taxonomy will provide the basis for variations in interface features such as help, tours, and tutorials. Third, the taxonomy will provide the basis for testing prototypes with scenarios. A previous version of this taxonomy was used by the NDL Working Group to develop brief scenarios that will be used to guide and test the interface prototypes. An aggregation of the scenarios is attached as Appendix E. As the taxonomy evolves, new scenarios will be created to guide and test the interface prototypes.

4.2. Design Implications.

The first interface prototypes must aim to satisfy much of the user diversity. This needs assessment has identified many design challenges specific to LC. Table 3 summarizes these challenges. As the design process proceeds, these challenges will be prioritized. It seems clear that all the general challenges should be considered first as design progresses.

Table 2. User Taxonomy.

1. LC staff. high motivation, medium domain knowledge, high library system knowledge, high focus, and limited time allocations

2. Hobbyists (e.g., genealogy, Civil War, railroads, other examples). high motivation,

typically high domain knowledge, a range of library system knowledge, high focus, and high time allocations

3. Scholars (e.g., historians, sociologists, anthropologists, authors). high motivation, high domain knowledge, high library system knowledge, high focus, and high time allocations

4. Professional researchers (e.g., picture researchers). high motivation, medium domain knowledge, average to high library system knowledge, very high focus, and medium time allocations,

5. Rummagers (browsers) (e.g., PhD students looking for topics; scholars looking for new directions, topics). high motivation, medium domain knowledge, range of library system knowledge, low focus, and medium to high time allocations

6. Object seekers (e.g., some authors, CD-ROM/multimedia developers, TV/video producers, instructional materials developers). high motivation, range of domain knowledge, low library system knowledge, high focus, and low to medium time allocations

7. Surfers (e.g., those who are curious, those who bump into the NDL, etc.). low motivation, low domain knowledge, low library system knowledge (but may be high computing system knowledge), low focus, and very low time allocations

8 Teachers K-16 medium motivation, medium to high domain knowledge, low to medium library system knowledge, medium focus, and low time allocations

9. Students K-16 low to medium motivation, low domain knowledge, low library system knowledge, low to medium focus, and low to medium time allocations.

This needs assessment has identified a wide range of users and needs and corresponding interface design challenges. The interface must communicate to users what the NDL is and is not, i.e., is composed of multiple but not uniform data types (both formats and levels of representation) and is not the entire LC let alone entire Internet. The interface must help users see that the NDL has multiple but not uniform access points (entry points are useful for some objects but not others). It must support a range of search strategies from hierarchical selections to formal and comprehensive queries so that novices and experts are all well-served. It must provide help and guidance and emulate the reference interview. It must be usable on a variety of platforms and sensitive to a variety of physical infrastructures. The interface must allow users to meet their needs without the benefit of a human intermediary and for casual users it must do so without long processing delays.

These are strong requirements and the degree of success will depend on how the challenges identified in this investigation are prioritized and used to guide and test the prototypes in the months ahead. The general user needs identified in this assessment require a range of interface features.

- •Serving users ranging from school children through seasoned scholars, including those with special needs, implies an interface that supports a range of information-seeking strategies from easily-navigable selections to complex queries.

- •The lack of human intermediaries requires that the interface provide significant help, tutorials or tours, and last resort communications.

- •Serving a range of user platforms implies multiple interfaces that provide a default lowest-common denominator interface (e.g., low-speed, all text) as well as a graphical interface that takes advantage of visualization techniques.

- •The nature of the NDL collection implies that the interface must provide clear delineations within the NDL and among the larger collections of the physical Library of Congress and the entire Internet.

- •The interface must clearly distinguish secondary and primary materials.

- •The interface must also distinguish and rapidly display texts, graphics, and sounds to facilitate browsing, as well as find ways to support non-textual search for non-print media.

- •The interface should also allow users to search across collections or not, and if they choose to limit searching to a collection, provide clear linkages to other collections.

Table 3. Interface Challenges

Content - interface challenges

General interface challenges across reading rooms

- •developing a framework characterizing for users the granularity, size, and nature of objects in the NDL across all the reading rooms
- •communicating to the user what items are NOT in the NDL
- •supporting users in the NDL without human intervention
- •creating an interface that is accessible to users with state-of-the-market technology
- •inventing new techniques to search for multimedia objects and to integrate those techniques into the interface (e.g., visual and audio query languages)

Specific interface challenges from different reading rooms

- •audio access (searching as well as download times)
- •access to multi-format items (i.e., a sound track and textual fieldnotes)
- •user specification of areas/regions on maps
- •place name ambiguity
- •identifying and representing links
- •distinguishing documents that help one do genealogical research from the primary materials

•integrating full-text and controlled vocabulary searching both across and within collections

- •distinguishing finding aids levels and primary material
- •need for linkages from browsable covers to bibliographic records and microfilm text available at LC
- •image searching (including displaying series of related images and images in challenging formats such as panoramas and oversized posters)--possible use of P&P thesaurus;
- •enabling researchers to absorb enough of the context for historical images and captions (why images were made) to deal sensitively with content that might otherwise be deemed offensive.

Users and strategies - interface challenges

General interface challenges across reading rooms

- •serving a wide range of users
- •serving a wide variety of information needs
- •helping users distinguish primary and secondary materials (including multiple layers of each)
- •helping users make links among items across different collections and reading rooms
- •capturing the essential elements of the reference interview so that users can find what they need without human intervention

Specific interface challenges from different reading rooms

- •specifying geographical areas

•potentially huge files to transfer and display

- •determining when to point users elsewhere
- •helping LC NDL users to quickly understand that few of the primary materials are online
- •helping LC NDL users to quickly understand that there are many levels of search to work through
- •identifying copyrighted materials (so patrons do not find pointers to them and expect they can come and copy them at LC)
- •supporting hot topics, specialized exhibits
- •overcoming patrons lack of knowledge about media (e.g., how pictures were produced at different times)

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