Browse and Search Patterns in a Digital Image Database

C. OLIVIA FROST   cfrost@umich.edu
BRADLEY TAYLOR
ANNA NOAKES
STEPHEN MARKEL
DEBORAH TORRES
KAREN M. DRABENSTOTT
University of Michigan, School of Information, Ann Arbor, MI, 48109, USA

Abstract.   A prototype image retrieval system with browse and search capabilities was developed to investigate patterns of searching a collection of digital visual images, as well as factors, such as image size, resolution, and download speed, which affect browsing. The subject populations were art history specialists and non-specialists. Through focus group interviews, a controlled test, post-test interviews and an online survey, data was gathered to compare preferences and actual patterns of use in browsing and searching. While specialists preferred direct search to browsing, and generalists used browsing as their preferred mode, both user groups found each mode to play a role depending on information need, and found value in a system combining both browse and direct search. There were no significant differences in performance among the search modes of browse, search, and combined browse/search models when the quasi-controlled study tested the different modes.

Keywords: browsing, digital images, image retrieval, user studies

1.   Introduction

One of the primary attractions of browsing is that it allows users to recognize what is interesting rather than formulating a precise information query in advance. Browsing can serve a unique role in retrieving visual images, since as Arnheim (1970) observes, a pictorial image is able to present itself whole and in its own medium of expression, and thus has the potential to allow users to employ their cognitive abilities to scan image content within sets of images to retrieve desired information. Shatford Layne (1994) maintains that browsing through a group of images can allow users to search for single images, and that indexing the basic elements of an image and thus emphasizing recall rather than precision would allow users to rely on scanning, or browsing, to make the distinctions needed to refine a search. Kwasnik (1992) asserts that browsing has an added advantage of helping users navigate without prior knowledge of subject content; a point made also by Bawden (1993, p. 72) who notes that browsing has the particular and unique advantage as "a simple and convivial form of access to information sources, particularly for occasional and inexpert users."

This article describes research which explores the role of browsing in information retrieval of images. A research project at the University of Michigan School of Information (formerly

the School of Information and Library Studies—SILS) conducted user studies which included experts in art history as well as generalists. The study used focus group interviews, and tested a prototype browsing system in both a controlled study and in an online survey of users of the image browser. The prototype browser was constructed specifically to test browse and search usage patterns, and as a result was able to gather information about usage patterns of both browse and search, in addition to qualitative data concerning search preferences and desired features. The controlled study and online survey provide quantitative data comparing browse and search effectiveness and preferences. The focus and post-test interviews provide qualitative data to give context to help explain the quantitative findings. The role of broad classification categories used in grouping image sets in the SILS Art Image Browser is discussed in two previous papers (Frost/Noakes 1998) and (Frost 1996).

2. Previous work

Providing intellectual access to images to a broad set of users is challenging on a variety of levels. There is the problem of providing descriptor terms which the non-specialist can understand and use, and there is the additional complexity of dealing with content at a variety of levels. The challenges of developing descriptors which will match terms that users may bring to a query is brought out in Enser's (1993) study of user-assigned descriptors in an image collection.

There is a considerable body of theory and some research on approaches to provide intellectual access to images through subject content, with the primary focus of this literature centered on art history. Panofsky (1962) categorized art into levels of pre-iconographic (primary subject matter—a level requiring knowledge of practical experience and thus accessible to everyday users); secondary subject matter or iconographic (secondary subject matter, or study of subject matter or meaning in art, thus requiring more specialized knowledge), and iconological levels of subject description, requiring yet another level of specialized knowledge.

Shatford (1986) stresses the distinctions between what an image or representation is of and what it is about, and calls for a theoretical basis providing general principles that could guide the provision of subject access for images. Krause (1988) argues for the importance of indexing the subjective as well as objective characteristics of image content. Markey (1988) points out the prevailing emphasis on secondary approaches, and the need for increased access to primary content. Leung (1992) likewise argues that systems developed for art history specialists restrict access to users outside this area, and that the emphasis of this discipline on iconological interpretation to art images fails to serve non-expert users. He proposes an alternative approach to subject analysis called Picture Description Language, which is based on an entity-attribute-relationship model for data, permits natural language description, and allows the relationships between elements of a picture to be described.

Image indexing and retrieval has also received much attention lately in the computer science community (Jain 1997), (Gudivada 1995), with the emphasis of research being placed on content-based retrieval systems which allow users to search images by visual features. To date, retrieval based on visual characteristics is computationally intense and has not yet reached the point where it can be efficiently used to formulate intellectually

subtle queries, especially for non-specialist users. Content-based retrieval techniques have also been applied to a collection of digital art images (Holt 1994).

Research in content-based retrieval has not to date included much emphasis on a user-centered perspective, and there is much to be learned about use of these systems and requirements which will make the systems of interest and value to a broad set of users. There is relatively little interaction between researchers active in retrieval of images by visual content and those dealing with retrieval by semantic or conceptual content. Cawkell's (1992) study of co-citation patterns between the two fields, and the lack of collaborative research efforts, suggest this is a rich area for exploration.

Besser (1990) describes an early pre-network prototype, the UC Berkeley's Image Database Project, which provides indexing terms to identify documents of potential interest, and surrogate images which provide visual representations which users can browse to determine which documents are relevant. Ester (1991) looked at users' requirements for the quality of surrogate images of art objects. Issues in image indexing and users' query types are addressed by Keister (1994) and Jorgensen (1996). A study by Hastings (1997) explored problems of image retrieval in a database of 66 paintings of Caribbean art made available on a distributed network; survey data, interviews, and query analysis were used to examine categories of queries and types of index access points used in searches of digital art images.

A review of the literature on qualitative methods in information retrieval with a focus on users is given by Fidel (1993). Bawden (1993) provides a literature review of discussions and research related to the process of browsing, primarily from a text-based information retrieval perspective. Very little empirical research has been done to gain a user's perspective on the role of browsing in the use of digital image resources in a networked environment, or to compare browse and search strategies in systems which provide surrogate images in digital image databases Rasmussen (1997). The research described in this paper is distinctive as a user study which focuses on the use of browse and search patterns among both art history specialists and non-specialists (generalists) in digital image collections, and which compares image retrieval of specialists and generalists in a relatively large image database developed specifically to test browse and search patterns.

Research questions

The focus of this study is on browsing in image retrieval and the factors which can influence its effectiveness, such as user preference and search behavior, system design and size, resolution and downloading speed of images used for browsing. For browsing to be of value to users, it must fit the way in which users search for information. For a browsing system to be effective in helping users to scan a gallery of images, trade-offs will have to be made concerning image size, resolution, and downloading time. In order for the user to view and scan group of images to form a set for browsing, images will need to be small enough to fit on the screen, yet large enough for the user to ascertain if the image is of interest and value. Users scanning an image will also need to have images of a certain quality of resolution.

Research questions dealt with users' perceptions of browse and search in image information retrieval, as well as with users' actual experiences in interacting with an information

retrieval system which provided both browse and search capabilities. Themes in the research questions were explored in all three parts of the study. The subjects in the online and quasicontrolled study were able to formulate opinions directly related to their experiences in trying out an image browser offering browse and search capabilities. All three studies looked at differences between domain experts and generalists. The focus group part of the study asked users to consider questions based on their own experience, rather than direct experience with the prototype browser. The quasicontrolled and online studies asked questions after users had tried out a prototype browsing system. The following section describes the methodology design of the three studies.

Methods

Focus group study methodology

A series of focus group interviews gathered qualitative data on a variety of topics relating to visual resources and online image databases. The interviews, conducted on the campuses of two large midwest universities over a six month period, led assembled art "experts" and "generalists" through a series of open-ended queries covering such topics as information seeking; general uses for art images; preferences for searching or browsing for art images; what text-based information subjects would like to see accompanying online images; and, specific features subjects would most like to see incorporated into an online image delivery system. Subjects were categorized as either art experts (masters degree or higher in history of art, art or architecture, or fine arts) or generalists and were interviewed with other members of their cohort group, with subject group sizes ranging from as few as four to as many as eleven.

In analyzing data from the focus group interviews, each transcript was indexed thematically to create new subject oriented overviews distinguished by expert or generalist status (i.e., pertinent passages on information seeking behavior were culled from each of the transcripts and combined, being distinguished only by expert status). The research team was thus able to identify dominant themes across all the interviews and to determine particular points of view that might be associated with relative expert status. An important part of this study was the collection of narrative-intense qualitative data, which provided a rich context to trends seen in the quantitative parts of the study. This paper includes much of the narrative from the original interviews, in order to provide richer detail for the themes that emerged from these discussions.

Quasicontrolled study methodology

A prototype system, the Art Image Browser (http://www.si.umich.edu/Art_History/), was tested and evaluated by a group of art history specialists and generalist users. The Art Image Browser allows users to choose a browse or search approach, or to combine the two. If the browse option is chosen, the user makes selections from a menu organized by broad conceptual categories of artist, title, date, medium, object type and subject. After choosing a category, users can view sets of thumbnail images. The resulting displays contain 1 to 20

images per screen. The user can then click on the thumbnail to retrieve a record containing the thumbnail and accompanying textual information. At this point users can also retrieve a full-page image. Users could choose the direct search function using keywords at the outset of the search, and can also activate the search modality at any point in the browse stage. Search queries can be executed using any of the category fields used for the browsing (e.g., artist, medium). The categories can also be combined.

The Art Image Browser was used for both the quasicontrolled and the online study. The collection's content was in large part determined by the availability of images which were free of copyright constraint. The database consisted of approximately 2,500 digitized images built from collections in the University of Michigan's Museum of Art, History of Art Department, Kelsey Archaeological Museum, and a private collection of photographs of Chicano murals. The collections spanned several centuries of art primarily from North America, Europe, Asia, Africa, and the Middle East, and include photographs, paintings, prints, drawings, murals, sculpture, and archaeological artifacts. Metadata was provided by the participating contributors of the collections.

The research design allowed a comparison of the modes of browse using broad categories, keyword search, and a combined modality using a combination of the two. The research also looked at the differences between art history experts and generalist users. Subjects were randomly assigned to two of the three different search modes, and were assigned tasks to find images in the data base, e.g., "Find a stoneware vase," "find an oil painting by Renoir." The test tasks covered a variety of search attributes, and each image in the test could be located a variety of possible search paths. Demographic data was collected for each subject, including familiarity with the web and with the subject content. Post-test questions asked subjects to compare their experiences using the two systems, as well as suggestions for system improvements.

Since the prototype system was designed to be used in a distributed computing environment, the quasicontrolled study of the system took place in a number of distributed locations—campus computing sites, libraries, university residences, and offices, as well as at private homes. A minimum modem speed was required so that system speed would not unduly reduce the time needed to complete search tasks.

Online study methodology

A second test and evaluation of the prototype browser was conducted using an online survey with 15 questions covering four general categories: 1) users' education level and academic area of specialization; 2) individual use of the browser; 3) issues of image size, load time, and image resolution; and 4) two open-ended questions to elicit comments about possible enhancements to the browser. Participation in the study required a WWW browser capable of displaying forms in order to fill out the questionnaire. A hyperlink was added to the front page of the browser inviting users to take part in the survey. Viewers could then go to a page containing a short explanation about the survey and a release form soliciting the user's permission to participate in the study. After consenting to participate, the user was then presented with the online questionnaire. In contrast to the quasicontrolled study, users were not asked to do specific searches but instead responded on the basis of searches they

had already performed on the browser. After completing the questionnaire, a click on the "submit" button sent the response to a server. The online survey was available on the Art Image Browser from the end of March 1996 to mid-August 1996.

Profile of respondents

For purposes of the study, an expert was defined as a person holding a master's degree or higher in the disciplines of art, art history, museology, or architecture. Since the only requirement for generalist status was the absence of an advanced degree in the history of art (or related disciplines), generalists comprised a diverse pool of subjects. The same definition was used for the focus group interviews, the quasicontrolled and the online studies. The following section provides a profile of individuals participating in the three studies.

Focus group profile

The focus group sample was comprised of 74 individuals broken into 11 groups (5 expert groups; 6 generalist groups) drawn from the campuses of two large midwestern universities. Generalist subjects were recruited through personal connections and through e-mail messages posted to a listserv maintained for librarians affiliated with the university residence hall libraries. The seven generalist units included university groups of counselors, social science librarians, graduate students, undergraduates, and community based music administrators.

Given the narrow definition of expert groups, most expert participants were recruited by direct inquiry. The five expert groups were comprised of: three faculty groups representing departments in the history of art, fine arts, and art and design; one group of museum professionals, including curators, registrar's staff, and museum educators; and one group of visual resources curators. The only expert population not represented in the study were graduate students in the history of art or fine arts. In spite of repeated attempts by the research team to recruit subjects, no participants emerged.

Profile of quasicontrolled study respondents

The quasicontrolled study included a total of 31 subjects comprised of 9 experts and 22 generalists. The expert group was comprised of faculty and advanced graduate students from local university and museum locales. Subject expertise was in art and design, art history, and architecture and urban planning. This group also included curatorial staff in art and archaeology museums, and in the art history slide and photograph collection. Generalist subjects were recruited from university residences and various academic departments.

All of the expert subjects and 91 percent of the generalists reported daily computer use, with the remainder reporting weekly use. Over half of the expert subjects reported using the World Wide Web at least weekly, and a third monthly. Over three quarters of the generalist group reported using the Web at least weekly, one quarter only a few times per year, and a little under a tenth had never used the Web before. Over three quarters of the expert group

had had some prior use of the prototype system, and eight of ten reported being familiar with the subject content of the images used in the browser searching tasks. None of the generalists had used the prototype browser prior to the study; however, about half of them said they were familiar with the images encountered in the search tasks.

Profile of online study user subjects

Respondents were recruited through e-mail messages sent to electronic mail discussion groups including ARLIS-L (Art Libraries Society), IMAGELIB (Image Libraries), MUSEUM-L (Museum professionals) and VRA-L (Visual Resources Association). In June 1996, the team also registered the browser with Yahoo, a directory of URLs organized by subject, and with ArtsWire, a WWW site, sponsored by the New York Foundation of the Arts, which maintains a searchable database of art-related sites on the Internet. A total of 66 responses were received, of which all but two were usable.

A little over a quarter of the respondents were determined to be art specialists, using the criterion established for the study. More than three-quarters of the respondents reported being very familiar or somewhat familiar with what they were searching for in the browser. Overall, the majority of survey respondents were college educated. All experts had education beyond the bachelors degree with almost three-quarters of the experts holding a masters degree. Of the generalists, 85 percent reported holding a bachelors degree or higher. Seven out of ten expert respondents reported a primary specialization in art history. Other specializations for experts were art and architecture, with none reporting a specialization in museology.

A third of the subjects reported having an ethernet connection. More than a third reported a modem speed of 14.4 or faster. About twenty percent each had speeds of 14.4 and 28.8. Twenty-two percent did not know their connection speed. Just under half reported having the "auto load images" setting on all the time.

Results

How are images used at the workplace and at home?

Subjects identified a variety of ways in which images are used. In the focus group study, both experts and nonexperts first relate the use of images to ways in which they might be used as part of their work lives. Experts identified research, teaching, exhibition planning, collections management purposes, and public outreach as specific activities that involve the use of images, and spent considerable time discussing the use (and relative merits) of images in classroom situations. They supported the use of online image searching toward the end of locating specific images, though they were hesitant about using digitized images for study purposes.

Generalist groups identified promotion and advertising and public education as work-based activities that might involve the use of images, but also pointed to hobbies, home entertainment, and children's education as ways in which art images might be used outside the workplace.

How do users look for images?

Obvious distinctions in information seeking were apparent between expert and generalist users in the focus group study. As expert users, academics and curators knew not only how to use a variety of print based reference sources and the local slide library, but spoke as well to the role that exhibition and auction catalogs, and web searching played in their search for images. Generalists spoke with less certainty about specific resources that might support their searches and were more likely to speak generally about asking a librarian or a museum curator for direction. A certain number of the generalist students thought it was easiest to begin a search for images by looking on the web: the searches they described would most often begin at a specific institution and work out from there as information on artists or periods of interest emerged. Generalists also mentioned the significant role that bookstores and framing shops might play in their search for images.

Do users prefer browse or search modes?

The quasicontrolled study provided data on the subjects' preferences for the browse, search, and hybrid systems. As expected, experts preferred the search to the browse system, and by a strong margin: 5 to 1. However, the browse function is not without its value to these users, and it is interesting to note that the ratios of preference were equal when comparing the search to the hybrid system. The generalist users preferred the hybrid to the search mode, but by a closer ratio: 6 to 5. They preferred the browse to the hybrid 3 to 2, and the browse to the search 7 to 5.

To what extent are preferences influenced by the type of user and the use to which the image is put?

In the focus group interviews, experts and generalists alike expressed interest in being able to both directly search for known items and to take a broader browsing approach when looking generally for images (e.g., looking for images with flowers as opposed to paintings by Monet with flowers). Preference for searching vs. browsing was tied more to the task at hand than to relative expert status. Since experts, by definition, are likely to be more familiar with artist names, types of artistic media, and titles of specific works, they would be more likely to be able to effectively use a search option than would generalists. Generalists thought their searching could be enhanced with either pop up menus offering a selection of names, movements, etc. or through the ability to use pattern matching to retrieve "more images that look like this." Nonexperts also voiced a strong desire to be able to search by general stylistic periods (e.g., Rococo, Victorian), though experts were equally vociferous in their insistence that such distinctions are so imprecise as to be meaningless as search categories.

   Comments in the post-test interviews in the quasicontrolled study group suggest that preference for searching vs. browsing was tied more to the task at hand than to relative expert status. Many generalist users felt that the browse system and the search system performed equally well and that a choice between the two was an individual matter of preference, and as one commented "It depends on why you're looking, what your goal is, and personal preference." Another quasicontrolled study subject felt that the hybrid system

would be preferable for image-oriented tasks and the direct search system for data-driven or bibliographic searching tasks.

Markey (1988) points out the different approaches which scholars in art history may employ when seeking subject access to visual resource collections. Some comments from the focus groups shed some insight on the varied ways in which specialists may look for a work of art and on the value of browsing even to users who are very familiar with the subject area. For many of the expert members of the focus groups, image use in teaching was based on concepts that the instructor is trying to convey in lectures, rather than a focus on specific artists:

> "I start off with an idea rather than looking at other artists. I don't necessarily look at other artists' work as much as I would look to ideas."

> "Images are very important to get across concepts, ideas, to challenge students to move beyond the point . . . It's not like I'm looking for the work of other artists."

> "The indexing structure of an artist is not what image browser people think it is. It is not based on just images. It is based on concepts."

These themes were similarly reflected in the comments of generalist focus group members, who pointed out advantages gained by browsing when the user was not able to articulate a known item search, or when the priority was on ideas.

> "When I would search or when I would browse would depend on what I was looking for. If I'm looking for something colorful or something flashy, then I might browse a set of images and see one that strikes my eye and hopefully they'd be nicely arranged into different thumbnails. But if I'm looking for something specific, say I was writing a paper on Monet, and I wanted to put one of Monet's pictures in, I would want to be able to get to a Monet specifically and do that."

> "Well, sometimes you're looking for something, you've got a very specific idea of what you're looking for, and you just want to get to it. And other times, you want to be fed ideas, and stimulate your own thinking . . . ."

Expert users who were curators of image collections also felt that their generalist clients are focused more on concepts or subjects than specific artists:

> "People from outside the department want subjects and they don't know, they don't care what artist, or they don't know what artist, they don't care what country or what medium, they want subjects, because they're trying to illustrate some point they're making in their history class, or their comparative literature class or their medical illustration class."

What are the levels of subject approach in which users may be searching?

Whether as a browse or search option, subject or concept categorization will be problematic; particularly for art, where intrinsically there are different levels of subject meaning.

Panofsky's (1962) categorization of three levels of subject matter into primary, secondary, and iconological is useful to remember here. As one expert in the focus group commented,

> "Standardization of subject terms can be really tricky. A lot of it depends on whether you're dealing with content or symbolism or allegory; I mean, there are all these different levels. I know for the museum, it tends to be content-based, what's in the subject category, if there is anything in the subject category at all."

> "Iconographical information as subject matter is also very problematic, because images are very complex. There are many many ways that people now are using images for social historical, intellectual historical, religious historical reasons . . . there are many many many possible motifs that could be analyzed."

Experts also identified the differences between subject categorization that would be used by domain specialists and lay users; in particular, primary versus secondary subject matter:

> "Art historians might have assigned certain keywords, which are important to them because of their background, or that's the way they've been trained to think, and those are the key things that they think to jot down, whereas a lay person might be keying into something for some other reasons, like they notice that there's this little dog in the corner, but that's not at all what the main subject is about, but that's all they can remember."

> "I think it would be helpful to have a search option for elements of a painting, because let's say you're looking for paintings that have some kind of image, like clocks, some kind of reference to time, or trees, but that's not the subject of the painting. You're looking for paintings that have some sort of nature background, or that are portraits. I could see how that could be useful, especially for people in museums, or galleries."

> "Yes, it would be interesting to have the ability to search by the elements in a painting, whether or not they're the subject of a particular work of art—ability to search by keyword 'dog,' and look for all of the images that are described by keywords that have dogs in them."

One expert described a situation in which a colleague's need for primary subject matter departed from his usual approach:

> "The other day, two of our faculty members just had a baby, one was going off to class and was looking for images of mothers with children, but not with Madonna and child—and was so tired, he'd obviously been up all night with a new-born baby and couldn't think of it! That was unusual for an art historian, because he didn't care who the artist was, or whether it was sculpture or painting."

An additional dimension of operational difficulty is posed by the lack of adherence to standards in cataloging of museum collections, and the resulting lack of subject information provided in the record. It should be noted that subject descriptors were lacking in the data provided for many of the images in the Art Image Browser; largely due to the prevailing cataloging practices of the image providers whose collections and cataloging data formed

the basis for the database. Subject terms which did occur were often lacking in vocabulary control. These practices notwithstanding, many of the expert users in the quasicontrolled group still insisted that subject terms needed to be provided for all images in order for subject searching to be a useful strategy. Even one of the generalist respondents in the online study called for greater consistency in subject terms, and the use of established thesauri such as the Library of Congress Thesaurus for Graphic Materials.

Do users prefer subject, title, or author search?

The study gathered data on preferences for author, title and subject search in image searching. One expert in the focus group said that subject searching is "not the way the curators necessarily search, but, that's the major way the people want it," but another noted that even expert users will search by subject when in unfamiliar collections or topic areas. In the survey of online users, subject and artist search were of relatively equal value to users. The categories chosen most frequently were searching by artist (26 percent) and by subject (20 percent), with no notable differences between expert and generalist users. Experts searched using the artist category almost a third of the time (31 percent) while generalists searched this category a quarter of the time. In contrast to the quasicontrolled study, experts in the online study searched using the subject category in about the same percentages as the generalists (22 percent, experts; 19 percent, generalists).

Title search was seldom used in the online survey (5 percent). In the focus groups, one generalist observed,

> "If you're looking for paintings or drawings or something specific by a specific artist, you might not actually know the painting by its title, you might only know it by how you've seen it. Like I know quite a few paintings from like older periods where I would have no idea what the name is, I only know the artist, I only know what they look like."

Some in the focus group study envisioned in theory the multiple search and browse options offered in fact by the Art Image Browser: "I'm picturing sort of the keyword entry space [with options for several categories including]: century, region or country, style, and even artist, though of course that would get a little unmanageable. There would be several different categories, and if you know some, you know three out of four, go ahead and enter those, but that fourth you're not sure of, you can click on the arrow and scroll down to whichever one you're curious about."

On their wish list, focus group members saw a need for a wide variety of search options, as voiced by one expert:

> "Maybe at one point I want to pick a particular artist, or a particular period, and sort of flip through what those options are. Or maybe I want to see it through a particular museum: 'Let's go to the Louvre,' and see an array of options, or maybe I want to access it by type of artist, by gender, by ethnicity, by sexual orientation. I could have all kinds of reasons why I would want to find out something about the art out there, and I might want to slice it in a number of different ways, depending on why I'm looking for it."

How do users view the advantages and disadvantages of browsing?

For many generalist users in the focus groups, browsing offers a distinct discovery appeal; as Bawden (1993, p. 72) says, [the] ability to find analogies, connections, new lines of thought; to stimulate the creative and innovative use of information sources":

> "Even if you found what you wanted, or close to what you wanted, you're not likely, if you're human, to be satisfied with that, anyway. You're gonna browse anyway, just to see if there might be something a little bit better."

> ". . . my kids sit on the computer and they just look and see what's out there, they just go from image to image to image, just to see what's in there."

> ". . . sometimes things will come up that I hadn't even thought of, and I think, "Oh, well, that would work too. I could look for something in that area."

In the quasicontrolled study as well, generalists found that one of the advantages of browsing was having the opportunity to find images they were not already aware of. In addition, generalists found the browser to be more forgiving when the exact subject terms, titles, artists' names were not known or when the user was unfamiliar with a subject area. One generalist user said that he had chosen to browse rather than search because he felt that he could not map the keywords in his task to terms he could use in the search interface. This was typical of many users: where there was uncertainty in users' minds about how to answer a question, they often choose to browse rather than search.

An additional appeal of browsing for generalists in the focus group was the independence it afforded its users in getting started on their search: "I wouldn't have to talk to anyone to get the information I want." Another observed, "Sometimes you just have no clue as to where to start, so sometimes having a starter list can be helpful to have some options."

Users also recognized the limitations of browsing. In the quasicontrolled study, expert users felt that browsing was a slower image retrieval model in general and that it typically offered too many choices which would involve the user in excessive amounts of filtering. This comment was echoed also by a subject in the online study, who was apparently viewing the browse option as the only means to search for specific images: "Too many layers to search through. I searched for very common subjects, e.g., Mona Lisa, as well as more obscure ones, e.g., Iphigenia by Anselm Feuerbach without success." However, it was apparent that the underlying difficulty lay in the user's failure to understand the limits of the collection being searched.

Experts, who are much more likely to be familiar with artist names, would be expected to use a search option more effectively than would generalists. Indeed, by and large, expert users preferred direct search, as evidenced in comments in the focus group discussions:

> "Almost always one browses for a specific image. Very rarely does one sort of graze. And I suppose, for faculty members, the longer you have been teaching, the more likely you are to go for something very specific, and maybe someone like a teaching assistant would be much more likely to browse."

> "We'd probably want to enter text, and get an image back, because we want to be able to specify what we're looking for, or what area we're looking for."

In the quasicontrolled study as well, the domain experts found direct searching to be quicker and more efficient, providing the user with greater control of the search and to go more directly to what was wanted when searching for a known item. In addition, direct search by keyword was a mode that some generalist users had become accustomed to from their use of commercial search engines:

> "I'm just using main, primary search engines like Lycos, Excite, Webcrawler. And if I'm looking for The Last Supper, I'll just type in 'The Last Supper.' And it searches the collections, all the collections. I think that's the way most people that I know look for image and textual information on the Web."

How do users view the advantages and disadvantages of direct search?

Some respondents in the quasicontrolled study who used the direct search method reported problems arising when the terminology used in the system was not known, or when it was not known how to combine terms to conduct a search. As expected, in the quasicontrolled study, generalists experienced greater difficulty with the direct search system than they did with the browsing system, and many had difficulty in operationalizing tasks into viable search terms. Even expert searchers experienced difficulties with searching by artists names in cases of inverted names, misspellings, and use of diacritics using a standard keyboard. These problems were averted in the browsing mode, which presented the artist names in the form in which they would appear in the database.

  Likewise, respondents in the online study who experienced problems with the direct search method primarily reported trouble with selecting the correct term or combination of terms used in the system. Expert and generalist users alike in the online study commented upon the difficulties in expressing subject query terms that match those in the system: For example, one found that a direct search using the terms "Brunelleschi and Cathedral" gave zero results, whereas browsing "Brunelleschi" gave 3 images of the desired images of the Florence cathedral.

  Other online users also commented on the difficulties of formulating specific queries:

> "Searches have to be very specific and you must know the exact term used for a particular object—which may be very subjective!"

> "I tried your search engine and found I was too specific. I typed in 'Japan' for country, and 'castle palace fort' for object type. There were no matches for these search strings. The Image Browser is much more intuitive. I found exactly what I needed almost immediately."

> "... the entries "Durer" and "Durer, German, woodcut" resulted in no hits, but "German, portrait" yielded results, as did "print, portrait, German." This suggests that the database assumes a certain level of training and specialized language/knowledge on the part of the viewer."

For many users, direct search was problematic because of the requirement that users formulate an exact query; however, some proposed that a way around this would be to provide pull-down menus. One expert user in the focus group suggested,

"Title, author, creator . . . I don't know why you wouldn't just have pull-down menus that you drag to the choice you want. Then you don't type anything in wrong. Don't put too many on there: less than twelve. And say "submit search," it generates a list, you click on the one you want. That's the way people are searching, I think. That's the way that you search in these commercial CD products. They have pre-written lists that related to fields in the image base, and you just check off the ones that you want, say "Give it to me. Give me a list.""

Similarly, in the quasicontrolled study, some generalist users thought it would be useful for the system to provide an online thesaurus of terms or pop-up menus of terms for each search field. And again, in the online study, one expert respondent also offered a suggestion to help the searcher by offering a list of descriptors, with the caveat that the system "emphasize that entering too many descriptors might result in no 'returns.'"

How well can users locate specific images using a browsing approach?

Difficulties with browse and search notwithstanding, both the experts (100%) and the generalists (86%) reported high success rates in using the prototype browser in the quasicontrolled study.

Overall, in the online user study, a little less than half reported finding what they were looking for. The responses for experts and generalists were about the same, with half of the experts reporting finding what they were looking for and a little less than half of generalists finding what they were looking for. The online group was more heterogeneous in its demographic composition, and even more significantly, users set their own search tasks and were more likely to be searching for objects outside the scope of the collections in the database. Indeed, the correspondence sent to the browser in general over the years has clearly indicated that users view the collection as a general purpose database, and often express surprise that an object they are searching is not represented in the database.

Are there performance differences between the three search modes of browse, search, and a combination of the two?

There were no significant differences in performance among the search modes of browse, search, and combined browse/search models when the quasicontrolled study tested the different modes. Thus users were able to locate images equally well regardless of whether they used a browse or search mode.

Is a browsing approach useful for a broad array of users interested in art images—both generalist users as well as subject domain specialists, who would be more likely to have the domain expertise to search directly?

In the quasicontrolled study, expert users responded very favorably to the browsing option, even though they preferred the search mode for their own use. Experts felt that browsing gave users a certain flexibility and the ability to change their mind or to readily alter their

strategy. In the case of a null search return, even expert users could find themselves without an alternative plan for searching the database. One domain expert preferred the search mode because it was more user-friendly and because it was set up to help the user find images as they are classified and thereby reduce guesswork. In the online study, a third of the experts and 28% of the generalists reported using only the browse mode.

How important is structure in browsing?

Bawden (1993, p. 72) characterizes browsing as "[f]ollowing a predefined characterization, probably hierarchical, through an information space, to identify interesting items; [o]btaining an overview of the variation in items in an information space, so as to identify interesting areas of that space." For both generalist and expert members in the focus group interviews, browsing was of value if there was structure provided by the browsing mechanism:

> "What we wouldn't be doing is just tiptoeing through collections of paintings. I might go looking for Tuscan villas, but still I'd have a region and a time period. I never want to browse anything really broad, it's too time-consuming."

> "One in fact might browse in a slide library or a slide collection through a time period, through a medium: painting, sculpture, architecture, or through an artist: early vs. late work kind of thing. And so the browsing is fairly contained."

Two of the generalist focus group members noted the value of a hierarchical browsing structure:

> "I would rather start out with maybe a searchable list, and then have that bring up another—if there are a lot of choices—bring up another sublist, with choices, and then go from there. Narrow it down. Sort of a tree effect."

> "[Yahoo has] got pre-selected categories, or you can do a keyword search. So you could follow through a bunch of pages, just following categories. You go to education, then go to colleges, or something. You follow that logical progression, or if you know you're specifically looking for something, then you put in that keyword."

What is the importance of the size of the browsing set?

Focus group respondents recognized that, for browsing to be effective, the user must be presented a manageable set of images to scan.

> "Sometimes, too, you can get too much of a good thing. If you just want five choices, you don't really care, the world won't fall in, you just want to pick something, but instead you get 75 thumbnails. You just would rather not bother. So sometimes it can be too much."

> "I would not want three or four hundred images. That's way too much to go through and it would take way too long. I would want it to be a little bit more of an intelligent

system, which would ask you more questions to allow you to refine . . . or have a list, but a list that's readable."

In the quasicontrolled study, some task failures were attributable to browsing categories which were too large or insufficiently subdivided, as excessive numbers of thumbnail images in any given category tended to discourage users from browsing. Generalists suggested increased classification subdivisions that would minimize displaying long lists of terms for users to scroll through. In addition, generalists would like to know in advance how many thumbnails they can expect to have load on a given page when using the browser.

Is a multimode search—combining both browse and search—useful?

Experts and generalists alike expressed interest in being able to both directly search for known items and to take a broader browsing approach when looking generally for images. Both groups of users in the quasicontrolled study found the combined system (in which both browsing and searching were available) to be helpful in their search, since it provided alternate modes of access to the image collection if either the browse or search alone proved inadequate. Although domain experts largely preferred the search interface for its speed and directness, they also seemed to appreciate the usefulness of the browsing system as an alternative and indicated that the combined system would seem to offer the greatest number of users the most options. About half of the users in the online study reported using the system to both browse and look for a specific image, and one expert commented with appreciation that "having the option to search for a predetermined artist, subject, etc. or to browse by category is excellent." This preference for a dual mode of search supports Bates' "berrypicking" model (1989), in that it allows users to browse and search in an adaptive strategy.

How important is image resolution and what are the trade-offs?

Image quality and resolution are critical criteria for images used by art experts, especially when the use was for study or research purposes. This was emphasized by expert respondents in the focus groups, who considered the surrogate as a far less than perfect representation of the original.

> "We would regard the use of reproductions as a surrogate for the original always to help the students to understand and experience as closely as possible the nature and the quality of the original, and so we are constantly, as it were, apologizing for the problem of scale, definition, color, and the way a two-dimensional image is always misleading in relation to a three-dimensional object."

When asked about the extent to which they as faculty would be concerned with the quality of the images they use for instruction or research purposes, expert members of the focus group responded emphatically,

"I would say that the image quality is key. Absolutely key. I would prefer actually for my students to see a black and white photograph than a bad color reproduction of a painting, if it comes to that. As close as you can get to the original color."

"The quality of the image is very very important, because if you're basing opinions or research or some direction that you're trying to progress through a project, and it's based on sort of false data, meaning a really poor reproduction, then you can come up with completely erroneous conclusions about the piece.

"If you're just doing your slide show at your computer, you can get by with very low resolution images, assuming that you have something in your head that tells you, "Oh yes, that's the image I want.". . . On the other hand, when you're going to show it to students, using whatever delivery means, whether it's going to be video, or electronic projection, or traditional slide projection, then you want *the* best possible."

Fidelity to the original was seen by focus group experts to be particularly critical in an environment where digital reproductions could be easily altered and enhanced:

"This is just like a Bible—once the thing's misquoted, you don't trust anyone's picture anymore. How can you say which one is to be trusted?"

"I think if there were a database that people were using where images had been altered, like if it was a ceramic piece and mends had been kind of camouflaged in Photoshop, so it looked like it was a whole piece, when in fact it was a reconstructed piece, I think you'd throw out the whole database and say, 'You can't touch any of it.'"

In the quasicontrolled study, generalists tended to view the images as artifacts having their own intrinsic value rather than as imperfect surrogates to be compared against an original. However, generalists were still cognizant of distortions from the original, especially when these arise from variations in a digital image. A generalist from the focus group noted the problems of displays which vary from the original due to software or system problems, "you think that you're getting one thing, and then when it comes it's almost a totally different look, because it wasn't what you saw originally." One member from the expert focus group made a suggestion to help deal with such problems:

"a sort of read-out of the current number of colors on the screen. I always forget if I've got it at thousands or millions or even 256, because as I change between apps all the time I've got to change the bitdepths because the different apps don't work right. And then I'm looking at something and I'm wondering why it looks so funky, then I realize I'm still at 256."

When are users willing to make a trade-off in image quality?

As vociferous as they were in their insistence on quality of the digital representation of an image, when asked if reproduction quality is equally important in every usage context, expert users responded that a lesser quality image might do in a browsing context or when dealing with images outside the fine arts:

"Under certain circumstances, mostly in browse mode. Where subject matter or some general category is what one is after. I'm thinking of looking for things about transportation; for example, working toward a thematic lecture or thematic exhibition, then you know if a collection has something pertaining to your subject."

"With things that don't necessarily fall under the category of fine art, but are more natural history collections and artifacts, you might not need the highest quality, you just need to know that it is what it is."

In the online study, where users viewed the actual images in a prototype system, it was the generalists who were more critical of size and resolution of the thumbnail images than were the experts. In contrast, more of the generalists approved of the size, load time, and resolution required by the system and of the quality of the full-size images.

What are the tradeoffs between speed of download time and size and resolution?

Focus group generalists felt that speed of downloading was a key factor in browsing:

"I think speed would be of the essence, because I guess I'm not a very patient person, and I've been getting less patient as time goes by. So that would be the primary thing, because even if the system is really well indexed, with exactly my dream categories, and I know it has all the things that I want, if I know it takes too long I won't bother."

"You'd want a visual representation, so you can actually see what it looks like, and not anything too tiny so you lose a lot of detail, but not anything so large that it takes an hour for the system to download it. So speed would be an issue."

In the online study, two thirds of both sets of respondents thought the load time for the thumbnails was fast enough. The rest of the responses were almost evenly divided between fast (12 percent) or too slow (11 percent), while 11 percent of subjects (28 percent of the experts and 4 percent of the generalists) did not respond to the question at all. For the larger images, about 60 percent of the online respondents reported that the load time for the full images was fast enough. Fewer experts (44 percent) than generalists (63 percent) thought the load time was fast enough.

Do users want to rely on image information alone in browsing, or is textual information needed?

Since domain experts were less likely to make selection decisions based on visual cues alone, it was not surprising that in the quasicontrolled study they expressed a desire to see thumbnail images displayed alongside some summary information or short captions about the image (as was done in the searching mode) to assist them in making their choices. Even though they tended to be more visually-oriented when examining pages of thumbnails, they echoed the experts in their preference for thumbnails accompanied by very brief descriptions, such as artist, title, and date information.

All but one of the quasi controlled subjects found the textual descriptions accompanying images in the Art Image Browser to be either very useful or somewhat useful. Rather than relying too much on the images alone, experts preferred to have descriptive information about the images to help them make their choices. Generalists were much more likely to select thumbnail images on a purely visual basis. They relied more on the images themselves and not so much on the textual descriptions. For example, one generalist subject described his selection method as a process of scanning over a page of thumbnails looking for purely visual qualities in order to find "something different" or "something that stands out."

Online respondents provided less detail in addressing the question of textual information, but nearly 9 out of 10 of the online respondents reported finding the written descriptions accompanying the images somewhat helpful or very helpful.

What types of accompanying textual information are preferred?

In the focus group interviews, experts, citing concerns about timeliness and scholarly authority, were interested in accompanying text only insofar as it provided purely factual information about the image such as location, dimensions, medium, and attribution. This was in contrast to their expert counterparts in the quasicontrolled group. Generalists in the focus group were much more interested in the notion of an online image database as a vehicle for both entertainment and education. They were receptive to the notion of appended text and proposed a lengthy list of enhancements to the images proper that included artist biographies; criticism; history of the period; bibliographies; information on ordering a copy of the work; copyright status, etc.

As was the case in the focus group discussions, experts in the post test interviews found the textual descriptions of the images useful, but, like the focus group generalists, many would have liked to have access to greater contextual information such as artist biographies, related works, series information, social and historical notes, and information about the artistic movements of the period to which the image belongs. The experts felt this kind of contextualizing information would be especially important if an art image database were being used for educational purposes. Likewise, in the online study, a fifth grade teacher looking for sites to integrate into the curriculum commented that "to be more useful to me, it would be helpful to have more text describing the image."

Generalists in the quasicontrolled study were less dependent on textual descriptions for identifying interesting or relevant images, especially where the textual data was unfamiliar or confusing to them. However, even though they tended to be more visually- oriented when examining pages of thumbnails, generalist users echoed the experts in their preference for thumbnails accompanied by very brief descriptions, such as artist, title, and date information. These users also echoed the experts' desire to see information beyond the basic descriptors such as artist, title, date, etc., and would like to have seen more contextual information, such as artists' biographies, other works by same artist, links to groups of similar objects, even historical information or art history criticism.

How important is resolution?

In the quasicontrolled and online studies, users were asked to judge the image quality of items in an actual collection, as opposed to expressing opinions in the abstract. Both

experts and generalists in the quasicontrol groups favored higher resolution images, where this could be provided without seriously affecting the image loading time. Domain experts generally would have preferred higher resolution thumbnails so that the images could be better discerned.

Overall, almost two thirds of the respondents in the online group judged the thumbnail resolution to be either very good or acceptable, although generalists as well as experts commented that some images were too dark to be useful. One expert felt this might be due to the quality of the original artwork (e.g., lack of contrast) rather than the quality of the reproduction. Generalists were more critical of the quality than were experts. Only 5 percent of the experts reported the resolution as being not acceptable compared to 33 percent of the generalists. One expert commented that the thumbnails loaded quickly but were difficult to read.

When asked about the quality of full-size images, almost three-quarters of the online respondents reported the full-size image resolution as being very good (23 percent) or acceptable (50 percent). Fewer of the experts thought the resolution was acceptable (44 percent) compared to 52 percent for the generalists. One generalist found the quality of images once printed exceeded expectations. One of the experts commented that the image quality of the full sized image was fine, as compared to the thumbnail, which was illegible.

Will a small image provide sufficient information to assist the user in browsing?

One focus group expert remarked on the utility of retrieving small size images for visual scanning purposes,

> "With respect to electronic images, it's useful to have initial access to fairly small, lower quality images to allow you to sift through all these things that come up on your screen all at once, rather than having the browsable part of the database be images that each take a half an hour to come up. It's good to have initial access, or at least image browsing done through fairly small, lower quality thumbnail sketches of images that load quickly so that you're not having to wait half an hour for the results of your preliminary search."

Another expert observed that reduced size images can leave the viewer unaware of the actual dimension of the original; therefore some indication of the scale would be desirable to include:

> "I can remember from art history classes as an undergraduate is that you came out of those classes thinking everything was a projected size of a 35 mm slide. You don't realize that some of these are miniatures and some of them are gigantic, and the computer can very easily tell you something about scale. It could have a standard reference scale, whatever that object is, and this is how big the art object is, however big the art object is. I don't want the dimensions of the work shown. I don't want to have to translate that and think, "Well, it's about this size . . . " I want a comparison. This is a nickel; this is the art work."

In the focus group, experts felt that familiarity with the image was a factor in the usefulness of a search of small-sized images:

> "If you can tell from a very small thumbnail, you're already familiar with what the image looks like. If you haven't got a clue, if you were looking for the first time at someone's collection, a museum collection you might not be as intimate with, those little thumbnails mean nothing. I mean you can barely see the composition, so they can't browse from them, unless you're going to click on every single one."

> "If you're looking for something in particular, and you already have an idea of what it looks like, you might be able to work from the thumbnails and look at a group of them and say that's the one I want, but if you are just browsing, if you are just looking to see what the options are that you might want to purchase from the museum, you'd have to open every single one. I'd rather have a larger thumbnail so that you could guess well, that's probably not what I want, so I'll click on this group and open them up and see."

Expert users in the quasicontrolled study indicated that they were concerned by the loss of scale information engendered by the variations in thumbnail sizes in the test system. Some of the subjects noted that the size of the thumbnails made it hard to distinguish what was being depicted in the image. In these cases, subjects tended to want thumbnail sizes to vary depending on how clear the content of the image was.

In the online study, subjects appeared divided as to whether the thumbnail images were too small (45 percent) or just right (41 percent). More than a third of the experts thought that thumbnail size was just right; one third of the experts reported that the thumbnails were too small. Twenty-two percent of the experts did not respond to the question. One generalist: "Thumbnails were so small that I found them all but useless." More generalists (50 percent) than experts (33 percent) found the thumbnail images to be too small.

What new enhancements would users like to see in image search systems?

Experts envisioned systems in part through the lens of their professional activities: those involved with classroom instruction, for instance, mentioned the ability to build the equivalent of slide trays; the need to project images on a screen; and, to create side-by-side visual comparisons and to show detail. Experts and generalists alike both liked the notion of creating personal collections of images that could be downloaded, stored, manipulated, and printed at no cost and with no copyright restriction.

Generalists looked for the system to provide additional help in locating images, either through the inclusion of pop up menus providing possible next steps or categories to select from; the ability to retrieve items through pattern matching; or, the ability to search and retrieve by named iconographic element. Generalists were keenly interested in the ability to refine searches as they progressed, using both keyword searching and visual criteria (i.e., bring me more paintings like this one) to sharpen their search results. As concerns physical features of the ideal online image delivery system, both experts and generalists argued for faster downloading times though issues of resolution and clarity were of greater interest to the generalist groups than the expert groups (who voiced concern about an undue reliance on surrogate images of any sort).

Hastings (1997) points out that current image systems used in web environments do not provide users with the ability to group images into sets, as is possible with stand-alone

systems. Among the focus group experts, a prevalent theme among suggestions for image systems was the capability to allow users to compare images in sets was a system that would them to create their own groupings of image sets:

> "It's important to be able to have two, three images, four images on the screen so you can do comparisons. And that's again how students study, and how the exams are given, comparisons, so they're asking for that, so you want to be able to present that on the screen."

> "I'd like it to be able to find a picture on the screen, and then to be able to say, 'Add this to my slide tray,' and use a real-life, currently in operation metaphor. And I can see its sequence, what position it's in, relative to the other images I'm adding to my slide tray, and I'm assembling images like I do on a light table. If I want to move this image, I can drag it down on the table, and put it in a different position in the linear sequence of images that I'm assembling, because I want to search and find these images to illustrate a lecture I'm going to give, that has to be delivered through a projection system, and the images have to be sequential."

One generalist as well in the focus group noted, "Once we got down to ten or twenty images, I might like to see little postage stamps of all twenty at once, where then if it seems to interest me at some level, I can click on it, and open it up, but to get that array so I can be doing some comparisons for myself of what I prefer."

This was echoed in the online study as well by both expert and generalist users:

> "Is there a way to store selected images in a separate file so a 'show' can be assembled? One problem of computer based images is not being able to put them out on the table to see them at one time." [Expert]

> "The ability to show group records and accompany them with grids of thumbnails would be nice. Also, the ability to save sets of images to go back to at a later point would be nice, too." [Generalist]

In the quasicontrolled study, users' experiences with difficulties in the search mode were the basis for suggestions for enhancing image search systems to make them more useful for novice users; for example, options that would allow variable choices for "exact match," "close match," and "loose match," as well as Boolean and proximity operators, and a results ranking scheme.

Summary

This study confirmed, through empirical and qualitative research, that browsing is an important means of searching for image information on occasions when users are not sure of search terms or lack the domain knowledge to specify exact terms for a search query. It also indicates that, even for specialist users, browsing is a useful strategy for image search, and that users prefer a system which allows both modalities. The study also provides insight into the minds of users—both generalist and specialist—in information retrieval strategies used for image searching. Suggestions for improving image search are provided.

While there were significant differences in between domain expert and generalist subjects in time taken to complete image searching tasks, and in cumulative performance, generalists were still able to achieve a 86% success rate in finding the items for their queries in a controlled test. There was no significant difference between the three search modes—browse, search, and combination of the two, used by the two groups of specialist and generalist subjects. Domain experts tended to prefer direct searching to browsing, which they viewed as a slower and more cumbersome means of intellectual access to the image collection. Nevertheless, the expert users were impressed with the browsing system as a more user-friendly and forgiving mode of access for general users or users who were uncertain of either the collection contents or the specific image being sought.

In the quasicontrolled test of the prototype browser, nonexperts experienced greater difficulty with the direct search system than they did with the browsing system, and tended to prefer the browsing system due to its simplicity, and overall user-friendliness. The hybrid system helped both classes of users by providing them with alternate modes of access to the image collection if they should have difficulty completing a task by either browsing or searching alone. Although both experts and nonexperts expressed an interest in being able to use either system, they suggested that their choice of system might depend on their degree of certainty about a given task. Where the task was well-defined and expressed in concrete keyword terms, they would tend to prefer the direct search method. For less concrete tasks, or tasks whose key concepts are difficult to operationalize, users would tend to prefer the browsing mode, which they found more forgiving of user uncertainty.

Task failure analysis of the search system indicated that users had difficulty in operationalizing tasks into viable search terms. Task failure from the browser system resulted from insufficiently subdivided browsing categories, as excessive numbers of thumbnail images in any given category tended to discourage users from browsing.

Over and again, focus group experts stressed the importance of image quality. In the controlled test interviews, both domain experts and generalists stated the importance of high resolution images, where this could be provided without seriously affecting the image loading time. However, when respondents in the online survey were asked to evaluate the quality of images in the prototype browser, almost two thirds of the respondents judged the thumbnail resolution in the prototype browsing system to be either very good or acceptable, while at the same time, two thirds of both sets of respondents thought the load time for the thumbnails was sufficiently fast.

Domain experts wanted generous amounts of descriptive information about the images and suggested that image systems would benefit further from additional contextual information, such as artist biographies, art criticism, and bibliographies. Generalists were less dependent on textual descriptions for identifying interesting or relevant images, especially where the textual data was unfamiliar or confusing to them.

The prototype system described in this paper provided a means for users to retrieve images through broad classification categories which group image sets into meaningful categories that support browsing. While this strategy will never be a substitute for the type of access made possible by exhaustive indexing, results indicate that such a system can be effective in providing access to a collection when it is not possible or feasible to provide conventional levels of indexing. It also suggests that browsing can be an effective way for generalist users to gain intellectual access to images in digital collections without having an extensive knowledge of terms and concepts in the subject domain of the collection.
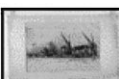
Appendix

	Task
1	- Find the works by Kandinsky
2	- Find the works by Manet
3	- Find an image of Dostoevsky by Beckman
4	- Find a sculpture by Picasso
5	- Find an oil painting by Renoir
6	- Find an image of a bridge by Hiroshige
7	- Find a mask made of shell
8	- Find a mural that contains Christian religious figures
9	- Find a Japanese woodblock print that contains a sailboat
10	- Find a stoneware vase
11	- Find an image from the Koran
12	- Find an image of a mother and child
13	- Find an image of geese flying
14	- Find an image of a reclining nude
15	- Find an earring and necklace set

Figure 1.   Questions used for image search.

SILS Art Image Browser
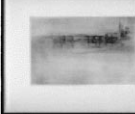
James McNeill Whistler

Please select a thumbnail image to view information about the image. Information for each image was provided by the holding institution or by the owner of the private collection.

More

Browser Home   Search Form

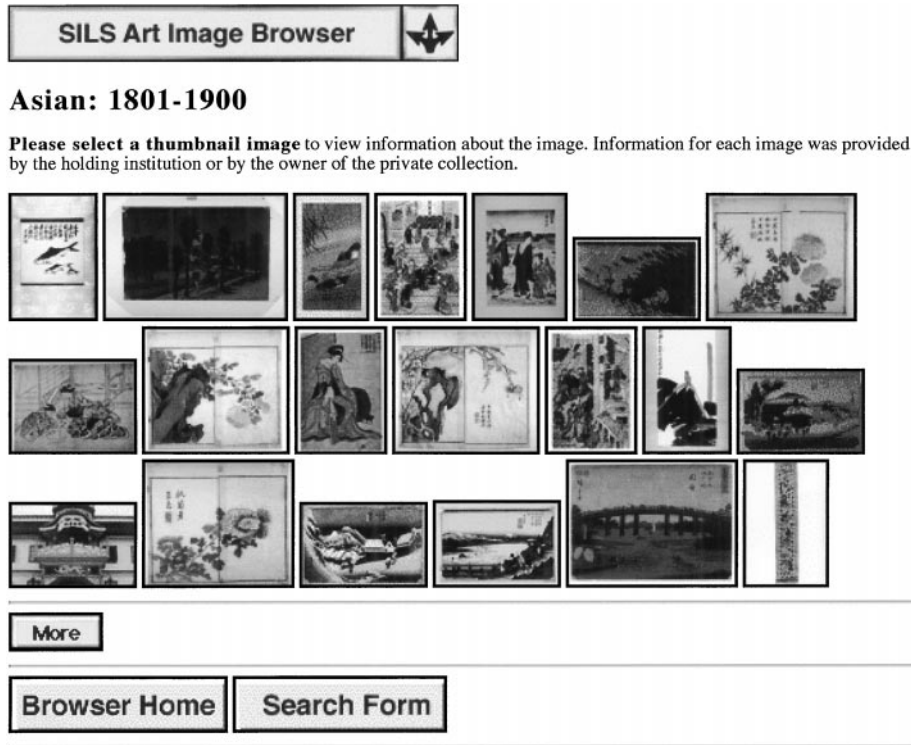*Figure 2.*   Art Image Browser search by artist.
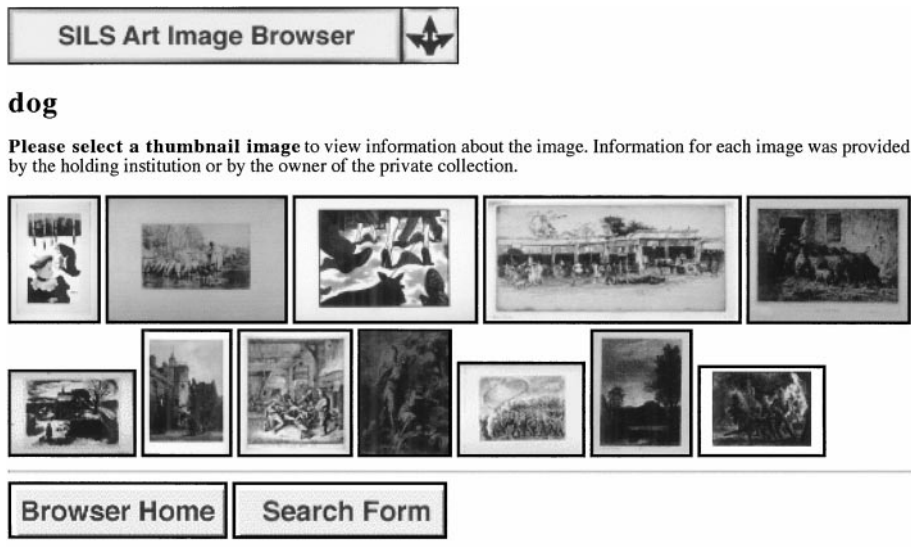
Figure 3. Art Image Browser search by time period.

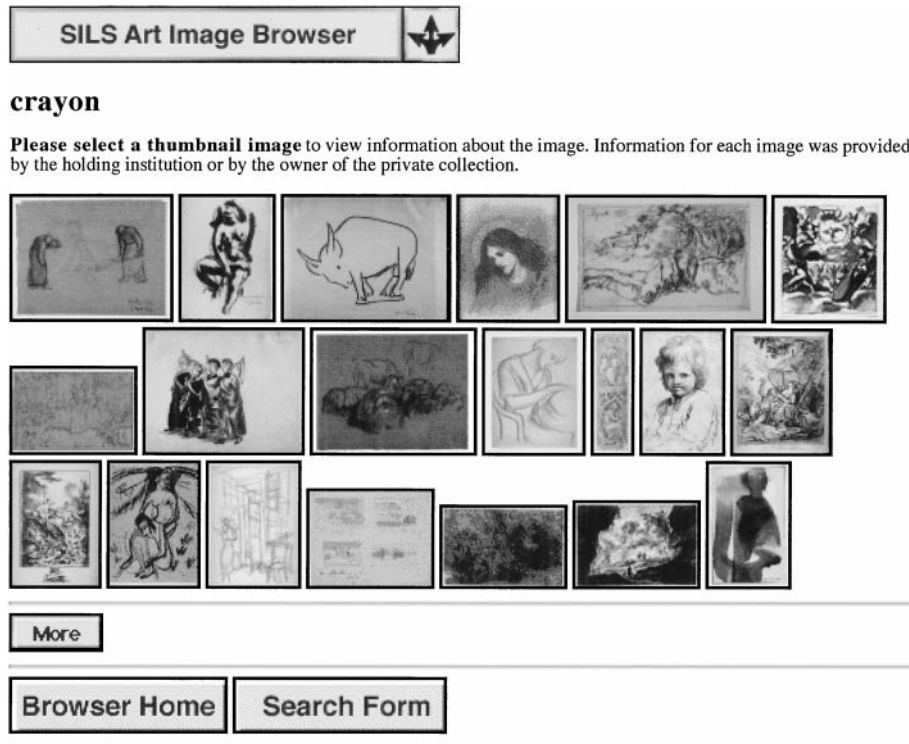
Figure 4. Art Image Browser search by subject.

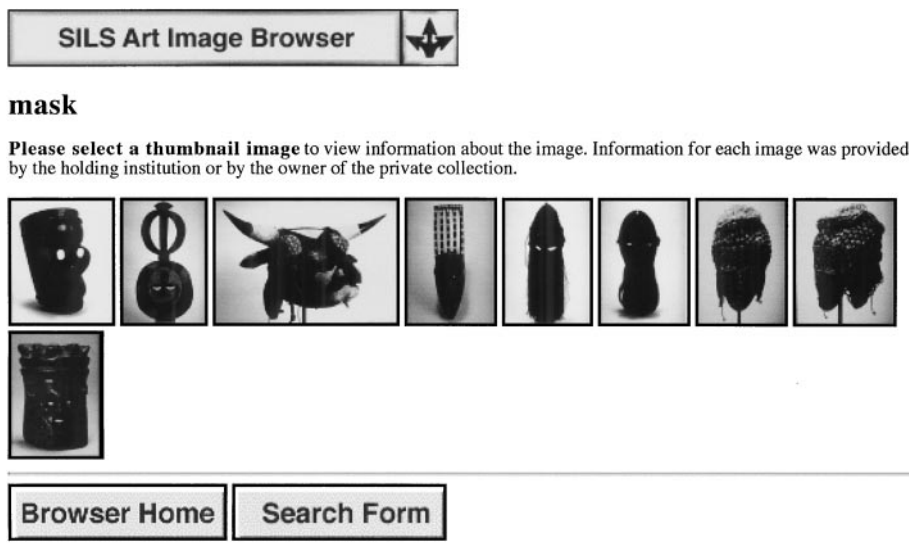*Figure 5.*   Art Image Browser search by medium.

Figure 6.   Art Image Browser search by object type.

Acknowledgments

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