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The *Texttiles* Browser: An Experiment in Rich-Prospect Browsing for Text Collections

by

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Abstract

Rich-prospect browsers aid research tasks by providing a meaningful representation of every item in a collection and tools to manipulate the display (Ruecker 2003). A number of rich-prospect browsers have been developed for exploring collections of items that can be represented visually. Several disciplines have recently shown interest in interfaces that attempt to leverage metadata in order to offer superior browsing environments.

This thesis examines the potential of applying rich-prospect browsing principles to the exploration of text collections by taking advantage of the metadata-rich text collections that are available through the World Wide Web. It also introduces and assesses the *Texttiles* browser, an implementation of rich-prospect browsing designed specifically for exploring text collections. Fourteen students participated in a qualitative usability study that evaluated the browser through two different testing approaches in a variety of research tasks: Human-Computer Pragmatics (Anvik 2007) and Affordance Strength Model (Ruecker 2006b).

Participants found the *Texttiles* browser to be a useful tool to explore text collections, understood how rich prospect browsing principles help explore collection, and were satisfied with the browser's implementation of those principles. Participants also suggested some improvements to the browsers. The results of this study uncovered two new ideas regarding the importance of order and direct manipulation of the data. This thesis reinforces the rich-prospect browsing principles of meaningful representation, display manipulation, and prospect, and provides directions for future research.

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Introduction

This thesis examines the value of rich-prospect browsing for textual collections. The discussion revolves around the *Texttiles* browser, which was developed and tested during the course of my masters program.

A rich-prospect browser takes advantage of metadata to provide prospect, or the ability to visualize a collection as a whole, and tools to manipulate the display in order to facilitate research tasks (Ruecker 2003). Rich-prospect browser interfaces have been evaluated and confirmed to influence positively research tasks such as synthesis and analysis.

Metadata, usually invisible to the user, provides a layer of additional information and structure for a collection. Metadata can be used for building rich visualizations and interfaces such as the *Texttiles* browser. The compilation and encoding of metadata have traditionally been expensive and time consuming (Butler et al. 2000).

Recent efforts in automating the processes involved in metadata gathering have been relatively successful. Author-based tagging and open access to public media have contributed to the accessibility of these structures. The availability of such textual collections on the web has exploded in recent years; a great number of these collections are rich in metadata that has also been released to the community.

The availability of metadata can potentially provide the core structural support and abundant information necessary for the development of visual tools to better understand, browse and organize a collection. The breadth of data grows exponentially but the tools to

understand it are limited; this presents a great opportunity for tool builders for the humanities.

Even though the availability of such rich collections has been growing, tools for reviewing and exploring them have been mostly limited to retrieval interfaces. There is a variety of ways that these interfaces gather information about collections to provide good results. The most popular of these rely less on information about the collection and much more on previous user interactions with the interface. However, some effort has been made recently to take advantage of metadata to enhance search results.

Furthermore, retrieval interfaces have probably had a great influence on the way in which collections have been made available. The nature of retrieval interfaces has shaped our understanding of information as a rather deep and compartmentalized system. The very network that offered broad, instant interconnectivity has instead evolved into a series of centers of homogeneous thought. Constellations of ideas and like-minded individuals exist in isolation from each other. These circumstances discourage discussion and diversity.

Rich-prospect browsing interfaces offer an alternative to search and retrieval interfaces. Rich-prospect browsers aim to present a researcher with the elements that constitute a collection in a transparent and direct manner and enable the researcher to learn new information about the collection as a whole and as individual items.

A rich-prospect interface requires a meaningful representation of each item in the collection. Meaningful representation within rich-prospect browsing has been understood as an affordance that functionally displays an item using familiarity and common

knowledge about the item that is shared with the user (Ruecker 2003). Textual collections present an interesting problem: the items do not possess a visual element that describes the item inherently or even consistently. Meaningful representation must be analogous to the research task being performed instead.

Certain factors must be taken into account when presenting a collection in order to limit the prejudicial agency of the interface. There are aspects in the perception of each affordance on the display that can influence a researcher to think in a particular way about the collection.

OBJECTIVES

In general terms, the purpose of this thesis is to provide a rationale and justification for creating rich-prospect browsing interfaces for textual collections. I will examine the traditional difficulties in the gathering and distribution of metadata. I will also analyze the affordance issues that arise from the presentation of text. For that purpose, I have participated in the development of and performed a user study to evaluate one such interface: the *Texttiles* browser.

The development of the *Texttiles* browser is part of this exploratory study in order to investigate the feasibility and performance of transferring rich-prospect browsing principles to text collections. As in any interface or visualization design, the perception of affordances might be different from the designer's philosophy and intentions. I conducted a qualitative user study to test the general performance of the *Texttiles* browser and, in particular, to evaluate the four textual rich-prospect browsing premises:

1. A meaningful representation of a text document in a collection is achieved by letting the user control which metadata from the item is relevant to the current task.

A meaningful representation of an item in a collection is one that not only denotes an element but also describes it specifically. The user must be able to recognize the item as part of the collection, but also recognize its individual properties. Achieving a meaningful representation of an item in a text collection immediately presents a problem in that it does not have an inherent pictorial characteristic that can be recognized. In the *Texttiles* browser I experiment with a technique in which the user can control the textual details pertaining to each item that are displayed to achieve a meaningful representation. I hope to understand how participants' choices vary across different research tasks and procedures. I am interested in finding any patterns, if they exist, in the choices participants make in adding or subtracting information from each representation. I am also eager to discover how the participants' choices are influenced by different research activities, and if they are aware of such decisions.

2. By being in control of the amount of information about each item being displayed, the user will work together with the interface to achieve prospect.

Prospect is the affordance brought about by the display of a whole collection simultaneously. By visualizing the whole collection, the participant gains a level perspective that educates and influences further research tasks. The *Texttiles* browser presents the whole collection whenever possible. Due to limited screen real estate, when much information is displayed, the size of each tile will decrease to fit the whole collection in the available space. I am interested in exploring how participants will choose to display each

item in the collection in relation to how many items are displayed at once. Participants' choices of the amount of information displayed at once will effectively give them some control on the achievement of prospect. I am interested in observing whether participants will work in collaboration with the automatic processes of the interface to achieve an efficient balance of prospect and meaningful representation in situations where they have to choose between prospect and displaying less information.

3. Variation in visual arrangement and organization contributes to understanding the collection as an organism and to exploration of its internal structure.

Manipulation of the display is one of the principles of rich-prospect browsing. Within the *Texttiles* browser, a participant can group items according to their distinct characteristics. A participant may also sub-select and switch the selections to create more complicated queries. These interactions are achieved by arranging the same items in different formats while keeping them all in sight. This feature of the *Texttiles* browser introduces a second level of variation to rich-prospect browsing. I am interested in examining how variation of the display contributes to the participants' understanding of the collection as a whole and the structure of its contents. I want to find out how do the participants use item display and arrangement manipulation to arrive at a better understanding of the collection.

4. The order in which items are arranged visually carries meaning to the user.

Within *Texttiles,* metadata available about each item in a text collection is represented as components of each item. In most cases, these details themselves are presented as text. A user can choose which of the details pertaining to an item will represent it during a research task. Items in a collection are also displayed in a certain order. The participant

manipulates the way in which these items are visually organized. However, even within groups the items will have a certain order. Different details about each item carry their own connotations: for example, a date would be interpreted differently than a name or a number. I am interested in observing the perception of participants when items are reordered according to the available metadata and the type of information that each detail represents. Will participants always attach some meaning to the order in which items are presented? Will the order of the items be associated with a particular visual element currently on display or will it be hidden? Perhaps the order will be associated instead with the current research task.

Metadata

Metadata is an invisible layer of information that is encoded into a digital document. Metadata provides additional information than is apparent in the text at first glance. For example, metadata could include details about a blood relation between characters in a story, the format in which a unit of measurement is given, or the type of word in a sentence.

There are multiple ways of encoding metadata; some of the most common frameworks to define metadata markup languages are SGML and XML. HTML is one example of a markup language and is used to write documents for the web. A markup language is a format to write in the same plain text file the contents of the document and metadata indicating semantic qualities of that content. For example, in an HTML file, the title of the document should be inside an `H1` tag, or heading 1:

```
<h1>Title</h1>
```

When we use a web browser to read the final document we will not see the tags, but the web browser will understand that the text inside the `H1` tag is the title and it will style it appropriately. The title will probably be interpreted in larger font size than the rest of the document (see Figure 1).

Figure 1. The title of a document as interpreted by the default styling definitions of a web browser. A browser will typically represent the title of a document with a larger font and in bold letters.

It is important that metadata describe semantic information about the document. The H1 tag does not only indicate that its contents should be styled bigger on a web browser, but, since it holds semantic information about what its content are, it can be read as a title by a screen reader application for the hearing impaired or recorded accordingly by a search engine spider, etc. Metadata holds the key for information to be not only read and understood correctly by the person reading the document, but also by machines. Computers can learn to interpret the document by using metadata and ultimately creating a richer experience.

Collecting Metadata

The traditional method for collecting manually-created metadata is slow and tedious, albeit sometimes fascinating for its collector. A digital humanities scholar can spend several years creating a catalog record of a collection of interest. The real interest in metadata however is the potential that it holds for derivative works, not the long and expensive hours spent coding the data. The collection of metadata requires tremendous resources and is often performed by large groups of individuals with different levels of expertise. The sheer

quantity of text to be analyzed for such a project is immense, and therefore the task is often shared between principal researchers, such as faculty members and academic staff, and groups of junior researchers with varying expertise, including graduate students, research assistants, undergraduate students, etc. The difficulties in getting this sort of team to work together successfully are considerable.

Gathering metadata from a text collection consists of carefully labeling the desired characteristics of each work in a digital format. The team identifies a type of information to be gathered and a restricted vocabulary, or tagset, is defined in order to capture this information most accurately. For example, the purpose of the encoding might be to highlight linguistic information about ancient texts or be designed to provide an underlying structure to the relations between the locations, characters, and institutions that are referenced.

One of the major problems in gathering metadata is achieving an acceptable level of consistency. The researchers might be in different institutions or might not share the same level of expertise about the subject. The difficulty achieving consistency with a complex tagset is well documented. Leonard's in-depth survey of inter-indexer reliability measures and his subsequent experiment and results show little association between a collaborator's work and her peers (Leonard 1977). Ellis et al. conducted an experiment similar to that of Leonard, asking participants to attach appropriate hyperlinks to articles, and arrived at similar conclusions (Ellis et al. 1996). Text encoding requires an even more complex set of associations, which gives researchers additional room to disagree and creates correspondingly complex consistency issues.

There are some strategies that can be employed in order to achieve a higher level of consistency. The Orlando Project had success by limiting the tagset and instituting a series of controls, including collaboration from team members, and computer tools that automated the process of checking the researchers' work (Butler et al. 2000). They also established, however, that discrepancies and errors in tagging will always occur. Researchers need to simplify the tagging process, use all the tools that are available to them, and learn to accept errors. An early paper by Garside (1993) presents a system from the University of Lancaster that attempts to use computers to aid the process of annotating a corpus for subsequent analysis. This system provides the researcher with a tool through which the work can be done quickly with the aid of a computer, which pre-analyzes the corpus and breaks down some of the tasks that can be automated without much compromise, and leaves the difficult decisions to the researcher.

Automating the Process

Automatic techniques for extracting, tagging, and indexing data have been around for some time. These techniques consist of using a computer program to automatically do the work of a researcher: reading the text, identifying the parts that need to be labeled, choosing the appropriate label, and tagging the text. There have been a variety of approaches to overcome the shortcomings of computers at inferring the appropriate tags as well as a human does. With variable results, there are certain statistical measures that can sometimes be sufficient to deduce the necessary information successfully (Widdows and Ferraro 2008). For example, simple common vocabulary frequency counts will sometimes be sufficient to identify the author of a work. More often, statistics fall short in providing

acceptable results, and machine learning techniques must be used. Machine learning consists of feeding a computer program a dataset in which the encoding has already been done by a human researcher (Witten and Frank 2002). There needs to be some set of parameters by which the computer is going to judge those results and learn from them. Afterward the program is given new texts for it to tag. Depending on its effectiveness, the program can be continually set to learn from its mistakes and do a better job in subsequent tasks. This technique has been used in a variety of applications, including computational linguistics and machine translation, and it has been shown to provide adequate and consistent results. Moreover, it is less resource intensive and is the subject of continuous research, which increasingly surpasses expectations.

Its application for the humanities has not until recently been taken into consideration. Humanities scholars are most aware of the complex issues present in manual encoding of collections. Researchers in the humanities have recently become interested in using a combination of statistical and machine learning techniques to extract additional information from large textual collections. There are also parallel efforts to bring data-mining tools that combine highly technical computer operations with simple interfaces in order to make them accessible to non-technical researchers in the humanities. The Nora project is a collection of analysis and data-mining tools made available to humanities scholars to aid their research tasks with complex computational techniques in an intuitive and forthright manner (Plaisant et al. 2006). In another example, TokenX is an XSLT-based interface for exploring large corpora with complex metadata structures to help the research analysis by exploring visualizations (Zillig 2006).

These efforts contribute to the analytic exploration of text collections by making tools available to humanities scholars in a simple fashion. The automating of these processes contrasts with the large amount of resources required for the manual tagging and review of the collections. Not only are they providing systems that are within the reach of humanities scholars, but they are also contributing to the further availability of data collections to the public. Since a large number of these projects are web based and publicly accessible, they can be easily reached without much effort from around the world, further expanding the possible audience, and hopefully expanding, or at least facilitating, research efforts. Even if full automatic interpretation of texts is still not possible, the benefit from these resources becoming widespread is significant and most probably will contribute not only to perfecting of the techniques themselves, but positively advancing research in the community.

Metadata Availability

Libraries and universities have been working hard to make their collections available through the web and libraries have been pioneers in taking their catalogue indexing systems online. The Machine Readable Cataloguing Record Standard (MARC) was designed to translate the traditional catalogue card to a format that a machine can understand. It has been used to keep an electronic record of every item in the United States Library of Congress since the 1960s (Furrie 2003). In 1995, Weibel defined Dublin Core, a data set format for the minimum pieces of information that are optimal for indexing items in a library collection (Weibel 1995). Weibel saw an opportunity for creating a guideline that would provide detailed information about a library collection through the web, which can

be used directly by researchers to explore the library's collection as well as other computers to communicate with the library's collection. Dublin core is now used in libraries around the world and provides a standard for searching through library catalogues online.

The open access movement has further identified a desire by the public that the complete content of scientific articles should be made available to the public (Willinsky 2005). Willinksy argues that making scientific research available on the web in an open and accessible fashion has the potential of creating the most research impact and a sense of increased contribution in authors. The Metadata Encoding and Transmission Standard (METS) was devised by a multi-library collaboration project to produce a common standard, written in XML, to encode and transmit entire documents. Regardless of the public accessibility of any individual library's collection, librarians are already designing and implementing systems to provide a framework for communication and transmission.

More significantly, there has been a considerable effort in making these collections available in formats that are not only useful for researchers directly, but are rich in metadata and accessible by other machines. In 1997 the Stanford library undertook an analysis to determine the infrastructure needed to create a system to provide interoperability between library catalogues and standard retrieval interfaces (Baldonado et al. 1997). Their system made headway into creating a metadata architecture that could allow library systems to provide and share metadata about their collections between library services in several standard formats. Finally, their system provided a mode of communication between actual data and services by setting a standard metadata model.

This culture of opening application programming protocols is not exclusive to academia. As evidenced by projects like OpenId[1] and DataPortability[2], a change has occurred in the way organizations and individuals think about information and what they expect to be able to do with it. The web contributed to the availability of metadata-rich, expertly-tagged, high-quality collections from libraries and universities, including literary works, media, and even scientific articles. Furthermore, it has created an environment through which metadata is the *de facto* mode of communication. The interoperability of the ever-growing set of internet access devices with expanding media formats is dependent on metadata.

[1] http://openid.net/

[2] http://dataportability.org/

Exploring Data

As metadata gets increasingly complex and collections expand and grow more accessible daily, a growing need for tools to navigate this information arises. If we consider only the size of collections, navigation itself quickly becomes problematic; exploring the nuances of these collections seems impossible. The hard work involved in gathering, encoding, and distributing the detailed information included in these collections seems futile when faced with the impossibility of effectively using that metadata. Researchers in many areas are starting to notice the lack of unanimity in the way that resources are available, the formats in which the available metadata is distributed, and the shortcomings of tools to make sense of all this information (Hull et al. 2008). We cannot afford to ignore these problems with online resources.

Retrieval Interfaces

Researchers have been learning to perform research tasks using retrieval interfaces. There are a variety of different systems, from a small site-specific search to a range of university resources linked together by complex infrastructure and massive systems of information gathering and categorization like Google. The manner in which they gather their resources are very different, and the complexity of their interfaces also range. While single site search interfaces usually consist of one text box that performs a simple text comparison, library services offer complex Boolean operations and allow for searches limited to particular fields. Library retrieval interfaces are commonly used by expert librarians who have a better understanding of research tasks and are able to retrieve more accurate results.

There is one thing all retrieval interfaces have in common: they offer results to the researcher on the basis of some kernel of knowledge that is familiar to the researcher *a priori*. There is evidence that shows that domain knowledge gives a researcher an incredible advantage in locating relevant results (Hölscher and Strube 2000). A researcher performs a search based on something that she already knows about her results; it could be the name of the author or maybe the general topic of a scientific article. The query is typed into the textbox and the interface will return a list of hits, usually ranked by some algorithm, with the most relevant article on top. The interface will typically limit that list to an arbitrary number. The default Google interface lists 10 items, while a search that I performed at the time of writing in the University of Alberta Library returned 20 hits. It is up to the researcher then to judge if the retrieval system's algorithm has ranked the items correctly and whether the items are relevant to her search. Often the criteria used to evaluate the relevance of the items are not known by the researcher, and she relies solely on a first glance at the results to judge if the items are useful or not.

Retrieval systems research has been concentrated on how to manage more information and how to provide more accurate results rather than advancing the interface. The process of searching is considered a trial and error learning process. The researcher will learn to perform better searches with time by executing bad queries and learning to be more precise or broad. There is, however, some research that has tried to present new paradigms in retrieval interfaces. Natural language processing research aims for queries to understand questions that are written in somewhat plain English and are understood by a retrieval system (Turtle 1994). These types of queries would ideally understand direct questions like "What country currently holds the Presidency of the European Union? " or "Where is the

closest pizzeria?" They would also be able to recognize and provide references for more complex queries such as "What kinds of business models would work for online newspapers?" Turtle shows that researchers are able to find more relevant results with natural language queries than traditional Boolean queries. These occurrences seem commonsensical, as more and more the users of retrieval interfaces are not expert librarians but users of all kinds who are not trained in advanced techniques. For this reason, there have been calls for designing retrieval interfaces that are simple and responsive, which can adequately accommodate the needs of the expanding and ever more diverse community of online researchers (Marchionini and Shneiderman 1988).

Google offers some integration of Boolean searches and natural language processing to emulate the multiple options and settings that a traditional library retrieval system would offer. A complex retrieval system like that of libraries usually performs not only a text-based search but makes use of metadata to offer a customizable control over the results. A researcher, for example, can choose to search only by one bibliographic facet: the name of the author. The system would then query only the entries in its catalogue that shared that author's name. These systems also allow for the researcher to combine these directed instructions into a complex and precise query. These types of queries are available to researchers, because libraries have spent significant resources in carefully and systematically encoding their catalogues with metadata and indexed their collections accordingly.

On the other hand, the primary methods by which web search engines index information is by calculating statistical figures about the connections between items in collections (like

Google) and by looking at the behavior of previous successful searchers (like Amazon). The famous PageRank algorithm through which Google ranks and classifies web pages that are indexed from the web is a simple process. It ranks a website by keeping a count of the hyperlinks which appear on that page and the ones that are directed to that page. It also takes into account some general statistics about each page, and the words that are used in the hyperlink. By using a secret formula, Google then decides which page is more relevant to a specific keyword. Amazon, an online books and electronics superstore, on the other hand, looks at every customer search and previously looked-at items to build an intelligent and personalized recommendation system. Further, when a customer makes a search query, Amazon will use this information to offer that customer results that she has looked at before or similar products. It also uses statistics gathered from other customers with similar search patterns to provide her with products that she might like.

Recently there has been some research aimed at helping search engines enrich results by analyzing semantic metadata encoded into webpages. Swoogle is a search engine that crawls the web and identifies metadata encoded in webpages in the form of microformats (Finin and Ding 2006). Microformats are HTML-encoded metadata within a webpage that can be accessed and understood by browsers as well as specialty applications, like address books or internet telephony programs. For example, a personal site has an identity card encoded in a microformat. The personal information is on display for a reader, who will not see any difference. The browser can recognize the metadata encoded in the website and ask the reader if she wishes to save the contact information to her address book. Because the metadata is encoded within the HTML of the page, the address book knows exactly how to fill in the contact details and is able to save them. There are microformats defined to encode

contact details, telephone numbers, images, data tables; more definitions will be developed in time. Swoogle attempts to index the web using this encoded metadata and provide a metadata approach to search.

Googleization of Information

Short of calling for an overhaul of Google on the grounds that it is making us stupid and hindering our ability to read (Carr 2008), the demand for a more integrated, customizable, and powerful tool to search through collections is valid and growing. Carr's article conveys scandalized consternation about a new technology and its consequences on traditional media and the way we consume it, and, as he himself admits, it should be read with some skepticism. However he does have a point in that the way in which retrieval interfaces have presented us with information for the past decade cannot help but have had some influence on the way we perceive information as well as in the production and distribution of online works. Our behaviors have changed. We are used to skimming articles looking for multiple headers and lists. At the same time, we are accessing a greater number of resources even if we don't read them completely and attentively. As a result, content providers, authors, and publishers are changing the way in which they write. The explosion of blogs has given rise to two-paragraph posts and report-like writing that is filled with lists, figures and tables.

The web can be envisaged as the extreme implementation of Vannebar Bush's Memex machine (1945). The Memex is an imaginary desk-like machine that organizes a researcher's resources, like articles, books, photographs, and even research notes. It would also allow the researcher to create connections between items stored in the Memex machine, so as to keep track of arguments or explorations in the process of devising them

(Bush 1945). Even though Bush's model for the technological aspect of the web did not come about, its concept can be seen as the theoretical model for the web. The web is an extreme implementation of the Memex machine, because it not only attempts to organize one researcher's private library, but the entire works of humanity, past and present. Little did Bush know that his Memex would be accused of affecting our ability to read. But it is that immediate availability of information that is accused of changing the way we consume it.

Google and specifically its academic oriented search service, Google Scholar, have been the target of librarians' discussion. Google Scholar has sparked sharp criticism for its lack of advanced search options, lack of controlled vocabularies, its functions that limit the results by specific attributes, and most importantly, its failure to disclose the publications it indexes (Cathcart and Roberts 2006). In spite of its popularity, Google Scholar has been rated quite poorly by information experts. Librarians feel that the lack of precision in Google Scholar, and its inherent popularity, is a call to action for information-seeking literacy. Researchers, librarians claim, need to be educated in identifying the information they need. Google Scholar, rather than being a tool to aid in that central and important task, is hindering our ability to explore the wealth of information at our disposal. Google is presenting researchers with an arbitrary subset of that information without making it apparent that it is doing so. While libraries attempt to provide researchers with a comprehensive list of resources relevant to our research, Google uses an unpredictable algorithm return a limited subset of results in an arbitrary order.

Although Google Scholar has improved in the past few years, and the criticism of its use as an academic resource has waned, its pitfalls as a vertical search engine have not changed in essence. New features such as limited sharing of metadata and greater collaboration initiatives with libraries, publishers, and repositories have been integrated into Google Scholar. Currently Google's presence at library conferences is not uncommon, and many libraries have integrated Google Scholar into their systems as an additional resource for research (Hartman and Mullen 2008). Moreover, a greater integration with Google could help bring novice users to libraries. Google's interface is present and familiar in academic and private spheres of the lives of a new generation of researchers. It has already proved to be a valuable resource for discovery throughout their lives. When these new researchers face new challenges they will return to this valuable resource. If libraries are connected to Google, they can offer their services in conjunction, combining Google's ubiquity and excellent discovery attributes with libraries' delivery capabilities (York 2006). This marriage could provide the basis for new researchers to not only discover new resources, but also to become information literate. As libraries integrate with Google, a new generation of technology-savvy researchers can discover their library through Google.

Librarians, who once feared that the intrusion of Google into their field would do a disservice to researchers, have now adopted a more relaxed view in which Google offers a place to start. However, librarians continue to make efforts to encourage researchers to use their tools, which they believe are more powerful, have access to more resources, and provide more comprehensive results to searches. Yet the powerful library resources that experts have been attempting so fiercely to defend from Google Scholar's fast and ubiquitous, but limited and vertical, search engine are still retrieval interfaces. Librarians

typically become the liaison between inexperienced researchers and the resources they need; nevertheless, retrieval interfaces still require the researcher to have a small but important kernel of information, a small level of domain expertise to be able to formulate the appropriate queries that will yield valid results.

Facet Analysis

One of the most important tools that advanced retrieval interfaces offer is the ability to perform searches by specific facets. Facets are characteristics of an individual search that may be shared by others in the collection. Facets can be bibliographic elements, like the name of the author or the title of the journal in which an article was published. In the 1930's Ranganathan defined facet analysis as a complex theory for knowledge representation governed by 3 planes, 46 canons, 13 postulates, and 22 principles. Researchers in library science have subsequently adopted it, simplifying and refining it for their purposes (Spiteri 1998). The three planes represent the need to divide a subject into components in order to assign the appropriate terminology to each of the components and to create a notation that reflects each component. Each component must be mutually exclusive and each item in a collection can then be identified by a specific combination of terms (Broughton 1998).

It is unclear whether a conventional understanding of facet analysis can be successfully transferred to the web. The magnitude and distribution of information makes it an impossible task for librarians to manually classify information and organize it into viable facets. More importantly, for the researcher the web is an open environment, a library with no disciplinary boundaries. As information crosses disciplines it is unlikely that a

systematic classification of content would in fact be useful to everybody, and achieving mutually exclusive components is not only difficult, but also even more ineffective (McGregor 2008). The idea of a universal classification system has to be abandoned either due to practical impossibility or conceptual fallacy.

The success of retrieval interfaces and the detachment between the authors and researchers have yielded a common representation of collection items in terms of the immediate purpose of the researcher. Retrieval interfaces are designed to provide the most relevant results to queries by catering to the imagined purpose of the researcher. Results from a query performed by a food scientist or a UFO enthusiast will be different because their needs are different. The system will try to predict what the most relevant results are for each one. An authoritative classification of items will not fit this model. Still, facet analysis can permeate the web by providing support for research tasks. Facet analysis can be used to analyze results and choose a limited set of keywords generated from the search itself (Ellis and Vasconcelos 1999). Future searches can be also aided by the set of keywords that are gathered within a persistent theme. Metadata can also provide a context to the gathering of keywords, ultimately making them more useful. This hybrid model can both improve the retrieval system as well as create a more useful classification model. Even if it might not comply with Ranganathan's principles on a universal scale, it could provide a series of parallel structures that are both efficient and useful.

Faceted Interfaces

Evidence has shown for some time now that researchers make little use of advanced techniques in query formulation when using retrieval interfaces (Sewell and Teitelbaum

1986). Without advanced query formulation, like Boolean operations AND and OR or filters such as a query, a keyword is only matched to a previously designated facet. In this sense, the powerful tools that libraries offer to researchers are no better than Google. Advanced queries are what make those tools powerful, and without them the results are still only a partial list of resources ranked in an arbitrary order. Faceted browsers are ones which take advantage of metadata available encoded into diverse collections to allow more precise control over research tasks. Faceted browsers can use metadata to utilize both data and metadata and create bootstrapped visual environments that facilitate research tasks.

Significant efforts have been made to take advantage of metadata in library collections in order to bring some of that advanced functionality that librarians use, but researchers tend to ignore them or else are unaware of them. These retrieval interfaces present researchers with controls that replicate advanced query mechanisms and are based on available metadata. For example, in a library collection, there would be bibliographic information embedded in the catalogue. A faceted browser for a library would create controls for each of the bibliographic elements by looking at the available metadata. The faceted browser creates filters by author, journal, editor, date of publication, and so on. The encoding format definition of the data gives clues to the faceted browser about what information is available and how to use it. A researcher can then perform a search and use the controls to increasingly build a more advanced query similar to those of information professionals.

Any delay or inefficiency created by this visual display and control-based querying process is counterbalanced by the interactive nature of the new research task. This new form of querying is not precise, but it allows the researcher to manipulate the data to understand

its structure. After making an initial search, for example, the researcher may realize that the majority of the results are from a journal that is not very credible. The interface may also present the user with an alternative, more mainstream keyword, which all the results share. This process will have an effect on the research task. The researcher can tweak the controls until a more useful dataset is gathered. None of the individual queries used would probably be precise or very advanced; still, through this iterative process of trial and error and result manipulation, the researcher is discovering important details about the research topic.

There are numerous interface prototypes that attempt to use the metadata to provide a visual research environment and offer an exploratory approach to research. The Flamenco Browser uses a strict hierarchy to provide information related to specific items in a search query (Elliot 2001). Flamenco is an attempt to present images from architectural databases in context. The location and presentation of the images are important for architects as they often need to find images with similar characteristics, which they use later for inspiration. A fair amount of metadata and a structured organization model is already available and distributed in association with these images. Flamenco takes advantage of this information to suggest similar searches, related images, or themes that can be pursued to find additional material.

Flamenco's retrieval interface uses metadata to aid queries which are typically too broad or too limited. This allows architects to explore image databases without having to use external information to judge their selection, but instead benefit from information available in the same environment, thus making the process more productive and enjoyable. When an architect performs an initial search, Flamenco will display a list of matches, just as a

regular retrieval interface would. However, it will also provide important information about the location, style, source, etc., of the architectural piece depicted, as well as a set of keywords associated with the piece and a link to find similar items. Architects can also save images that they have found to be relevant and recreate the creative process they are familiar with in their work.

Facilitating the formulation of queries is important, as we have established that complex queries are not typically used by researchers. The Searchling interface takes a different approach to assist in the formulation of those queries (Stafford et al. 2008). Searchling uses a multilingual thesaurus to help formulate and enhance queries on a database containing French and English keywords. A researcher can search for keywords in the thesaurus in one language and receive results related to that keyword in both languages. In addition, filters can be iteratively set up to limit the result based on any keyword. A user can locate a word in English, the interface then will display a set of works associated with that keyword as well as the translation of that keyword. The results will include works in both languages. Additionally, the interface will also display related metadata from the database, like the source of the works or their repositories. The researcher can filter and enhance the results using both facets from the thesaurus and the works database. In this process, the interface uses metadata embedded in the thesaurus and in the database.

Searchling makes the task of query formulation explicit: researchers are presented with a pane that, as they add or remove filters, will visually represent the precise query that is being formulated. It is interesting that, in addition to aiding the researcher to construct these complex queries, the researcher will not only collect relevant information directly

related to the project at hand, but will also learn about complex querying in the process. Combining hierarchical structures from a thesaurus with metadata from a multilingual collection, Searchling provides researchers with an additional layer of resources when exploring the collection for the first time. Searchling is an environment where previous knowledge about the collection or an idea about what the result is going to be is not necessary. The initial query can be made to the thesaurus. That query will be the gateway to exploring the collection, as the keyword will guide the exploration of the collection. Thus, the user must only have previous knowledge in English or French and know how thesauri work, in order to be able to use this interface and explore the multi-lingual collection.

Highly structured data is not always available and so interfaces that look at facets must account for these kinds of metadata. Semantic data, encoded in Data Resource Description Framework (RDF), for example, does not follow a central body; it does not have any hierarchy outside of what is defined in each document, and may or may not be unique in its content or its form. RDF is an XML-based specification to encode data in transmissible, portable fashion (Beckett and McBride 2004). Data is distributed all over the Internet in any website that chooses to encode its data in this format and RDF is designed to accommodate any kind of data. It is particularly difficult to visualize large-scale collections, as any document encoded in RDF can define its own structure and may be the only one of its kind. Fortunately, RDF includes a fairly strict rule for the definition of its internal structure. Visualizing a single data set that is somewhat uniform is rendered an achievable task.

Longwell is a faceted browser designed to explore semantic information encoded that is available from disparate sources on the web (Longwell User Guide 2006). Longwell not only bootstraps its controls from metadata, but is versatile enough to handle very differently structured data. It reads RDF data from different sources, including the data from MIT's Dspace[3] repository and Cascading Style Sheet (CSS) style definitions and their availability in different Internet browsers. RKBExplorer is another faceted browser that aims to display highly heterogeneous data (Glaser et al. 2008). In addition to providing all the basic visual elements to filter facets, search, and read data, RKBExplorer also builds a graph to allow the user to visually understand the structure of the collection and the position of the document that is currently open. RKBExplorer includes a separate panel that draws a map of the data that was just read from the RDF file. This panel displays the title of each of the data points with connections showing the hierarchy in the whole data-set. Variations in color indicate to the user which document is currently open.

[3] http://www.dspace.org/

Rich-Prospect Browsing

It is clear that exploring vast amounts of information has become an issue of great interest in both computer science and digital humanities. Shneiderman advocates for a greater integration of research in data-mining and visualization, two different subjects within computing science, to provide better discovery tools (Shneiderman 2002). Fantastic advances in data mining, in combination with development in human computer interaction, could potentially provide researchers in disciplines that traditionally have limited access to new technology with the tools to leverage metadata-rich collections. For many, this would mean a re-introduction to their collections and an opportunity to examine their material in a completely different light. Furthermore, tools like these could point to the long-awaited legitimization of digital humanities (Juola 2008). It is this type of research in particular that can take the future of humanities research as a whole in a new direction.

Rich-prospect browsing is a new interactive visualization paradigm, born out of the desire to provide advanced visualization tools that encourage a more powerful and inclusive connection between researchers in the humanities and their metadata-wealthy material (Ruecker 2003). Rich-prospect browsing combines a meaningful representation of each item in a collection with tools to manipulate the display (Ruecker 2003). A rich-prospect interface relies on metadata available in a collection to provide controls and represent the collection in terms of its own characteristics. It provides an environment that facilitates research tasks such as synthesis and pattern finding. The visual nature of a rich-prospect interface fosters exploration of a collection rather than simply retrieval of individual items. It does so without requiring a researcher to share a common understanding about a

collection's content, but allows the user to manipulate the visual representation of an entire collection, or parts of it, to reflect its different aspects and reveal particular information. A rich-prospect interface attempts to share a collection so that the researcher can understand and interact with the collection as a whole, with each individual item, the relations between items, and the relations between individual items and the collection.

Meaningful Representation

For an item to be meaningfully represented there needs to be an implicit agreement between the designer and the researcher for a common understanding of what an item is (Ruecker 2003). A meaningful representation of an item, as opposed to just a representation, must direct the researcher to the concept of that specific item in the context in which it is being visualized. For example, an address book application, like the type within an email client, keeps track of details about contacts, either individuals or institutions. A representation of a contact could be, for example, a black and white icon of a person (see Figure 2).

Figure 2. Top: a representation of a person where the icon does not present any characteristic of the person being represented. Bottom: a meaningful representation of a person where the picture represents a specific characteristic of a person.

However, a black and white icon is not a meaningful representation, because it does not provide the user with enough detail about the specific contact being represented. It allows the user to think that the item represents a contact who is a person, but the icon does not tell the user which person in the list of contacts the icon is representing; a meaningful representation for a single contact could be a portrait of the person whose information is being stored. The meaningful representation of the contact allows the user immediately to associate the image of the contact to his contact information. In addition, the meaningful representation is provided in context of the application; since the user is browsing through an address book, he is unlikely to associate the contact's image to unrelated information about the person, but will instead link the image to the person's contact information. In the example in Figure 2, the user would associate the picture of me with my name, e-mail

address, and telephone number, and not with my qualifications or my personality. If the same image were displayed in an interface for job placements, the user would associate it with my resume and qualifications. For a meaningful representation to be successful, the visual image of the object being represented and the context in which it is being represented need to be clearly understood.

Cultural conventions, language, and technological literacy must also be considered, as they can also influence both the perception and understanding of an image as a meaningful representation, as well as the application as a tool to manage this information. Within visual communication design, the perspective of the user has increasingly taken a central role in the design process, following fundamental principles of design or from social sciences (Frascara 1997, pp. 33-59). Taking the user perspective is especially important when designing rich-prospect browsing interfaces. Presenting the items in a collection in a recognizable fashion is as essential for a researcher who is first introduced to a collection as it is to a researcher who is already familiar with it. In the process of exploring the collection, a new researcher will become accustomed to the representation of each item. Paredes-Olea et al. (2008) described a concept for an interface in which rose-shaped diagrams were used to represent a state in a complex system in order to support decisions in a mining operation. Users would learn to recognize configurations of decisions by growing accustomed to the shape of the visualization. In this case, meaningful representations and recognizable visual elements can contribute to making an interface more useful with time. Time can affect the user's perception of a meaningful representation. A representation that is initially not meaningful may, with time, become meaningful as the user learns to recognize it. Although in this thesis I do not explore the

implications of time to rich-prospect browsing, it is an interesting factor that should be considered in future research.

Arriving at a common understanding for a meaningful representation might not be possible in all situations. A designer charged with the task of designing meaningful representations for feelings expressed in a novel or moods that a song evokes might have a hard time finding agreement with even a single user. One user might associate the color blue with sadness, while another might think it evokes serenity. Additionally, users of the interface might not have any understanding about the context of a collection; therefore, no representation could be meaningful. An interface that presents the Volkswagen 2010 line-up viewed in the eyes of a peasant from Europe in the XVI century would be a complete failure. The peasant would have no understanding of what an automobile is and therefore would not be able to understand the context necessary to link a picture of a specific model with the concept of an automobile nor with any of its characteristics.

On the other hand, a meaningful representation might be possible but not be practical. A meaningful representation of a work of literature could be its actual text. The text is unique, identifiable, and carries a specific property of the novel that is being represented; it represents that specific piece and no other could be represented by it. If read in its entirety, the novel can be correctly identified. However, an interface that used the text of entire works from every piece to present every item in its database would be utterly impractical. Interfaces are limited by screen real estate and the ability of the user to retain sufficient information. Depending on the collection, an image of each book cover might be a much better meaningful representation of each novel. Since each book has its own distinct cover,

this would serve the purpose of identifying each novel individually and it would provide enough information for the user. A meaningful representation must be identifiable only in the context of the application. A single book cover in the context of the book covers inside a personal library, where there are no duplicates, would provide enough information about a novel to be a meaningful representation. On the other hand, a book cover would not constitute a meaningful representation for the collection of every available copy of a single novel.

Display Manipulation

> *The child laughs:*
> *"My wisdom and my love is play!"*
> *The young man sings:*
> *"My play and my wisdom is love!"*
> *The old man keeps silent:*
> *"My love and my play is wisdom" (Blaga 2004)*

Representing a collection in a manner that it is both meaningful and useful is an important factor if an interface is to aid research tasks effectively. Still, researchers will need more than to recognize the items in a collection to be able to explore it. The purpose of a rich-prospect browser is not only to present the collection in a direct and clear fashion but also to allow the researchers to examine the collection, to study its contents, and to be supported by its rich metadata. A rich-prospect browser must create an environment in which the researcher is allowed to play with the data. This action of playing with data will allow researchers to discover nuances, connections, relationships, and anomalies in the content of the collections that they would have otherwise missed.

In Huizinga's anthropological review of the history and importance of play in culture and civilization we find that there is something in the nature of a game, in the action of playing, that is intimately connected to how we discover and learn (Huizinga 1955). Play may arguably be the most interesting component of exploring and finding, learning, and living. And there is something in a game that resembles very closely the drive and the excitement with which we arrive to a long thought conclusion, create a new technology, or contemplate a phenomenon never seen before. Sinclair compares the action of navigating text with walking through a new city, in that we venture through the unknown, building our own experience, exploring and discovering (Sinclair 2003). Contrary, or perhaps complementary to Shneiderman, Sinclair prescribes an approach to developing tools that is more humanistic and less scientific. He wants to see tools as an enhancement to the experiencing of data rather than a strict analysis. Perhaps this approach can begin to dissipate resistance to text analysis, both the one based in fear, and the one based in ideology.

A rich-prospect browser can encourage this kind of exploratory play by providing controls to manipulate the display. The controls reflect the available facets of the collections metadata. The purpose of manipulating the display is to accentuate different aspects of the data. Metadata indicates characteristics of the collection that can be displayed visually. By manipulating how item representations are arranged we can visualize relations between items in the collection. A visual interaction between the representation of each item will allow the researcher easily to identify connections, differences, classifications, and patterns between items. Previous research has shown how the organization or positioning of items in a display can greatly influence the outcome of research tasks. Rodden (2001) shows how arranging images by similarity greatly improves the performance of image related queries.

The principal way in which a rich-prospect browser achieves this sort of exploratory interaction is by allowing researchers to group the items in a collection (Ruecker 2003). Visual groups of items will reflect some sort of relationship between items (see Figure 3).

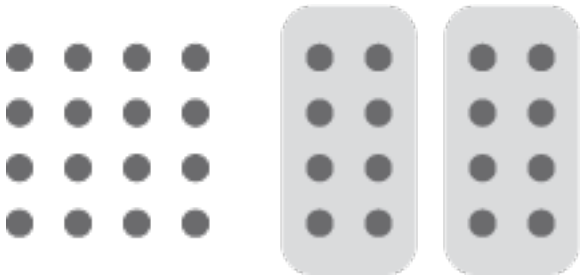

Figure 3. Left: A visual representation of all the items in a collection. Right: A visual representation of all the items in a collection divided into two different groups of equal size.

For example, a collection of literary works can be composed of works by only two authors. A rich-prospect browser would provide a control to group by author. When a researcher activates the grouping function with the author field as an argument, the browser will divide the collection into two groups of items. The researcher would then be able immediately to visualize the two groups of items. The researcher would also be able instantly to discern which author has more works included in the collection, or if the authors share the collection equally. She would learn that the two groups of items in the collection have some sort of relation to one another: each group of items shares the same author. This sort of interaction does not require from the researcher any kind of previous knowledge. With one simple action the author is able to understand some important characteristic of the collection and adjust further actions accordingly.

Supplementary to the grouping function, a rich-prospect browser also has a sub-setting function (Ruecker 2003). Sub-setting a collection is an equivalent function to grouping, but it implies that the researcher is only interested in visualizing the selected items. Sub-setting provides the researcher the ability to further manipulate the display in order to learn more about the interactions within the collection and with the collection as a whole. A researcher, for example, would be able to select one of the groups arranged in the previous action. Next, the researcher can use the grouping function with a genre argument, now only with the selected items. Assuming that the author wrote only in one genre the items will form only one group. A subsequent grouping by genre of the second author group might yield two genres: one which is the same of the first author, and a second, different genre. The researcher would see then, that there are two genres represented in the collection, and two authors, but the groups are not equivalent. Sub-setting lets the user visualize the relationships between items in the collection: items share certain characteristics, some share the same author, some share the same genre. Sub-setting also lets the user visualize relationships between the items and the collection: the collection is divided by two author groups and two genre groups.

PROSPECT

An affordance is an opportunity for action. The definition of the term comes from Gibson's study of perception from an ecological perspective, and it came into being as a way to define the visual qualities of an object that invite or offer a functional possibility (Gibson 1979). An affordance can additionally be understood as the counterpart to the action in an interactive relation. Within an interactive communication model, an affordance is the

message from the object to the agent that produces, invites, or even causes an action: the response from the agent to the object. For example, a bottle is an object designed for use as a liquid carrier, maybe even to function as an easy drinking device. Still, a bottle offers many more opportunities for action: it can be thrown; if it is made of glass, it can be used as a weapon; if it is large and plastic, it can be used to play soccer with; it can be used as a candle holder or as an ashtray; it can even be used as decoration. The function of the bottle is not equivalent to the perception of what one can do with a bottle. The affordances that an object offers to an agent transcend its conventional parameters.

The popularization of the term affordance within product design and human-computer interaction is due largely to Norman. He argues that product designers should create objects to match their perceived affordances and functions (Norman 1990). In order to create successful interactions and ensure the proper usage of a product, a product must be designed to offer the right affordances. The agent, or the user of the product, must perceive an affordance to match the function of the product. If an image on a screen is designed to be a clickable item, then it must visually invite clicking. Norman also introduces the concept of constraints, which is a sort of negative affordance (Norman 1990). If a possible outcome of a use of the product is negative, an error, or maybe even dangerous, the designer must make it hard for the user to make that mistake. A constraint is a negative affordance in the sense that it prevents the action by inhibiting the process or obscuring an action that would lead to a possible misuse of the product. For example, propane and other toxic chemicals are usually odorless, but their distributors add pungent smells to prevent people from breathing them. Constraints are also used when the action is not necessarily bad but should be performed cautiously. Many graphical interfaces for irreversible processes, like deleting

a document, will have dialog boxes that force the user to confirm these actions. These constraints are designed to prevent unintended activation of irreversible or dangerous processes.

Like the term affordance, prospect is also derived from a concept in a separate field that has been adapted to describe parallel phenomena in interface design and evaluation. Originally a term from landscape painting, prospect refers to the interactions occurring within an environment. In design, prospect refers to the conditions or circumstances under which an agent perceives an affordance and further acts upon it (Ruecker 2003). Ruecker argues that the prospect affects the conditions through which an affordance can be evaluated by the agent and the subsequent action that is taken. Traditionally, the communication is evaluated by looking at the agent's judgment of the perceived performance of the object in a particular action: how well would a bottle hold a candle? Ruecker argues that a more accurate evaluation should also take into account the circumstances under which the performance judgment is being made: given the objects that are within reach, in a low light condition, how well would this bottle hold a candle?

Prospect provides the context in the construction of a useful visualization or interface. In *Envisioning Information*, Tufte explained small multiples as a solution to what he considered the central issue in quantitative visualizations (Tufte 1991). A series of small graphics seemingly identical, though with small but important differences, provide valuable context to the reading of each individual graphic. Small multiples offer insights into the scale of the data being represented, the magnitude and significance of each variation, and a general idea of what the greater system looks like. The concept of prospect attempts to

identify the collective affordances provided by the simultaneous and consistent meaningful representation of every item in a collection.

To reiterate, a rich-prospect interface is one that offers a meaningful representation of every item in a collection and controls to manipulate the display (Ruecker 2003). A representation of every item in a collection, or prospect, is important to provide the context within which a researcher can explore the collection. The affordance of a meaningful representation of an item in the collection must be supplemented by the perspective presented by the representation of all the other items in the collection. By displaying the entirety of a collection, any manipulation of the display will reflect not only the relationships between items in a collection, like the relationships between items, but also the relationship of items and groups within the collection.

In the previous section I described a collection that was composed of literary works by two authors and contained works in two distinct genres. The researcher was able to observe the interaction between items by grouping them into two separate groups that each shared a characteristic. The author groups were equivalent in size. The visual representation of all the items and groups gave the researcher insights not only about the content of a specific group but also about the interaction of each group with the collection as a whole. The visual structure represents not only two equivalent groups, but also a collection divided in half. For example, a grouping of the collection by date of publication might find five groups, each reflecting one year. Further examination might reveal that all the groups except one represent sequential years. The one odd group could contain only one entry, compared to the other groups' multiple entries. The complex structure of this division can be visually

appreciated in an easy and quick manner. Any insight deduced from this subdivision of the collection would be premature; not enough information is displayed to arrive at an acceptable explanation. Nevertheless, prospect and meaningful representation presented on the display invite further exploration. The visualization even offers an interesting path to follow, a lead to further the investigation.

A rich-prospect browser displays the entirety of a collection at all times, and thus includes the perspective of an environment to facilitate exploration of the collection. Prospect thus is an affordance itself. The persistent display of every item turns the process of exploration into an interaction with the whole collection. It invites its understanding as an organism of interrelated parts, and in discovering those parts, grouping and sub-setting, characteristics pertaining to the whole collection will come to light.

ORDER

Norman introduced the concept of natural mapping as a guideline for interfaces to arrange the placement of controls in a manner that they correspond to the objects they command (Norman 1990). In his example he describes how a kitchen's burners and the knobs that control each burner are not necessarily arranged in the same way. In an effort to save real estate, the designers might have placed the knobs in a sequence, either underneath all the burners, or maybe to the side. The difference in the arrangement of the knobs and the arrangement of the burners may cause confusion. A user will not necessarily associate a knob with the burner that it controls. At the turn of the knob a burner will start, though not necessarily the intended one. If the knobs were arranged in correspondence with the burners, the user would naturally associate each burner with the correct knob (see Figure

4). The arrangement of knobs in correspondence to the burners creates a map of the burners, and makes coherent for the user the correlation of each control with the appropriate burner.

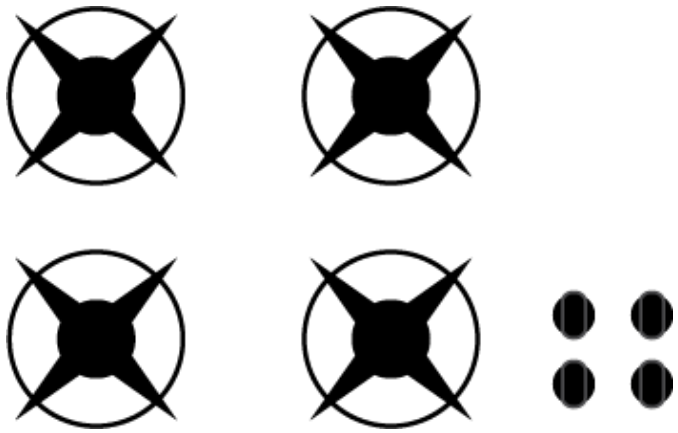

Figure 4. The burners and knobs are arranged in a similar pattern. A user will naturally associate each knob with the correct burner. The controls provide a map to the burners.

The arrangement and order of elements in the control interface of the kitchen is essential to the understanding of the system. Retrieval interfaces will list results in an ordered list. It is tacit understanding for the user that the first item in the list is the most relevant, the most appropriate match to the query. Interfaces make use of arrangements to reflect hierarchies, importance, size, time, etc. In a timeline, for example, events are placed in succession from the left to the right marking specific occasions with a position in a line; left representing the past and right representing the future. LifeLines is a prototype interface to display a patient medical history (Plaisant et al. 1996). It uses a timeline structure to visualize events in a patient's medical history. It also uses vertical subdivisions to present different categories of events. In this case the position of an event and its length will correspond to a period of

time marked by its corresponding shadow on the horizontal axis and a position on the vertical axis, representing the event category.

The position of an element on a map, whether it is created by an axis or simply by the landscape, will always invite an interpretation. A researcher using a rich-prospect interface will always interpret the order of the displayed elements and the position of each element as meaningful. Even if there is no intended meaning in the order and position of the elements, the user will try to figure out a valid interpretation for them. If no interpretation is valid, this will cause confusion and frustration in the user. The algorithm which sorts the matches in a retrieval interface may be arbitrary. For example, it may list the results sorted by the date in which the search engine last visited the site. For someone using the interface this may not be apparent, but the order of the items in the list will be interpreted in some way. This could lead to the user forming a bad opinion about the accuracy of the search engine when, in fact, it was the order of the results which was not understood.

Exploration of a collection in a rich-prospect interface is facilitated by meaningful representations of each item in a collection, prospect, and controls to manipulate the display. A meaningful representation will be placed on a map of similar items, giving the user perspective and creating prospect. The display of all the items in a collection will create a visual map, allowing the user to take decisions about how to explore that collection and observe each item in the collection in context. Every item, however, will be placed in a specific position in this map, and the position of each item will necessarily be interpreted by the user. The meaning of this position, the order in which the items of the collection are placed in the map must always be apparent to the user. It is imperative that the faculties of

a rich-prospect browser always be accompanied by an intentional algorithm to sort and display the items in the collection in a manner that can be transparently interpreted by the user.

A hierarchy may not always be relevant to the specific task or the items being displayed. In those cases, the interface can take advantage of conventions that predispose the user to interpret the order of items in a certain way. I mentioned that some retrieval interfaces display a list of matches according to relevance. Within retrieval interfaces this would be the standard way of displaying items. The user's cognitive load required to interpret a list returned after a query would be low. There are other basic conventions for the ordering of items, like alphabetical and chronological order. An alphabetical order might not be very appropriate to the research task being performed, but a user would be predisposed to seeing lists of items in this context arranged in such order and therefore displaying a list in chronological order would not make much sense to the user.

Allowing the user to change the sorting order of a list is desirable, as the affordances of a collated list can prove to be useful to the research task. For example, a search query in an electronic phonebook will return all the persons that share the same last name. The interface will return the matches in a specific order, maybe the most contacted person is at the top, and the least one at the bottom. If a user is allowed to change the order, she can sort the items by birthday. The affordances of having a multiple-way sorted list are many. A collated list allows the user to quickly scan the 5 most contacted contacts in the list. The user can also quickly determine which are the people with upcoming birthdays.

RICH-PROSPECT-ESQUE INTERFACES

Even though not rich-prospect interfaces by name, there have been some efforts that incorporate some of the principles of rich-prospect browsing. From the University of Virginia, project Blacklight is an open source project aimed at providing a faceted browsing environment to explore the nineteenth-century studies online (NINES[4]) collection (Nowviskie et al. 2007). Researchers can browse and search through the collection. It provides a faceted browsing environment making use of metadata to create filters or complex queries. It is also an effort to create a collaborative environment for researchers, allowing them not only to use structured metadata already offered in the collection, but also to contribute in the form of tags and create exhibits. Collaboration allows and encourages researchers to become closer to their resources and form part of the community that is working to improve them.

Efforts to visualize large data-sets often encounter problems when trying to display the entirety of a collection. LensBar is a visualization prototype for general purpose browsing of large lists (Masui 1998). Lensbar displays a small representation of the whole collection, which contains unreadably small text and a panel for filtering and viewing single entries. The collection can be a list of words, such as a dictionary or a thesaurus, or a long text document, like the code for a software package. The representation of the whole collection provides prospect while the detail panel allows the user to learn about a particular entry or line of the document. The querying system makes it easy filter through the list without having to browse through everything. A slider on top of the list representation allows the user to center on a specific area of the collection and browse through the items in the list in

[4] http://www.nines.org

detail. A density marker on the list representation also shows, when zooming into a specific area on the list, the size of the current area on display. This list view provides prospect; it allows users to look at the size of the whole collection and the area where they are currently focusing.

The Mandala Browser is another interesting interface that derives some of its elements from rich-prospect browsing. It is an interface for browsing interpretatively tagged XML collections (Cheypesh 2006). The Mandala Browser's design focuses on the exploration of connections between items as defined by one or more parameters. The interface represents every item in a collection with a floating dot on top of a round canvas. The user then can add magnets, a visual representation of a filter. The magnet attracts dots according to the filter, and the dots that are related will gravitate towards that magnet. Magnets can be added on a variety of filters: match words, phrases, themes, authors, etc. The power of the filters is limited only by the richness of the collection's metadata. A researcher can add several magnets at once. If two magnets have shared items, the dots will get attracted to both and form a third cluster of dots in the center between those magnets (see Figure 5). This visualization emphasizes relationships between items. It allows the researcher to quickly browse through items that share a specific facet. The Mandala Browser allows the user to quickly find groups constituted by peculiar items that share two or more characteristics. Not only would this help a researcher identify these groups, but she will also learn useful insights about the characteristics of those groups, their relative size, and where they appear.

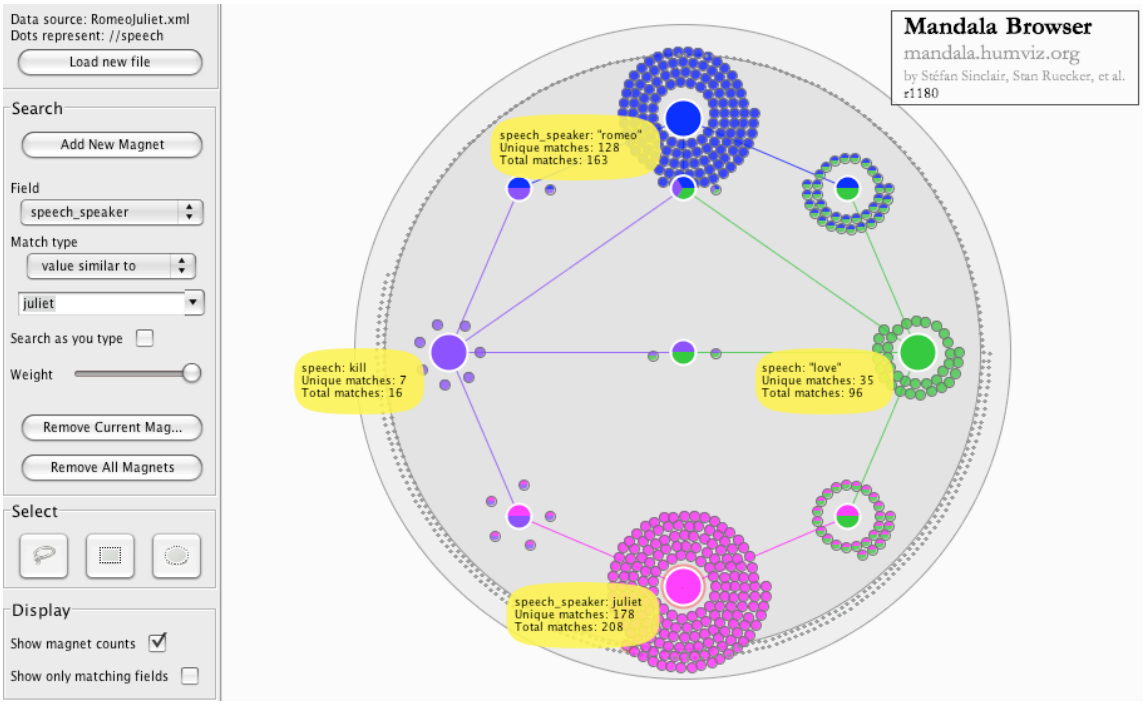

Figure 5. The mandala browser displaying every speech on Romeo and Juliet. The speeches are represented by floating dots. Large dots are magnets that attract the speeches based on a specific relationship. In this case there are 4 magnets: Blue, all speeches by *Romeo*; pink, all speeches by *Juliet*; Green, speeches that talk about *love*; Purple, speeches in which *kill* appears.

For example, exploring a collection of political speeches using the Mandala Browser, a researcher could add magnets for themes of patriotism, war, and economic troubles, and quickly see the speeches that share those themes. A visual representation of the groups would show how many speeches share those three themes or at least two of them. It would also allow them to quickly answer complex questions, like how many of the speeches about war do not talk about patriotism or economic troubles. By providing prospect, and controls to manipulate the visual representation of hundreds or thousands of speeches, the Mandala

Browser offers an exploratory tool that allows researches to quickly learn insights about the collection, individual elements within it, and the relationships between those elements.

Rich-Prospect Interfaces

The Humanities Computing program at University of Alberta has been home to extensive research in interface design and development. Several interface prototypes and some studies have been conducted on the effectiveness of rich-prospect browsing. The Pill browser is a browser that intends to provide a usable interface for a senior population to help them identify and properly use medication (Given et al. 2007). The researchers noted that the proliferation of complex medical regimes often leave the elderly to manage a large quantity of medication with a variety of purposes and conditions for utilization. This often becomes a difficult task. In view of the recent growth of public resources to help cope with this task, the Pill browser was designed to provide a visual interaction model to help search, identify, and learn about the medication.

The Pill browser is powered by publicly accessible information from external resources but uses them to present information following rich-prospect principles. The user is presented with a small image of every pill from common databases and offers the user functions to organize, group, and subset their display. The display of the pills can be manipulated through sorting by color, shape, and other physical characteristics, as it is intended for users who probably possess the medication but have failed to recognize what it is. The user will systematically reduce the possibilities by checking on and off different characteristics of the pill that they are holding. During the study, a group of seniors with varied experience with web tools were presented with the interface and asked to perform a few research

tasks. The study found that the interface was successful in solving the problems with traditional interfaces. The searching tasks were performed more smoothly and led to reduced confusion about the information being presented. More importantly, the Pill browser showed that participants were able to discover classifications and patterns in the data that were previously very difficult to observe.

The Delegate browser is a project derived from the Pill browser; it uses a similar interface to provide a browsing environment for conference attendees (Ruecker 2006a). In this case, the motivation is to provide a tool to supplement people's memory limitations. Conference attendees typically meet other attendees, listen to their presentations, or are introduced to new colleagues during the short period of time that those conferences last. Keeping track of all these people is often a problem. However, some recollection of the event is usually retained; maybe physical characteristics of the person, or the topic of the presentation that the person gave, etc. Preliminary analysis of the Delegate browser usage showed that researchers would make roughly equal use of the several metadata controls to organize the delegates, as opposed to most users making use of a single or a few common paths to navigate the collection.

The Delegate browser presents an image of every person attending the conference (see Figure 6). In addition, it also holds many other details about that person's physical characteristics, like the color of their hair, or whether they wear eyeglasses or not; it also provides circumstantial information like the title of their presentation during the conference and the institution with which they are associated.

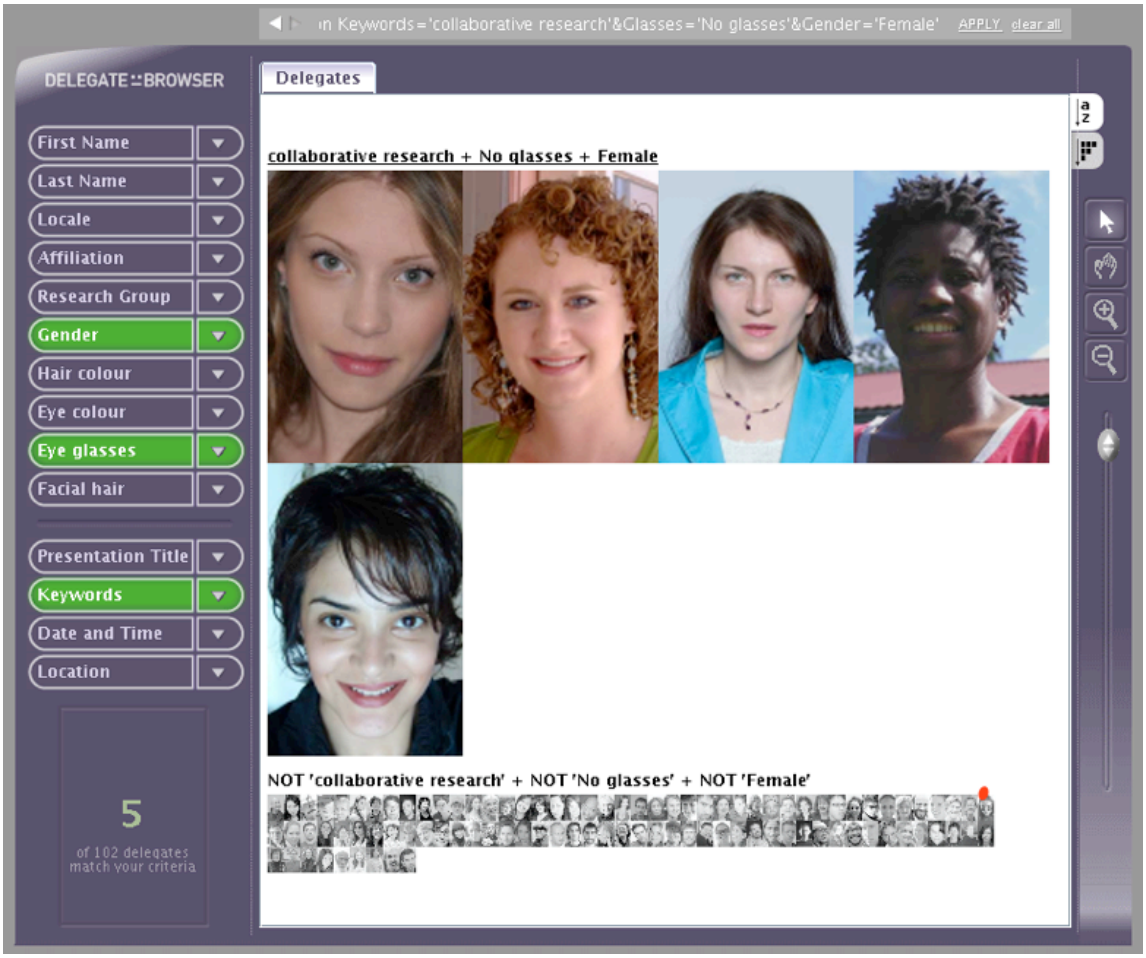

Figure 6: The Delegate browser displaying portraits of conference attendees that meet the conditions of the query: Collaborative Research, No Glasses and Female.

A conference attendee after a long day of presentations and events might want to send an email to a colleague he met that day. Using the Delegate browser he can identify the colleague. To do this he can start by sorting the delegates by the topic of the presentations given, then he can select all the female speakers and discard the delegates with eyeglasses. With only a few options left, their portraits should be enough to identify the person. The browser will provide her contact information and maybe other details that were not discussed during their last conversation.

Texttiles

Texttiles, formerly called *Ripper* (see Figure 7), is a rich-prospect browser prototype for exploring large text collections (Giacometti et al. 2008). It is an attempt to provide researchers with an exploratory tool to facilitate research tasks in collections that are mostly comprised of text. *Texttiles* takes advantage of the diverse collections and available metadata around the web. Each item in the collection is represented by a "text tile", an icon. The icon contains text consisting of some part or properties of the item being represented. Controls are provided to manipulate the contents of those tiles and their organization and position on the display.

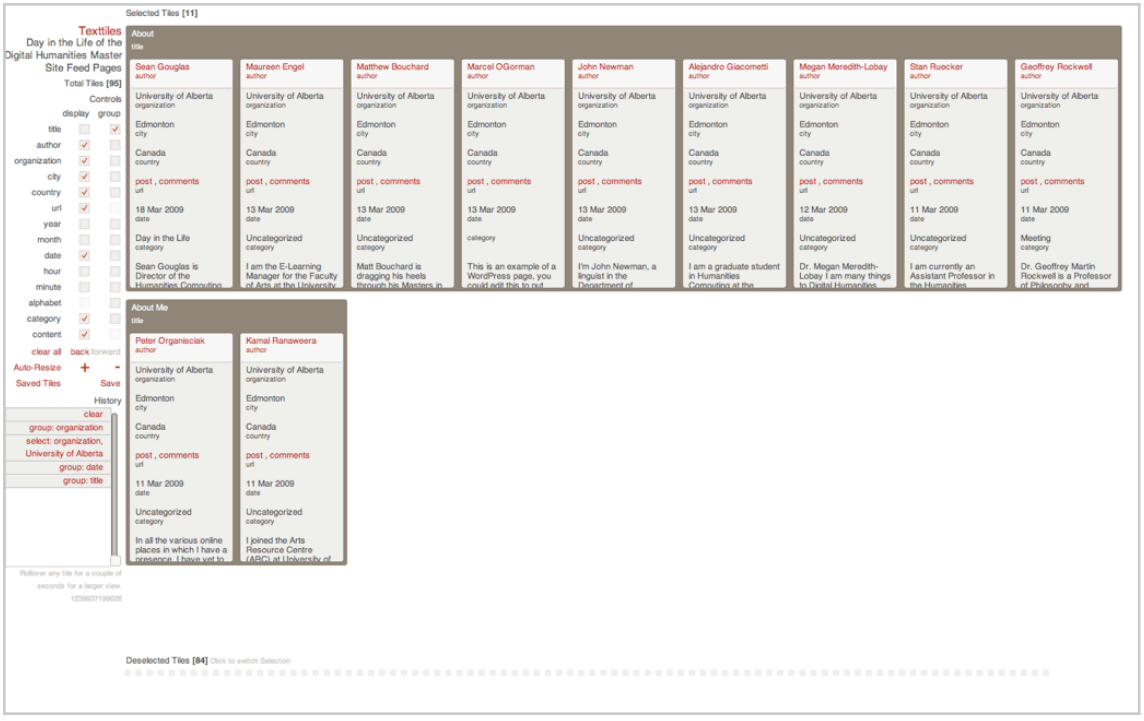

Figure 7. The *Texttiles* browser. A rich-prospect browser prototype for exploring text collections.

The *Texttiles* browser is designed to be easily configurable to accept any kind of XML encoded metadata collection, for example RSS or ATOM feeds from blog sites like Wordpress[5], or Blogger[6]. Configurations for popular metadata formats are provided, but the mechanism to add a customized configuration for any kind of XML encoded collection is simple and open. The implementation follows the principles of rich-prospect browsing of meaningful representation, display manipulation, prospect, and order.

The motivation to develop the *Texttiles* browser came from previous experiments at the University of Alberta, Humanities Computing Program with rich-prospect browsers and the positive results that those studies yielded. The conclusions and suggestions of those previous studies have been incorporated into the design and development of this prototype. Some considerations had to be taken into account when applying previous understanding of rich-prospect browsing principles to text collections.

Transfer of Design

As described in the previous chapter, rich-prospect browsing is a relatively new model; it was outlined in 1993 in Affordances of Prospect, Ruecker's doctoral dissertation. Also mentioned in the last chapter are some prototypes, the Delegate browser (Given et al. 2007) and the Pill browser (Ruecker 2006a), which have been produced and about which studies have been conducted. These studies provided confirmation to the proposed theory and also suggested some directions for future research. The *Texttiles* browser is a further

[5] www.wordpress.org

[6] www.blogger.com

endeavor to add substance to previous studies and also to investigate further areas in which rich-prospect browsing can potentially be of service, namely text collections.

Previous rich-prospect interface prototypes used small pictorial elements organized in small tiles to provide a representation of the items in the collection, i.e. a picture of a specific pill or a portrait of a person. The *Texttiles* browser design extrapolates the analogy made in the previous prototypes of an item as a single readily identifiable tile. This analogy immediately presents a problem due to the lack of an inherent unique graphical element of text that can be used to represent a document as pictures represented a person or a pill.

In an effort to produce an analogy that would represent the textual element in a meaningful way, and before settling with the tile analogy, *Texttiles* underwent a process of design iterations. Figure 8 shows the first design, which produced a series of rectangular blocks that represented text. These blocks would render actual text at a scale in which the text would become readable.

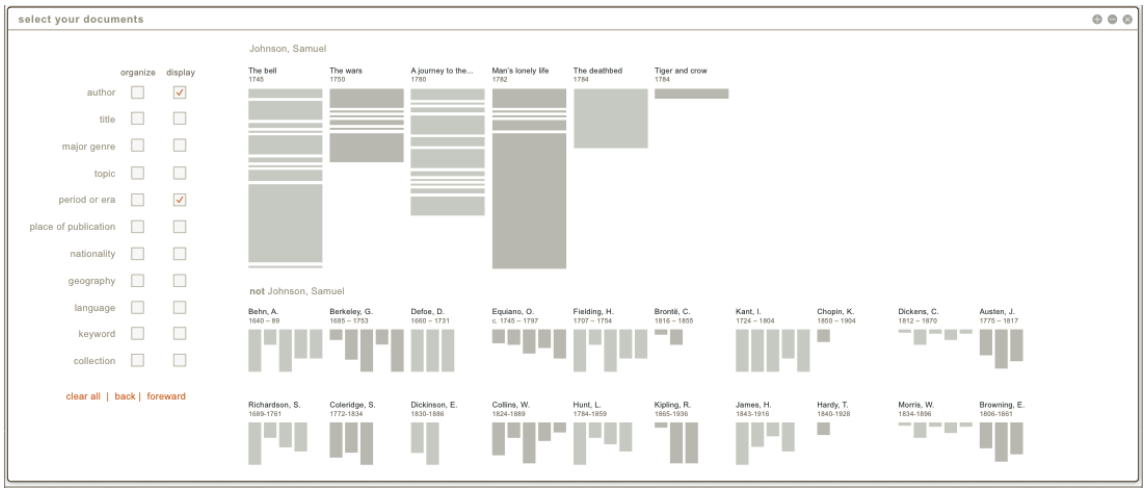

Figure 8. This design by Milena Radzikowska shows the text as a series of rectangles that represent text blocks.

Blocks represent a subsection of the document, for example a chapter or paragraph. Although it successfully used the intrinsic qualities of an item to represent it, this design replaces all text with a stylized representation of a document's sub-elements, offering a representation that resembles, very closely, bar-charts. This design presented an interface that was too closely related to numbers and could bewilder users expecting text. Further it could confuse and detract them from experiencing the rest of the interface affordances due to the initial lack of engagement.

The inclusion of more text in the representation of items was deemed necessary. Figure 9 shows a design that relied mainly on typographical elements to visually differentiate between items in a collection. It provides a meaningful representation of each item, as the text is actually part of the document. It also allows for some ranking of items through the use of different font sizes, vertical and horizontal hierarchies. Although some space was left for the controls, no clear workflow model is provided for the manipulation of the display. Also, in the style of a retrieval interface, presenting items in a hierarchical form, some preconceived structure of the collection from the interface could take visual precedence over the researcher's current task.

Figure 9. This design by Gerry Derksen shows items in a hierarchical list, using text as the main representation and some typographical elements and color to separate each item.

The prominence of textual elements, however, proved to be the form in which the items representation was most successful. Figure 10 shows the next iteration; the closest approximation of the final version of the implementation of the eventual *Texttiles* browser appearance. Each element is represented by a tile with the user's selection of details appearing in each tile. When the size does not permit all the details of the element to be shown, dots represent the choices of the user. Although the dots did not contribute to the meaningful representation of the item, they did offer visual feedback on the user's choices.

Figure 10. This design by Ian Craig shows the tiles in a reduced size, where some textual element is representing each item, and dots represent items that are not visible.

Tiles would actually hold information about each item when displayed in larger sizes and therefore contribute to a meaningful representation of each document. These ideas were incorporated into the final version, in which technical aspects, like presenting heavy graphical elements for large sets, speed, etc., also had to be taken into consideration.

It is also worth noting that the representation of documents as icons with small text is not something unfamiliar to users. The desktop metaphor in operating systems has been doing this for a long time. However, we are striving to not only create a useful representation of a document in a collection, but, carrying the analogy from previous rich-prospect browsers, to create a meaningful representation. Similarly, the notion of a tile containing text is a concept that is very similar to the library's quintessential index cards: a mental parallel that can potentially help some users to be comfortable with the *Texttiles* browser.

Meaningful Representation

In order to present the collection accurately and create a representation of each item that is meaningful to the researcher, the *Texttiles* browser surrenders control of what the tile contains. By the use of display controls the researcher is able to choose the most relevant details about each item for the current research task, and thus include, or exclude them from the current representation of the item.

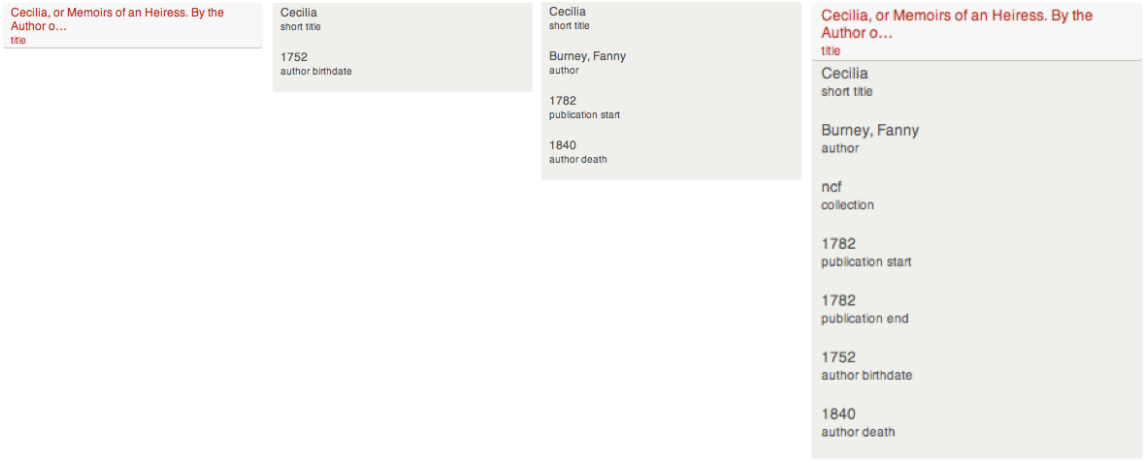

Figure 11. A meaningful representation is achieved by allowing the user to choose the details that are pertinent about the item for the current research task.

The researcher not only gains authority on how to display the collection but is also forced into awareness of how much information is available about the collection at any point. By being in control of how the items are represented, the user becomes aware of constraints in space and size. This allows the researcher to work in conjunction with the *Texttiles* browser to decide the best way to display the collection at a specific time. The representation of the items becomes more meaningful by not only representing each item uniquely, but also taking the task at hand into account as an important factor in its display. For example, a researcher might be exploring a collection of books. The designer of a browser could make

an arbitrary decision about what is the most meaningful piece of information that represents that item. In that case, all books could always be represented by their title. However, a researcher might be exploring the collection and need to find out about the book's authors. The researcher could organize the display of the collection by authors and use some other mechanism to discover the author of each book. That model would present an extra step and increase the cognitive load on the researcher. The exploration would be limited by an arbitrary decision taken by a designer who is not necessarily aware of all the permutations that a browser can offer its users.

The variability in size and content of the tiles does increase some of the technical challenges. Multiple calculations must be done to manage the available screen real estate and the selection of the user. Throughout the development stages, these and other technical limitations were contrasted to the affordance benefits. The *Texttiles* browser implementation is an attempt to offer maximum versatility to explore a collection.

PROSPECT

In order to create prospect, the *Texttiles* browser, whenever possible, displays all the items in the collection at once. In the previous chapter we discussed how prospect allowed the researcher to understand the collection as an organism and to visually explore its inner dynamics with the help of its own characteristics. Displaying the whole collection and displaying variable information pertaining to each item in the collection, though, presents some difficulties when managing space and organization. The *Texttiles* browser displays the whole collection in the available screen real estate without making the user scroll to find hidden elements.

The current selection is displayed in a main panel. This selection is the set of tiles that the user is currently exploring. This panel's display is the main area where the user can manipulate the organization and display of tiles. The size of each tile displayed in the selected panel varies according to how many items are currently selected and how much information about each the user has chosen to display (see Figure 12).

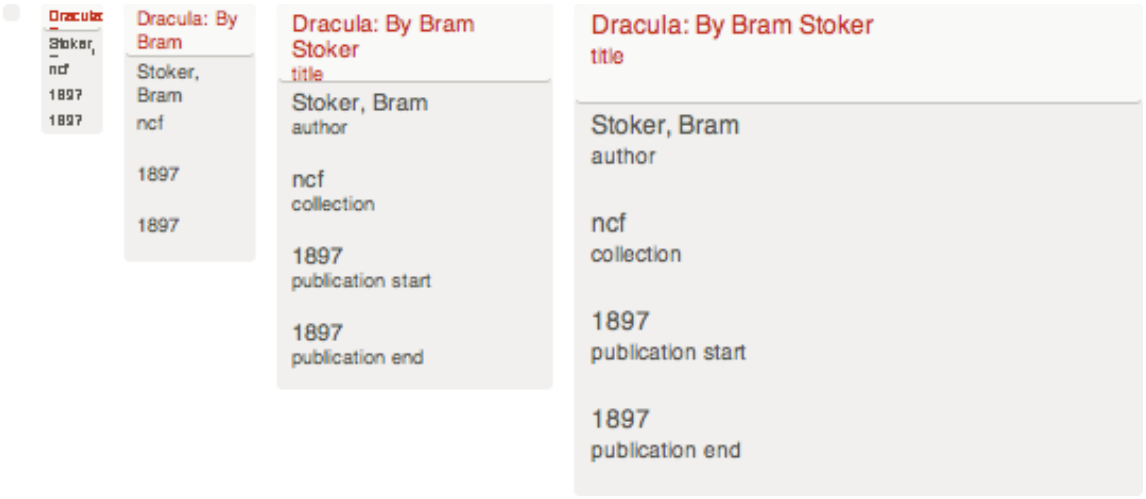

Figure 12. Tiles are presented in five sizes, according to how many items are currently on display and how much information is shown about each item.

Controls to resize the items manually are available to the user at all times. Even though the interface will automatically resize the items to try to fit the screen and display the whole collection in the available real estate, the user can decide to resize the tiles and view only a portion of the collection at a size in which she is comfortable. Manually resizing can serve two purposes. It can serve as a backup function to reinstate prospect if for some reason the automatic sizing function is malfunctioning. It can also provide the user a second exploration mode, in which she can go through each tile displaying all the information

desired at a size that all the information can be comfortably read. The second mode would destroy prospect.

The deselected tiles are also kept on screen whenever possible as they are part of the collection. Even though the user is not currently investigating those unselected items their presence makes the researcher aware of the magnitude of the whole collection, the size of the current selection in comparison to the whole, and perhaps also the significance of any finding. The deselected tiles are kept on a panel under the selected tiles and, as cognitive reinforcement, tile counts for both panels are provided. Deselected tiles are kept at the smallest tile size. This way they are still present, but they do not take too much space.

Grouping & Order

The purpose of a rich-prospect browser is to visually highlight connections, differences, or patterns between items in the collection. As discussed in the previous chapter, the primary way in which the *Texttiles* browser shows mutual relationships between items is by grouping. By selecting a single facet in the control panel, the selected tiles will cluster in groups with tiles that share those same facets. For example, if the author facet is selected, every work by the same author would form one group. All tiles would appear in an appropriate group (see Figure 13).

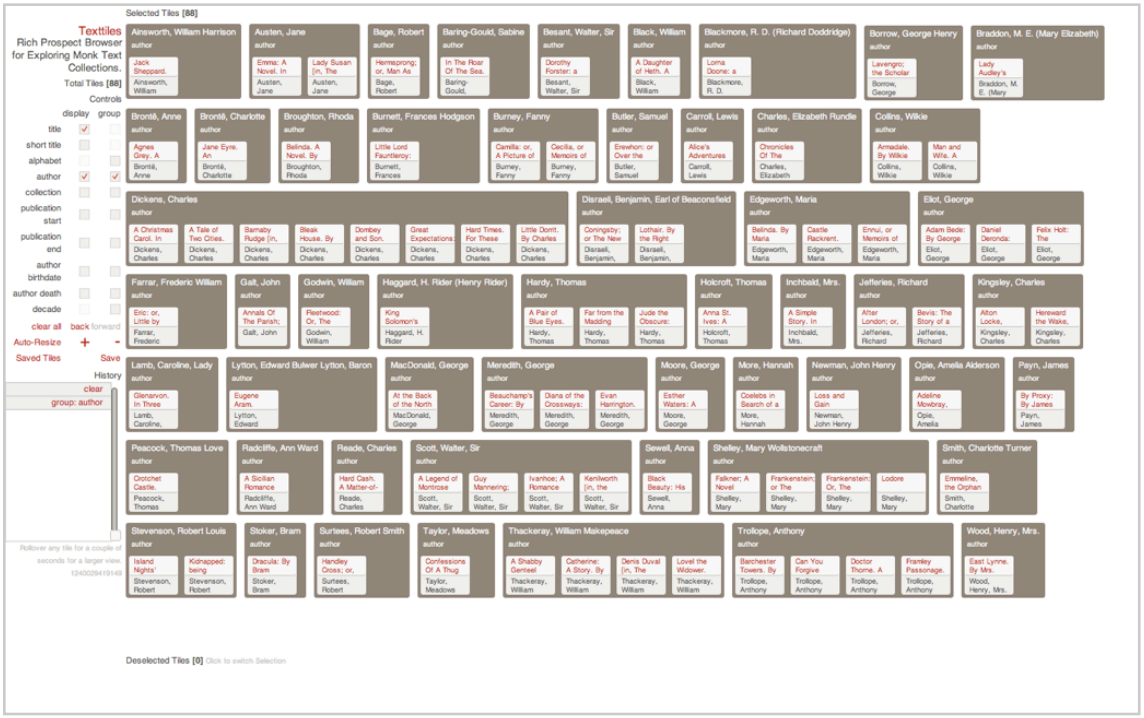

Figure 13. The *Texttiles* browser showing all items in a collection grouped by author. Notice that in the control panel there are checked preferences for the *title* and *author* facets to be displayed in each tile. The *author* facet for grouping is also checked, which means that the user has selected the items to be grouped by author.

Groups are always displayed in some sort of order that is appropriate for the type of facet that they constitute. The groups of authors in this example would be sorted alphabetically. *Texttiles* will correctly sort groups constructed of facets in supported types: alphabetical, numerical values, and dates.

Some design decisions had to be taken into account to accurately represent a collection. The design of typical metadata allows for items to be part of several groups in some of the facets. In the case of blogs, for example, a post is usually part of one of the defined categories and, often, part of several tags. In computing science this is referred to as a

many-to-many relationship, a relationship where a post is part of many tags, and a tag is also part of many posts. The *Texttiles* browser must be able to handle items that can appear in several groups at once. The *Texttiles* browser duplicates items that appear in several groups and includes a copy in each group. A design decision had to be taken on whether to highlight these duplicate items or make the user aware of this duplication in some way or another. The user can be confused trying to identify elements that appear in several groups. Furthermore, the visual properties of prospect would get somewhat distorted. However, highlighting the item would bring unwarranted attention to that item. The *Texttiles* browser currently does not highlight or notify the user in any way of this duplication.

Although groups, in their current form, are limited by one-dimensional relations, they can be selected. By sub-setting a group the browser would turn that group into the selection that the user can then organize further into subgroups. That functionality allows the user to identify further patterns and discover more precise relationships. It also allows the user to focus on a sub-set of the collection that might be more interesting or appropriate to the current research task.

Other Interface Elements

Even though they are not part of the rich-prospect model, the *Texttiles* browser also includes some standard and supplementary interface elements that add to the experience of exploring a collection. Perhaps the most important ones of these elements are the tooltip feature and the marking feature. The user holds complete control of what is being displayed inside of each tile. Some research tasks might require finding some additional piece of information quickly. The tooltip feature allows the user to access all the metadata of a single

tile by positioning the mouse over a tile for a period of 3 seconds. At that point, a detailed panel with all the metadata available from that specific tile would come up on top of the display (see Figure 14).

Figure 14. The tooltip shows all the metadata available from one item. It appears by placing the mouse on top of the tile for 3 seconds.

Another feature that the *Texttiles* browser includes, which helps to create a more versatile browsing environment, is marking. A user can temporarily change the background color of a tile. Subsequent manipulations of the display, like grouping, selecting, and deselecting, will show the tile in the marked color. This function allows the user to place visual emphasis on one tile, following it around as the display changes (see Figure 15).

Figure 15. The *Texttiles* Browser showing tiles by the same author marked in one color. The tiles have been regrouped by category. The user can follow tiles by the same author as the display is modified to emphasize different characteristics of the collection.

A few other standard interface elements have been added to the interface to facilitate user interaction. For example, all the actions and modifications are tracked by a history panel, which the user can access to go back and forward to any stage in the exploration. Also, when a grouping or selection process is taking some time to finish, there is a progress bar displayed with a message notifying the user of the action that is currently taking place, and visually showing the remaining process time.

Technical Considerations

The *Texttiles* browser was developed to function within a web browser. The technologies used were HTML to render the display, XML to transmit information about the collection, and Javascript to set the interface behaviors. Javascript modifies the Document Object Model (DOM) of the HTML rendering engine. The implementation also makes use of a Javascript library: jQuery[7]. As Javascript engines and HTML rendering engines differ from browser to browser, the jQuery library facilitates cross-browser compatibility by wrapping general functions into ones that can be used with confidence. Thanks to this library, the *Texttiles* browser is available in any modern browser and can be deployed to a wide range of users without requiring installation of any software or third-party package.

This technology, however, is new. Even though it has been recently used to develop advanced user interfaces, the intense graphical manipulation that the *Texttiles* browser requires pushes the limits of what is technically possible at this time. The browser today can handle collections of a few hundred items before becoming slow. Still, this decision was supported by the recent push to advance this sort of technology by the major browsers on the current market. The speed at which Javascript can run within a browser environment has been steadily increasing for the past year. Moreover, the graphic capabilities of the HTML rendering engines have shown some significant improvements. Thus, the *Texttiles* browser has the potential of improving in speed and power with little or no effort from developers, and enjoying the advances of web browser development.

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[7] www.jquery.com

Methods

In the previous chapters I justify the place for a rich-prospect browser that leverages the metadata of text collections to provide an appropriate environment for exploration and facilitate research tasks. I also lay down the rationale and principles behind the development of the *Texttiles* browser. I conducted a usability study in order to determine whether the *Texttiles* browser is useful for exploring text collections, whether the rich-prospect principles truly aid research tasks, and whether those principles were successfully implemented into the *Texttiles* prototype.

The user study was conducted with 14 participants. The study consisted of three sections: a pre-test questionnaire for background information and to determine the participants' research habits and preferences, a list of tasks to be conducted with the *Texttiles* browser, and a post-test questionnaire with a series of usability and affordance strength measures. The tests were run on an individual basis: one participant and the researcher. This user study, using a combination of qualitative methods, including an informal conversation with the participant and observation of the interaction with the developed prototype, allowed us not only to evaluate the premises which were the basis for the development of the *Texttiles* browser, but also to develop concepts and discover new ideas about the information seeking behavior of participants (Wilson 1981). The tests were run in such a way that the participants were encouraged to make comments about their current actions, their former practices, and what they learned. They were also encouraged to be self-aware during the test about the performance of the tasks and to reflect on their actions during those tasks. Please see Appendixes A, B, C, and D for a complete set of the research materials.

Materials & Procedure

Pre-test Questionnaire

The pre-test questionnaire consisted of a series of background questions. Apart from demographic information, participants were asked to identify the type of work that they do and the area of their research. They were also asked to identify and describe some of the common research tools that they had at their disposal and the frequency with which they used them. They were given categories of research tools like search engines, databases, and citation managers and were asked to describe the reasons that they preferred the tools that they used and also to state why they did not use others that they were aware of. Further, participants answered some questions about their experience with research tools, explained some of the problems that they had, and described what their requirements and expectations were. Finally, they were asked whether the research tools that they used had any influence on their research work.

The pre-test questionnaire was designed to give context to the actions and comments of each participant. I was interested in getting a general idea of the level of the participants' experience with research and interactive tools. I was also interested in knowing the tools that the participants were used to working with and the different aspects of them that they liked or disliked. Last, I was particularly interested in how they thought these tools influenced their work.

Tasks & Behaviors

During the second part of the study participants were given a brief explanation of what the *Texttiles* browser did and how it worked. They were then given four tasks to complete with

the browser. Participants were told they could ask questions about the interface, collection, and the tasks. During the tasks, participants were encouraged to talk about what the purpose of each tasks was and express their immediate concerns following the verbal analysis protocol (Guha and Saraf 2005, Morrison 1999). The verbal analysis or "thinkaloud" protocol is a method that allows the researcher to keep track of the participants' progress on a given task while enabling the participant to keep the instructions in mind and complete them. It also enables the researcher to identify problems with the interface and tasks or the participants' ability to complete those tasks. The identified problems provide useful information that contributes to the research task. In some cases, the problems are irrelevant to the current research task and can be solved immediately by the researcher without affecting the results of the study.

After every task the participants were asked whether the task was simple to complete and given a 5-point scale to answer. The participants were also asked to comment on the features of the *Texttiles* browser that facilitated the current task. A space for comments was also available.

The four tasks were designed to highlight particular aspects of the *Texttiles* browser functionality and to be progressive in complexity. None of the tasks referenced the content of the collection, but expected the participants to learn about the available information by themselves. The first task was to get a general idea of what kind of information was being offered by the collection. Also, the intention was to show them how to use the two basic functions of the interface: display and group. The second task asked the participants to perform a series of more complex queries. For this task, the participants had to use a

combination of grouping, sub-setting, and switching between the selected and deselected tiles. The third task requested the participants to locate an individual tile and try to learn something from it and its context within the collection. This task aimed at getting the user to use the features of the browser in combination with each other. The fourth task was general and consisted of open-ended instructions to find an interesting relationship between tiles. This task was designed to let the participants use the features that they were more comfortable with. At this point the participants would have been presented with all the functions of the browser that are available and could use a variety of methods to arrive at a satisfactory answer.

The researcher was present at all times to answer any questions the participants might have while completing the tasks. The researcher also observed particular behaviors as they were performed by the participants. The list of behaviors was developed to ease the note taking by the researcher. The behaviors consisted of a few of the basic feature actions of the *Texttiles* browser and several combinations of actions, which were anticipated as common. Combinations of actions were particularly interesting, because they would allow participants to make judgment calls about the efficacy of the interface at aiding certain research activities. The researcher also took notes of combinations of actions that were not predicted in the behavior list, but that were performed by a participant. Each behavior was noted in a form next to the task in which the behavior was observed (see Appendix B for list of behaviors). This was useful to determine in what situations the behaviors where observed. In addition, the researcher kept a log of any comments, concerns, and suggestions made by the participant. An automatic log with limited information about each

participant's session was also kept by the browser. This log was consulted to confirm the researcher notes.

Post-Test Questionnaire

A post-test questionnaire was administered to participants after they had completed the four tasks. It asked a combination of questions about the usability of the *Texttiles* browser and some of its functions. The questionnaire is divided into two parts; both parts were intended to evaluate the interface's usability, but each evaluation is based on a different approach. The first part of the questionnaire uses *Human-Computer Pragmatics*, an approach to evaluating interfaces proposed by Anvik (2007), based on the premise that the use of a computer interface is, in effect, an act of communication between the user and the designer.

The questions in the second part were based on the affordance strength model proposed by Ruecker in 2006 (b). This model sets up a framework through which we can evaluate the performance of the interface as a whole as well as its specific features. The majority of questions were set on an ordered response scale, ranging from *Strongly Disagree* to *Strongly Agree* when presented with a statement; *Very Difficult* to *Very Easy* when asked about their efforts understanding a specific feature; or *Not at All* to *Very Much* when asked about preference. Some open-ended questions were also included to provide participants with the option of explaining their responses in more depth. Throughout the study participants were encouraged to make comments on any of the questions as well as the browser. Finally, the participants were asked how they would use the *Texttiles* browser. This question was designed to determine if they saw the benefits of such an interface and

could extrapolate its features to tasks and collections which would be more useful and familiar to them.

Post-Test Questionnaire: Human-Computer Pragmatics Questions

The first part of the questionnaire requests participants to evaluate their interaction with the *Texttiles* browser as a conversation and is based on Human-Computer Pragmatics. Anvik introduced the term in his thesis in 2007, based on Habermas's theories of universal pragmatics. He argues that a computer interface is a medium through which a user communicates with the designer. Thus, such conversation should be successful if it follows the concepts of *comprehensibility*, *truth*, *truthfulness* and *normative right* (Anvik 2007).

In order to attain *comprehensibility* it is necessary for both interlocutors to understand what is being communicated. The designer must devise a consistent method for communicating to the user what is happening in the interface. In a computer interface the user must be able to understand the actions that are possible. Users also need to be aware of the processes that are involved, the browser's progress in completing those processes, and to understand what those processes entail. The questionnaire asked the participants whether they thought that the browser was easy to use and whether the visual language helped them understand what was happening in the system.

Truth refers to the accuracy of the system's actions. A system must precisely perform the actions which are requested of it. The designer must be able to communicate that the processes that are occurring are those that the user has requested and only those ones. To assess *truth* participants where asked whether they thought the *Texttiles* browser presented the collection accurately.

The notion of *truthfulness* is related to *truth*, though it corresponds to the credibility of the interface. The interface must not only operate correctly but also convey confidence in its results. Conforming with *truthfulness* is central to rich-prospect browsing. The principles of rich-prospect browsing are shaped by the desire of presenting a collection accurately and letting the user manipulate that presentation transparently. The user's intimate involvement in the process will yield confidence in any results. During the questionnaire participants were asked whether they were confident in their findings when they used the *Texttiles* browser.

Normative Rightness refers to the standard of communication that has been set previously. For an interface to conform to *normative right* it would have to be designed with previous knowledge and respect for standards in human-computer interaction. The *Texttiles* browser, however, is a prototype for a new form of interaction. Its design and development, including this research study, aim at discovering and recognizing new features in the communication. Some elements of the interface will, however, be visual objects which the participants would recognize as standards within interface design. They would be able to see checkboxes and scroll-bars, interact with the interface using the mouse pointer, click on elements and expect events to be fired, etc. Therefore, participants were asked a subtler question: whether they felt the interface was designed properly.

This section also asked a general question about the design of the interface. Aesthetics were not directly covered in Anvik's Human-Computer Pragmatics approach, but were considered important for the purposes of this project. A multiple choice question was also

added; it asked users to select their preferences from a list of modifications that could be done to the browser.

Post-Test Questionnaire: Affordance Strength Questions

This second part of the questionnaire was designed to assess the *Texttiles* browser in terms of the concepts and structure offered by Ruecker's affordance strength model. Ruecker argues that it is difficult to evaluate or compare the affordance of different interface elements *per se* and suggests comparing them in context of a specific situation (Ruecker 2006b). He then sets a series of relational factors to evaluate the strength of each affordance in terms of the user's perception. The factors are *tacit capacity*, *situated potential*, *awareness*, *motivation*, *ability*, *preference*, *contextual support*, and *agential support*. *Tacit capacity* refers to the intrinsic values of the object to perform the action that is required. For example, everybody understands that the shape of a cup enables it to hold liquids. In a situation where liquid holding is required, the *tacit capacity* of a cup would be high, whereas the tacit capacity of a pair of scissors would be 0. A pair of scissors might have other affordances, but none that are useful in this specific situation. A comprehensive understanding of the participants' perception of the *tacit capacity* of the browser will probably be better assessed by an overall analysis of the test. Participants were also asked to describe how they would use the browser.

The second factor, *situated potential*, is also directly related to the circumstances. It refers to the object's perceived affordance when the agent's attention is positioned at the object. In our previous example, a cup's affordance is higher if the cup is available at the time where liquid needs to be held. The tests were performed in a controlled environment. Fortunately

the browser had the full attention of the participants while they were performing the tasks. The *situated potential* of the *Texttiles* browser during a regular research task is probably very low, as it is a prototype and not really available to the participants outside the testing environment.

Ruecker describes the next few factors as denoting the relation between the agent and the object, as opposed as being a quality or state of the object (Ruecker 2006b). The third factor is *awareness*; it refers to the perceiver's recognition of the object that has the desired qualities. The agent needs to be able to see the available cup to use it or even assess its qualities. If the agent is distracted, or otherwise does not see the cup, then its affordance value is not very high. The questionnaire asked the participant whether the function of specific aspects of the *Texttiles* browser were understood. Even though the participants were briefed on all actions of the browser, these questions would reflect participant's awareness of those functions after the test was performed.

The following factor is *motivation*. The agent might recognize the affordances of a cup, which is perfectly in reach, but decide, in a rush, that drinking water from the bottle is quicker. In this case, the motivation of the agent would reduce the affordance strength of the cup to a low number. During the post-test questionnaire, participants were asked directly about their motivation to use the browser.

Ability is the next factor and it refers to the circumstances or characteristics of the agent that enable or disable the intended use of the object. For example, the agent might be already holding other objects with both hands, and is unable to pick up the cup and fill it

with water. To test their perception on *ability*, the participants were asked whether they felt in control of the different functions of the browser.

The last relational factor is *preference* and it has to do with the individual inclinations of the agent in a particular situation. The agent might choose from a variety of different objects to perform the same action based on personal liking. There could be a variety of cups at the agent's disposal, all with equal *tacit capacity* to hold the required liquid; the agent would then probably choose the cup based on taste or personal bias. All the cups but one might be made of plastic; that single one will probably be chosen if the agent has a personal dislike for plastic cups. The questionnaire also asked participants how motivated they would be to use the *Texttiles* browser instead of the tools that they were already using.

Ruecker refers to the next two factors as external influences that affect the relation between the agent and the object (Ruecker 2006b). The first of these factors is *contextual support*. It is understood as the features of the environment that might affect the decision of the agent. External features might be, for example, the temperature of the liquid that needs to be held, the immediacy of the need for action, etc. For example, if the liquid is leaking from another container, the agent might act quickly and not choose the object that would hold the liquid better, but instead use the one that is closest. During the post-test questionnaire participants were asked whether they thought the interface would be able to handle the types of research tasks that they do during their research and the collections that they need to explore.

The last factor is *agential support*, and it indicates the influence on the perceived affordances by an external agent. Another person might be able to help the agent with the

performance of the task and this might further influence the agent's perception. The agent might be handed one cup by another person. Even if the agent would prefer another cup, she might choose this one out of respect for the other person. Participants were asked whether the *Texttiles* browser would facilitate work with their colleagues.

Ruecker also places these relational factors in a vector space (Ruecker 2006b):

```
affordance strength = ( tacit capacity, situated potential, awareness,
                        motivation, ability, preference,
                        contextual support, agential support )
```

Effectiveness in affordances would be measured then by the combination of these factors rather than one factor alone. A successful affordance would score highly on several, if not all, of the factors. The agent needs to perceive the object through a combination of these factors, all of which influence each other (for a more detailed description of the factors, their relationship and the affordance strength model, see Ruecker 2006b).

The purpose of the questionnaire is not to make a specific calculation of an affordance strength value for each of the elements of the *Texttiles* browser, but to build a comprehensive set of parameters that would help me understand the reactions of participants to the browser, its functions, and components. Evaluating the *Texttiles* browser using two distinct approaches will increase confidence in the results. This questionnaire also sets up a context to be able to evaluate further comments made by the participants throughout the test.

Participants

Participants were invited to take part in this study on a voluntary basis. Informed consent was obtained from each one of them. See Appendix E, F, G, H for ethics information. After the completion of the study, they were given the opportunity to ask any questions or clarifications, and were debriefed on the purpose of the study. The sampling technique was snowball-sampling. The study was conducted by the researcher, who collected the data, and administered the questionnaires and other materials. The researcher also acted as a facilitator, note-taker, and monitored the participants' performance during the task completion.

The participants were graduate students at the University of Alberta, and were working towards or had finished a graduate degree. One of the participants was about to join the university as a graduate student at the time that this study took place. The majority of the participants were enrolled in the Humanities Computing Program, though there were two from Computing Science, one from Medicine, and one from Psychology. However, there were a wide variety of research interests, including among others video-game analysis, English literature, and data visualization. Most of them stated that their occupation was student, however some added other activities, like consulting, coordinating, and account management. Out of the 14 participants, nine of them were between the ages of 25 and 35, four were between 18 and 24, and one participant between 35 and 50. Five participants were women and nine were men.

Results & Discussion

This chapter describes the results from each of the three sections of the study and is followed by a discussion and analysis of each section.

Pre-Test Questionnaire

Results

The pre-test questionnaire was designed to determine the participants' preferences and common practices in research information retrieval. Participants were presented with a list of different resources and asked how frequently they used these resources. Most participants stated that they often used resources like Search Engines, Online Encyclopedias and the Library Website. Most agreed as well that they seldom use Academic Journal Websites. Database/Periodical Indexes, Academic Search Engines, and Online Dictionaries were used often by about half the participants, and seldom by the other half. There also seems to be a tendency to seldom or never use Online Reference Organizers. Two participants chose 'Other' for additional, unlisted resources that they seldom use, but they did not specify which ones (See Table 1).

Table 1: Frequency of use of resources.

Resources	often	seldom	never
Library Website	9	5	-
Database/Periodical Index	7	6	1
Academic Journal Website	3	10	1
Search Engine	13	1	-
Academic Search Engine	6	7	1
Online Dictionary	6	6	2
Online Encyclopedia	11	2	1
Online Reference Organizer	2	7	5
Other	-	2	-

Participants were also asked to identify and state the reasons why they particularly liked or disliked a resource. Even though the majority of participants used the Library website often, most did not comment on why they did. On the other hand, several participants identified Google as the search engine that they prefer, due to its simplicity and effectiveness:

> *Because it consistently returns the best results. It's easy and fast (If I don't find what I need in the first page of results I reformulate my search).*

One participant also mentioned Google's assistance functions as the reason the search engine is so simple to use:

> *Simplicity. If you don't spell it right or don't know exactly what you need, Google will probably find it*

Wikipedia, the online collaborative encyclopedia, was also referred to as a favorite resource:

> *It's so simple to use. Great quick reference source.*

Even though Online Reference Organizers did not prove to be popular with participants, the ones who used Zotero were very adamant about its useful functionality.

The reason for participants to be unhappy about their experience with a resource seemed always to be related to the accessibility of the item that they are looking for. One participant complained about article embargoes in the Library website:

> *Most up to date articles are often embargoed.*

Another participant had a similar comment about Academic Journal Websites:

> *Usually the articles are not available unless you are a subscriber.*

Participants were asked whether they had a specific feature in the search tools that they used. All of their answers seemed to be in some way related to the effective use of metadata attached to the information that they were searching through. The ability to go through the results and use specific attributes to add or remove results was very important:

> *Advanced Search - I like being able to refine my searches by several different filters. I also often need to be able to search full-text, primary + secondary sources and find this very handy.*

One participant also referred to the ability to use crowd-sourced metadata, created from other users' interaction with the data in addition to metadata from the collection:

> *I like the "popular" feature in Delicious, and the "interestingness" feature in Flickr. Google Scholar ability to go through an article's citations is great.*

On the other hand, the participants' biggest problem in their use of research tools was identifying the correct terminology for what they were researching. Several participants talked about their difficulties in recognizing the ontologies used to organize collections:

> *Sometimes I don't know what is the exact keyword to use to find the right documents.*

A participant explained the inability to put their results in context as an obstacle:

> *I still feel constrained in understanding the picture. I always imagine having a bunch of notes written on Post-It and how you can work with it in expanding thoughts. None of my research tools offer a parallel to this.*

Participants were asked if they were aware of any interactive research tools and if they used them. Most participants answered that they were not aware of any interactive research tools or that they were aware of some, but the tools are not applicable to their own research. Some participants identified tools like Google Scholar as interactive and proceeded to explain why they considered it interactive:

> *Most all the tools I know follow the search engine paradigm. These are interactive in the sense that they show you results based on a query. Examples: google scholar, ACM digital library, citeseer, Library website.*

The most common research tools mentioned were tools to retrieve previously located information or information created by the participants themselves:

> *Mainly for storing and retrieving information, be it research papers (Citeulike) notes (Evernote) or bookmarks.*

The majority of participants did not seem to differentiate between the tools that they were aware of and the ones that they used. It seems that they were active users of all the tools that they commented on. Even though they were not aware of many tools, participants used the ones that they knew.

When asked about interactive tools that they would like to use, participants talked about a number of small functions that are particular to their own research interests. Again, participants focused on comprehensive ways to browse or interact with metadata; some were specific suggestions on how to display information:

> *An easy-to-use web-based timeline tool that would allow me to enter names, titles, and dates, and then put that info on a well-designed digital timeline for me.*

Some even recognized and described abstract concepts, directly reporting the problems that this study is trying to understand:

> *Allowing for definition of context, quick narrowing of results, showing relations (ex. listing [results] by anything in a subject area.*

Finally, participants were asked to explain how the research tools that they use affect their research. Comments on this section were divided. Some participants were happy about their ability to find information quickly; they were firm on the positive impact of research tools in their work:

> *Copy editing papers/manuscripts are easier/more efficient by being able to fact check, being able to find the right translation using a tool specifically created for editing in French.*

Conversely, some participants felt that they were being limited by factors that were arbitrary or out of their control. They complained about the discretionary subscription to journals from libraries, bad representation of their fields in popular journal indexes, and lack of accessibility.

> *My ability to find secondary sources is almost entirely dependent on the library database index and the databases our library subscribes to. I only rarely search for things in the wild.*

For a more comprehensive list of participants' answers to the pre-test questionnaire please refer to Appendix I.

Discussion

The pre-test questionnaire was intended to give us some insight into participants' research practices. The first thing that jumps to mind with the results from the pre-test questionnaire is the obvious omnipresence that search engines enjoy, specifically Google. Almost all of the participants stated that they often used search engines for their research. Moreover, they seemed to be particularly fond of search engines. Participants not only agreed that this is their single most used resource; they also made the most comments about it. They argued that it was the simplicity of search engines that made them attractive, but they also liked the fact that the search engine was proactive in helping them locate and identify items.

On the other hand, the questionnaire also indicated that participants are unhappy about the tool's ability to explore and manipulate metadata. They seemed to be aware of metadata being available in the collections they browse. Participants did not seem frustrated at lack

of information in the collections, but rather with the inability of their current tools to manipulate information that they know is there. This frustration can also be found in their confusion with pre-determined ontologies. Participants were annoyed at unknown keywords and at not being able to use their language. In this case, the obstacle is information that they do not possess, which is necessary to effectively locate an item. It is precisely the search engine paradigm, which requires researchers to have some previous knowledge of the item, that is an obstacle to their work.

It is also interesting to note that participants mentioned simplicity as the main reason why they use search engines, and, on the other hand, requested advanced manipulation and exploration functions for the interactive tools that they'd like to use. Advanced browsing and ability to build elaborate queries will obviously add some level of complexity to their tools.

One unexpected result from this section is the importance that some participants have placed on being able to manipulate and make use of metadata that is not necessarily available from the collection but from the interaction between them and other users with the collection over time. Tags from blogs, popularity of single items, and annotations are all examples of this new kind of metadata that participants are interested in using to aid their research experiences. It is also very encouraging that participants had quite developed opinions about what they needed. It reflects how users can become excellent partners for developing new interfaces.

Tasks & Behaviors

Results

Participants completed four tasks using the *Texttiles* browser. After each task they were asked to rate the difficulty of the task using an ordered response scale, from *Very Difficult* to *Very Easy*. The responses were added, the median was calculated, and the samples analyzed using the Wilcoxon signed rank test with $\mu = 3$. The Wilcoxon signed rank test will determine if the median is significantly greater than the neutral point in the scale (Siegel 1956, Hollander and Wolfe 1999). The order of the items in the scale is established; we know that *Easy* is less than *Very Easy*. It is, however, impossible to determine the distance between the items in the scale; we do not know if the distance between *Neutral* and *Easy* is the same as between *Easy* and *Very Easy*. The Wilcoxon signed rank test is used for this reason.

Participants ranked all tasks significantly above the neutral point with, i.e. the tasks were easy (4) or very easy (5) to complete (see Table 2).

Table 2: Task difficulty rating, median, V value and significance.

Tasks	Response					Median	V	*p*
	VD	D	N	E	VE			
Task 1	1	-	1	7	5	4	80.5	*< .01*
Task 2	-	2	2	6	4	4	69	*< .01*
Task 3	-	-	1	7	6	4	91	*< .001*
Task 4	-	-	-	5	9	5	105	*< .001*

VD: Very Difficult, D: Difficult, N: Neutral, E: Easy, VE: Very Easy

Participants were also asked to describe the single feature in the browser that was most helpful in completing each task. They were not given specific features from which to choose, but told to explain whatever aspect of the interface was helpful in that instance. Participants' responses were varied. The first task was supposed to get participants accustomed to the functions of the interface and determine, in general, what kind of data was available in the collection. The majority of participants chose grouping as the most useful function for this task. Some also alluded to the visual representation of each item in general terms, or the way in which everything is presented at once:

> *Visual representation of the items and their distribution on the canvas, color contrast helps.*

The second task asked the participants to do a more complex query that required a combination of functions: grouping, sub-setting, and switching. All participants mentioned at least two of the three functions:

> *The ability to regroup data easily and switch between the group being focus on and the group that has ben excluded.*

Some participants added some of the standard interface elements of the *Texttiles* browser to the list as well, like the history panel.

For the third task, participants had to focus on one tile, and then try to find tiles similar to that one. The favorite function in this task was color marking:

> *Being able to select a different color made it easy to relocate when the search was expanded.*

They often mentioned the coloring function in combination with the other functions of the interface:

Color control and grouping and tooltip.

Grouping was also a popular choice for this task.

The fourth task asked the participants to find an interesting relationship between tiles. This task was not designed with a specific function in mind, but to let participants use the functions with which they were most comfortable. The majority of participants described combination of functions as the most useful to complete this task, including grouping, selecting, prospect, tooltips, resizing, and changing the tile display. The most common features mentioned were grouping and tooltip. A few participants also described, in their own words, the concept of prospect:

Seeing all the tiles at the same time.

As described in the previous chapter, while the participants were performing the tasks the researcher recorded the participants' behaviors from a predetermined list. The list of behaviors was comprised of the browser's basic functions and some combinations of functions. The occurrence of each behavior was recorded for each task and participant. The median for each behavior per task was calculated (see Figure 16).

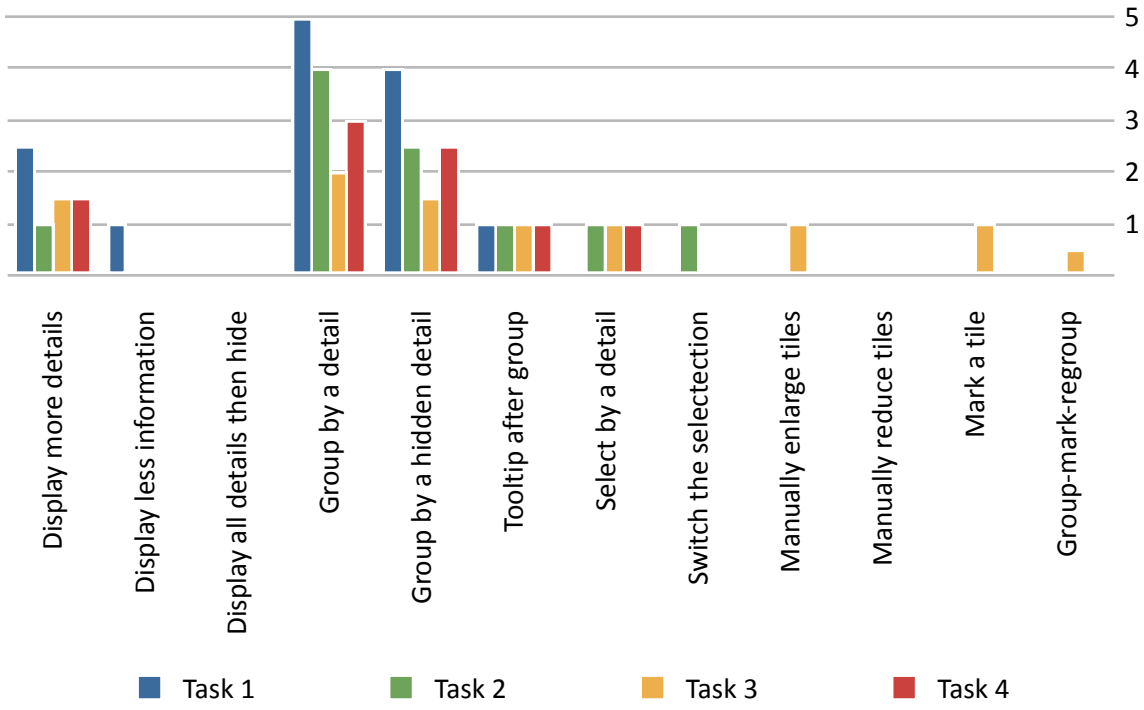

Figure 16: Median of the behavior observed per task.

The most common behavior was grouping, closely followed by 'group by a hidden detail'. The majority of the groupings were hidden detail grouping. The least used functions were 'display all details then hide' and 'manually reduce tiles'. 'Display less information' was used very rarely and only during the first task. Enlarging tiles was also uncommon. Marking and switching were a bit more common, though participants made comments on how these functions were useful but not very clear. The count of 'group-mark-regroup' is even lower than marking, however several participants performed other similar combinations that were not in the behavior list, like selecting a group, then marking, and then proceeded to regroup, and sometimes grouping by a detail, marking a tile, selecting that group, and then grouping again.

Throughout the test, and after each task, participants made suggestions on how to improve specific aspects in the design of the browser. Some of the suggestions called for small improvements in the functions that were already available. Participants asked for some of the standard interface elements to be more visible:

> *Make progress bar more prominent.*

They also asked to make the instructions for the switching function clearer:

> *Perhaps more detailed instructions a bottom instead of "click to switch selection."*

There was also a suggestion to add a count to the title of each group when the display is grouped by a single detail. One participant also asked for a way to mark an entire group. Participants also complained about the speed of the browser.

There were also some suggestions to extend the functionality of certain aspects of the browser. The main shortcoming that the interface has, which several participants noticed is the inability to group the collection by multiple details simultaneously. Also, some participants complained about the inability to sort the items and groups in ways different from the default alphanumeric order:

> *sorting/subgrouping would make this type of exercise much easier. Also, patterns may emerge without the user looking for them.*

Some participants made notes about their realizations about the interface. They commented when something about the interface was exciting to them:

> *This would be amazing for full text analysis!*

They also commented when they discovered some part of the browser or the collection that was previously unknown to them. For example, a participant wrote this after discovering the marking function:

> *Horray! this seems like the most important aspect of the interface (being able to mark selections and follow them through).*

Discussion

There were no correct or incorrect outcomes for any of the tasks and I did not record their results but was interested only in how they arrived at them. The participants were able to complete the tasks easily. As they progressed through the tasks, it seems that they became more comfortable with the interface. In the later tasks there were fewer participants that rated tasks as difficult to complete. Even though the fourth task had the least direct instructions the participants rated it as *Very Easy* [V = 105, $p < .001$].

Overall, participants identified the functions that were suspected to be of aid in each task. During the first task, most of them thought that grouping was the most useful function to perform that task. The task required them to find a detail that would divide the collection in groups of more or less even size. The second task required advanced queries to be formed. Participants once again correctly identified the advanced functions to aid this task. The third task asked participants to find one interesting tile and then look for similar tiles. In order to complete the third task participants needed to combine the multiple features in sequence. They needed to understand a bit more about the structure of the collection. Even though this task was more involved, most participants rated it as easier than the previous simpler tasks. They also identified marking as the most useful function in this task, and

some participants added other functions. The fourth task did not give the participants much direction. The participants showed that they were comfortable using the interface and started looking at the other supportive aspects of the browser.

The behaviors record showed that participants used the grouping function often and in every task. This is one of the principal features of the browser, as it allows users to visualize relationships between the items, and so it is not surprising that participants used it regularly. The number of times that they grouped by a hidden element, though, is an interesting phenomenon. It shows that participants want to visualize the relationships of items according to one detail while being able to recognize them through a different aspect. This is an important discovery, as it shows that users can deal with the cognitive load of having multiple layers of information displayed in the same visualization.

Another interesting result is the fact that participants did not use the display and hide detail functions as much as the grouping function. This could be the result of two factors. Participants showed that they are not confused by having layers of information mapped, and so they are still visualizing the other details of the items by grouping them. The other factor could be the fact that they had access to all the information from a single item by using the tooltip function. This allows them to still keep the size of the tiles small, keeping all items in the display at a manageable size, which allows them to recognize the tiles individually by the details still in display. Additionally, they can access all the information by placing the mouse on top of the tile in focus.

Several participants mentioned supplementary features as important to the task. I am especially interested in the success of the marking. Marking was an added feature that is

not part of the rich-prospect browsing principles. However, it proved to be quite useful for participants. It introduces another concept: manipulation of the metadata as a method for exploration. As users learn more about the collection that they are browsing they want to be able to add permanent markers to items that facilitate them in further exploration and analysis of the collection.

There is already some research on interfaces that use annotation as an aid to research tasks. For example, Pliny is an interface to aid the reading of a digital resource (Bradley 2008). It provides annotation tools that help researchers mark the specific spots in the document where they found something interesting, and also add side notes with their own interpretations or ideas about the resource. Marshall (1998) proposed a model to analyze annotations based on several dimensions, and how they can potentially add value to collections. Researchers have a long history of annotating the information that they are consuming or creating. Marking and personal annotations made by users for the purpose of exploration should be considered in addition to the existing rich-prospect browsing principles.

Suggestions show that there are several aspects of the browser that still need to be improved. There are some details to be worked out. There were some suggestions that could be implemented quickly and would improve the overall performance of the interface without much effort, like adding counts to the groups and marking for whole groups. There were also some improvements that are related to the fundamental purpose of the *Texttiles* browser, like adding multiple level groupings and additional sorting options. Though these changes would not be adding to the principles for rich-prospect browsing, they would

extend those principles to aspects of the interface that were not included in this prototype. This feedback is very useful; these new functions should be added to the *Texttiles* browser for future studies and taken into account for other rich-prospect browsers.

POST-TEST QUESTIONNAIRE

Results

With the post-test questionnaire participants were requested to evaluate the *Texttiles* browser. As discussed in the previous chapter, the post-test questionnaire is divided into two parts; each one was designed with a different approach to evaluating user interfaces. The majority of questions in both parts are set on an ordered response scale and were subsequently analyzed with Wilcoxon's signed rank test (Siegel 1956, Hollander and Wolfe 1999). The last question in the Human-Computer Pragmatics part is multiple choice, and the last question in the Affordance Strength part is open-ended. All the questions in the Affordance Strength part had a space for comments. Participants were told that commenting is not required but space was available if they did want to add a comment.

Human-Computer Pragmatics Questions

Overall the responses were quite positive. Every question in this section had significant results (See Table 3).

Table 3: Human-Computer Pragmatics questions (1-9), response frequency, median, V value and significance levels.

	Response					Median	V	*p*
	SD	**D**	**N**	**A**	**SA**			
Q1	1	-	1	3	9	5	82.5	*< .01*
Q2	1	-	1	5	7	4.5	81.5	*< .01*
Q3	-	-	-	8	6	4	105	*< .001*
Q4	1	-	5	5	3	4	37.5	*< .05*
Q5	1	-	3	5	5	4	57.5	*< .05*
Q6	-	1	-	7	6	4	100.5	*< .01*
Q7	-	-	1	8	5	4	91	*< .001*
Q8	-	1	1	3	9	5	88.5	*< .001*
Q9	-	1	1	9	3	4	85.5	*< .01*

SD: Strongly Disagree, D: Disagree, N: Neutral, A: Agree, SD: Strongly Agree

Q1 ,Q2, Q4, Q5, and Q6 had to do with *comprehensibility*; whether users understood the interface. A significant number of the participants agreed or strongly agreed that the interface would help them explore text collections (Q1) [V = 82.5, $p < .01$] and was easy to use (Q2) [V = 81.5, $p < .01$]. A significant number of participants were confident that their colleagues would find the browser easy to use (Q4) [V = 37.5, $p < .05$]. Changes on the display helped participants understand what was happening (Q5) [V = 57.5, $p < .05$]. Participants also agreed or strongly agreed that they understood how the *Texttiles* browser works (Q6) [V = 100.5, $p < .01$].

Q3 was an added question to find out whether participants liked the interface of the browser. Participants significantly agreed or strongly agreed that the interface was visually appealing [V = 105, $p < .001$].

Q7 was related to *truth*. It asked participants whether they thought that the *Texttiles* browser displayed the collection accurately. Participants significantly agreed or strongly agreed [V = 91, $p < .001$].

Q8 evaluated the interface's *truthfulness*, or whether participants trusted it. Again, participants significantly agreed or strongly agreed that they were confident with what they discovered with the browser [V = 88.5, $p < .001$].

Q9 asked participants whether the browser was designed properly. It evaluates the standards compliance of the interface, or *normative right*. Participants significantly agreed or strongly agreed [V = 85.5, $p < .01$].

The last question (Q10) was multiple choice. It presented the participant with a list of suggestions for modifying the browser and asked participants to mark which ones they would prefer. Figure 17 shows the added responses.

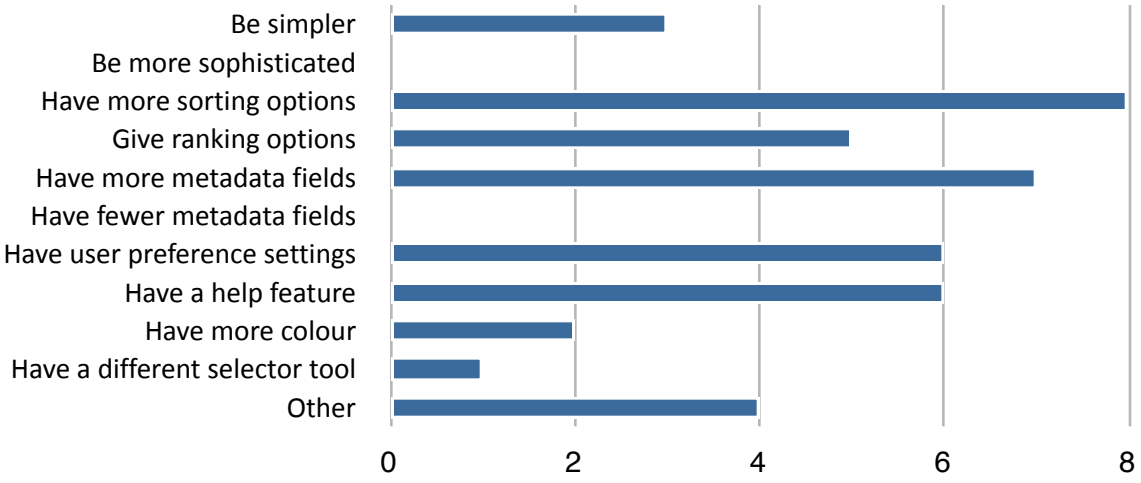

Figure 17: Frequency of feature suggestion.

Several participants wanted to have more sorting options and metadata fields. Participants also requested user preference settings and a help feature. Nobody asked for the interface to be more sophisticated nor to have fewer metadata fields. Four participants chose 'Other' as a suggestion, but none of them stated what they wanted.

Affordance Strength Questions

Responses in this second part of the questionnaire were also quite positive. Most questions had significant results (See Table 4 and 5). Participants also made comments in relation to the questions.

Table 4: Affordance Strength questions (1-2), response frequency, median, V value and significance levels.

	Response					Median	V	*p*
	VD	**D**	**N**	**E**	**VE**			
Q1	-	1	1	7	5	4	86.5	*< .01*
Q2[a]	-	2	2	5	4	4	58	*< .05*

VD: Very Difficult, D: Difficult, N: Neutral, E: Easy, VE: Very Easy
[a] One participant did not answer Q2

Q1 and Q2 (Table 4) asked how easy it was to understand the detail display and select functions, respectively. These two questions were in relation to *awareness*; whether the participants were aware of the affordances of the browser's interface. Participants significantly thought that the display function was easy or very easy to understand [V = 86.5, $p < .01$]. They also significantly thought the select function was easy or very easy to understand [V = 58, $p < .05$]. One participant also commented on how the display function was easy to understand:

> *checkboxes work well to communicate how to use it. Drag and drop may also be interesting.*

Q3, Q4 and Q6 (Table 5) were related to *ability*; they assessed whether the participants felt they could use the browser. Participants significantly felt that they were somewhat or very much in control of how the items where being displayed while using the interface [V = 68, $p < .05$]. They also significantly felt that they were somewhat or very much in control of how items were being grouped while using the interface [V = 95, $p < .01$]. Participants commented on how grouping helped them explore the collection:

> *Grouping was intuitive. Having grouping and display allows me to divide how much I want to refine the data I'm being shown.*

However, they reiterated their need to have multiple layers of groups and more control over the ordering:

> *grouping worked well, but I wanted the ability to add sub-groups. Also, a sorting option is necessary*

Table 5: Affordance Strength questions (3-11), response frequency, median, V value and significance levels.

	Response					Median	V	*p*
	NA	**M**	**N**	**S**	**VM**			
Q3	1	-	2	7	4	4	68	*< .05*
Q4	1	-	-	5	8	5	95	*< .01*
Q5	1		1	6	6	4	81	< .01
Q6	1	-	1	3	9	5	82.5	*< .01*
Q7	-	5	-	3	6	4	82.5	*< .05*
Q8	1	-	1	3	9	5	82.5	*< .01*
Q9	1	1	1	4	7	4.5	78.5	*< .01*
Q10	1	1	1	3	8	5	79.5	*< .01*
Q11	3	2	3	5	1	3	29.5	*n.s*

NA: Not at All, M: Maybe, N: Neutral, S: Somewhat, VM: Very Much

Participants significantly felt somewhat or very much comfortable using the *Texttiles* interface functions [V = 82.5, p < .01]. Comments showed how well they understood the functionality and purpose of the interface:

> *As a means of learning about a collection of texts and how they relate to each other, it would be very useful.*

Q4 asked the participants whether they would use the *Texttiles* browser. This question had to do with *motivation*. Participants significantly stated that they would somewhat or very much use the browser [V = 95, $p < .01$].

Q7 and Q12 evaluated the *tacit capacity* of the browser. These questions assessed the participants' perceptions of the browser's aptitude for aiding research tasks, the tasks that it was intended to perform. Q7 asked the participants if the browser would be useful to the participants' research. Participants significantly thought that the browser would be somewhat or very much useful to their research [V = 82.5, $p < .05$]. One participant commented:

> *If it could display articles as well as my own data, that would be wonderful. I can see, given markup of my own data based on themes, questions, asked, how connections could be made <u>for</u> me.*

In Q12 participants described how they would use the browser. The majority of the participants wanted to use the browser for exploring academic collections:

> *Research literature by keyword, author, year, titles, bibliographic references. Finding connections between text (transcribed interview) data and marked-up audio files, based on themes, responses, etc.*

Some participants also mentioned using the browser for other purposes, like browsing results of user studies or computer code:

> *In some code analysis. If each tile is a class and the metadata has things like: author, version, includes, lines of code, test coverage, number of methods, etc.*

Some others focused on the functionality offered by the browser without specifying what kind of collections they would use it to explore:

> *I would use it to get an immediate sense of relationships in data. I love how easy it is to play around with and I can anticipate making insights that I would have never thought of otherwise.*

One participant highlighted proximity as a property of the browser that would bring about additional affordances to online browsing resources

> *I would use it if it were a library interface. It could allow dynamic re-shelving of virtual books. It would be interesting to see which books ended up next to each other.*

Several participants also mentioned using the *Texttiles* browser as a supporting interface to browse the results returned by a search engine or the library website:

> *Using a search engine has been so engrained that I would be tempted to search for the item that I'm looking for and then use Texttiles to find the specific item.*

One participant did not see the use of the interface and felt confused by it:

> *I wouldn't - I found the interface confusing - Nay - alienating.*

Q8 was concerned with *preference*, or whether a participant would use the *Texttiles* browser instead of other tools. Participants were significantly motivated to somewhat or very much use the browser instead of the tools they were already using [$V = 82.5$, $p < .01$]. Again, some participants commented on how they would use the *Texttiles* browser in combination with the tools they use:

> *I would use to supplement what I currently use.*

Q9 and Q10 had to do with *contextual support*. It attempted to capture how features of the environment would affect participants' perceptions of the affordances of the browser. Participants significantly felt that the browser would somewhat or very much be able to

handle the research tasks that they needed to do in their work [V = 78.5, $p < .01$]. Participants also felt significantly felt that the browser would somewhat or very much be well suited to handle the collections that they needed to explore in their work [V = 79.5, $p < .01$].

Q11 dealt with *agential support*. It was concerned with how other agents would affect the participants' perceptions of the affordances of the browser. There was no significant agreement from participants on whether the *Texttiles* browser would be capable of facilitating collaboration with their colleagues. In the comments, participants seemed confused on how the browser would be able to help them collaborate with their colleagues:

> *I can't say one way or the other, but my work isn't very collaborative.*

One participant suggested a way in which the browser would be able to aid collaborative work:

> *If it had a "send to someone" option, or send citations or reference number.*

Discussion

The responses in both parts of the post-test questionnaire are extremely positive. They show that the participants generally reached a deep understanding of how the *Texttiles* browser works, were pleased with how it looked and functioned, and thought of it as a useful tool. They also had great suggestions and feedback that must be incorporated into future versions of the browser.

The first part of the questionnaire, Human-Computer pragmatics questions, evaluated the interface as a conversation between the designer and the user—in this case, each

participant of the study. The interface performed well in all four core concepts for successful communication: *comprehensibility*, *truth*, *truthfulness*, and *normative right*. Results showed that the visual language that was used to convey the different relationships and connections in the collection were successfully understood by the participants. Furthermore, participants thought that the browser was truthful in showing the contents of the collection and any discoveries that participants arrived at with the help of the browser were trustworthy. Participants also thought that the browser was well designed, following standards whenever possible; additionally they thought that it was visually appealing.

As evidenced by their comments in the task and behaviors section of the study, participants again requested more sorting options. They also requested more metadata to be available to use with the browser, and no participant requested less metadata. This suggestion is encouraging as it shows that the browser displayed the available metadata in a manner that is not overwhelming to the user, and therefore the more metadata that is available, the more useful the browser becomes. A help feature and user preferences were also requested from the users. These features had not been mentioned before but about half of the participants chose these from the list. Additionally, nobody chose a more sophisticated interface, and there were a few people who requested a simpler interface. These results probably express that there are still details in the browser that need to be worked out. Some of the instructions are not clear enough, and some of the functions can be made more apparent.

The affordance strength part of the questionnaire also presented very positive results. The results from the ordered response scale were in the majority significant. Moreover, the

comments that participants left below each question showed that they understand how the *Texttiles* browser works, what it is able to do, and how it can help them. The results are evidence that participants recognize its *tacit capacity*. Even though the *situated potential* of the browser right now is quite low, as it is not available with the collections that participants would use, participants seem interested in connecting it with their work and use it for their research. Participants are aware of the specific functions of the browser as well as its overall affordances. Results also show that participants are highly motivated to use the textiles browser and that they are confident on their ability to work with it. Participants felt confident in using specific functions of the browser as well as its overall affordances. Although some participants made comments on how they would use the browser in combination with other tools, they expressed their preference for the *Texttiles* browser over the tools that they are already using. Participants' perceptions were positively influenced when confronted with external features from the test environment, namely their own research tasks and collections. They even suggested uses for the browser in new types of collections.

The only factor from the affordance strength model in which the participants did not show significant agreement was *agential support*. Participants seemed to be confused about how this interface was supposed to facilitate collaboration with their colleagues. This result is not very surprising, considering that the browser was not designed to directly aid collaborative research or collaborative exploration. However, it could facilitate collaborative research in indirect ways by speeding up tasks of individual researchers.

As discussed in the previous chapter, the affordance strength model puts the factors in a vector space, evaluating interfaces in their overall performance in all relational factors. Some interfaces can score higher in certain factors and lower in others and still be successful. Participants rated the *Texttiles* browser highly in five of the factors, and a sixth one, *situated potential*, is not possible to achieve due to the experimental nature of this interface. With those considerations the browser was well received by participants—the affordance strength vector assessment is vastly favorable.

Conclusions

The web represents today an enormous collection of text. All this data is consistently being distributed in formats that provide structure and additional information in the form of metadata. Additionally, several efforts in automating metadata creation and recognition have been quite successful. The most popular tools to make sense of all this information have come in the form of retrieval interfaces. However, retrieval interfaces present this information in a limited and hierarchical manner, and are typically not presenting users with the rich metadata that is available. This metadata can provide the basic framework to explore and understand this vast collection.

Rich-prospect browsing offers an alternative to retrieval interfaces. Rich-prospect interfaces attempt to provide a transparent representation of the whole collection and a meaningful representation of every item in it. They also provide controls to manipulate the display in order to highlight different aspects, relationships, or connections between items. Rich-prospect interfaces achieve this by taking advantage of the available metadata within the collection.

The *Texttiles* browser is an interface prototype that was designed following the principles of rich-prospect browsing. It is an attempt to transfer the design from previous rich prospect browsing interfaces to a new browsing strategy that aids exploration of text collections. The *Texttiles* browser presents every item in the collection as a tile. Information about each item in the collection appears inside of each corresponding tile. Controls are provided to the user to manipulate the way in which those tiles are displayed and organized.

A user study was conducted to evaluate the performance of the interface. 14 Participants used the browser in four predetermined tasks to study a collection. The participants favorably evaluated the browser and its performance in a variety of situations. They also demonstrated deep understanding of how the interface works and how to use it to aid research tasks.

Previous rich-prospect browsing interfaces have been successful in assisting exploration of collections that have been made up of items that are pictorially represented. The *Texttiles* browser was successful at providing a meaningful representation of each item in the collection by letting the user control what kind and how much information appears inside each tile. In most cases participants added a limited number of details to the tiles and were able to recognize the items to the extent required by each task. They also suggested a variety of ways in which meaningful representation could be improved, including participatory manipulation of the data.

The *Texttiles* browser lets the user control the amount of information in each tile and, if necessary, the tile size. However, it also attempts to provide prospect by simultaneously displaying all of the tiles. During the study, participants were aware of both the display and resize controls. However, they appeared to benefit from being able to see the entire collection at once and were pleased by the performance of the auto-resize mechanism provided by the browser. Participants did not make much use of the resize controls. They also seemed to be conservative when adding details to the tiles. And some of their comments during the tests praised specifically the advantages of visualizing all the items in a collection at once.

Rich-prospect browsers provide users with controls to manipulate the display in order to visualize the dynamics of items within a collection. The *Texttiles* browser uses visual groupings that can be constructed and exchanged to highlight different details, recognize patterns, and discover new relationships. Participants in the study made use of the grouping functions more than anything else in the browser. They grouped the collection by different details, found interesting subsets, and identified unique elements. Participants also expressed how this function could be useful in their own research. Moreover, they suggested how grouping can be improved by providing visual markers reinforcing group sizes and requested the ability to group by several layers.

The *Texttiles* browser understands a limited set of data types, such as date, number, and string. This enabled the browser to display items in the correct order when the order is meaningful to the current detail. Participants during the research study recognized the order in most situations. They thought, however, that the sorting functions were insufficient. Many of them requested the ability to order the items by specific details in different situations, similar to how they could group items. Their commentary demonstrates that users will always attach a meaning to the order in which items in a collection are being displayed.

The *Textiles* browser and this study have provided additional corroboration of advanced rich-prospect browsing concepts. The contributions of rich-prospect browsing techniques in exploring collections have been solidified. It has revealed the potential of using rich-prospect browsing concepts to visualize and explore text collections. The methodology employed offered new insights that can potentially contribute to future rich prospect

interface prototypes. Further, this study has uncovered new ideas that can be integrated into future projects, like the implications of sorting and order in the display and exploration through participatory manipulation of the data.

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Appendix A: Pre-Test Questionnaire

q1: Age.

18-24 25-35

36 – 50 51-69

70 +

q2: Sex

Male Female

q3: Education (In progress or completed)

High school Graduate Some College – No Degree

Associate degree Bachelor's degree

Graduate or Professional degree

q4: Occupation

q5: What is your field of research?

q6: Please rate your use of online resources. Name and discuss the reasons for the ones that you particularly like or dislike.

	Often	Seldom	Never	Reason
Library Website				
Database/Periodical index				
Academic Journal Website				
Search Engine				
Academic Search Engine				
Online Dictionary				
Online Encyclopedia				
Online Reference Organizer				
Others				

q7: Do you have any favorite search features in the tools you use?

q8: What is the greatest problem you find in your research tools?

q9: Are you aware of any interactive research tools available to you? Which ones?

q10: Do you currently use any tools in your research?

q11: What kinds of interactive tools would you use if they were available?

q12: What kinds of projects are you working on now, and how are they influenced by the research tools that you use?

Appendix B: Behaviors

Display

b1: Display more tile details.

Task 1 2 3 4
Times

b2: Display less information.

Task 1 2 3 4
Times

b3: Display all details, then hide the un-necessary ones.

Task 1 2 3 4
Times

Group

b4: Group tiles by a detail.

Task 1 2 3 4
Times

b5: Group tiles by a hidden detail.

Task 1 2 3 4
Times

b6: Tooltip right after Group.

Task 1 2 3 4
Times

Select

b7: Select a single group.

Task 1 2 3 4
Times

Switch

b8: Switch the selected group.

Task 1 2 3 4
Times

Zoom

b9: Manually enlarge tiles.

Task 1 2 3 4
Times

b10: Manually reduce tiles.

Task 1 2 3 4
Times

Mark

b11: Mark a specific tile.

Task 1 2 3 4
Times

b12: Group - Mark - reGroup

Task 1 2 3 4
Times

Appendix C: Tasks

Please complete the following tasks using the *Texttiles* browser.

Task 1

Find out what kind of details are available for each item in the collection.

Find a characteristic that more or less divides the whole collection evenly.

q1: This task was simple to complete.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q2: What feature was the most useful to complete this task?

Comments.

Task 2

Find a somewhat large subset of the collection, that shares a common characteristic.

Find out if there are other characteristics that this subset shares.

Switch the selection, and find out if this subset also shares the same characteristics.

q3: This task was simple to complete.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q4: What feature was the most useful to complete this task?

Comments

Task 3

Identify one single tile that is interesting to you. Resize the tiles if needed. Mark the interesting tile by using the color controls in the tooltip.

Find tiles that are similar to the marked tile.

q5: This task was simple to complete.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q6: What feature was the most useful to complete this task?

Comments

Task 4

Find an interesting relationship between a few tiles.

q7: This task was simple to complete.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q8: What feature was the most useful to complete this task?

Comments

Appendix D: Post-Test Questionnaire

Human-Computer Pragmatics Questions

On a scale of 1-5, with 1 being Strongly Disagree and 5 being Strongly Agree, please rate the following items by circling the appropriate rating.

q1: I think the *Texttiles* browser would help me explore text collections.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q2: I think the *Texttiles* browser would be easy to use.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q3: I think the *Texttiles* browser is visually appealing.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q4: I feel confident that my colleagues will find the *Texttiles* browser easy to use.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q5: Changes in the collection display in the *Texttiles* browser helped me understand what was happening.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q6: I understand how the *Texttiles* browser works.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q7: The *Texttiles* browser displays a collection accurately.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q8: I am confident on what I discover with the help of the *Texttiles* browser.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q9: The *Texttiles* browser was designed properly.

Strongly Disagree Disagree Neutral Agree Strongly Agree

q10: My preferred browsing tool would (select all that apply):

be simpler
be more sophisticated
have more sorting options
give ranking options
have more metadata fields
have fewer metadata fields
have user preference settings
have a help feature
have more colour
have a different selector tool
other (please explain on the back of the page)

Affordance Strength Questions

q1: How easy or difficult was it to understand the detail display function?

Very Difficult Difficult Neutral Easy Very Easy

Comment:

q2: How easy or difficult was it to understand the select function?

Very Difficult Difficult Neutral Easy Very Easy

Comment:

q3: Did you feel in control of how items were being displayed while using the *Texttiles* browser interface?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q4: Did you feel in control of how items were being grouped while using the *Texttiles* browser interface?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q5: Would you use the *Texttiles* browser?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q6: Did you feel comfortable using the *Texttiles* browser interface functions?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q7: Could the *Texttiles* browser be useful to your research?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q8: If the *Texttiles* browser were to be offered in a database that you currently use, how motivated would you be to use it instead of the tools you already use?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q9: Would the *Texttiles* browser be capable of handling the research tasks that you need to do in your work?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q10: Would the *Texttiles* browser be well suited for handling the type of collections that you need to explore in your work?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q11: Would the *Texttiles* browser be capable of facilitating collaboration with your colleagues?

Not at all Maybe Neutral Somewhat Very Much

Comment:

q12: Describe how you would use the *Texttiles* browser.

Appendix E: Ethics Certificate

Arts, Science & Law Research Ethics Board (ASL REB)

Certificate of REB Approval for Fully-Detailed Research Proposal

Applicant: Alejandro Giacometti (Principal Investigator); Dr. Stan Ruecker (Research Supervisor)

Department / Faculty: Humanities Computing/Arts

Project Title: TextTiles Prototype Usability Study

Grant / Contract Agency (and number): NSERC/Mellon Foundation

(ASL REB member) **Application number**: 2044

Approval Expiry Date: 30 March, 2010

CERTIFICATION of ASL REB APPROVAL

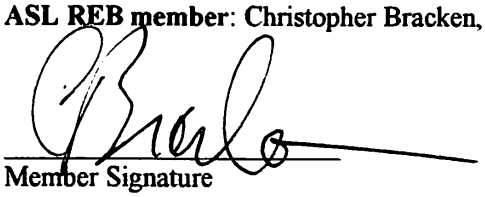
I have reviewed your application for research ethics review and have concluded that your proposed research meets the University of Alberta standards for research involving human participants (GFC Policy Section 66). On behalf of the *Arts, Science & Law Research Ethics Board* (ASL REB), I am providing ethics approval for your proposed research.

You may begin research with human participants.

Note that this approval is subject to review by the full ASL REB at its next meeting on 30 March, 2009. If the full ASL REB reaches a different decision, requests additional information, or imposes additional research ethics requirements on your study, I will contact you immediately.

This research ethics approval is valid for one year. To request a renewal to cover research taking place after 30 March, 2010, please contact me and explain the circumstances, making reference to the research ethics review number assigned to this project (see above). Also, if there are significant changes to the project that need to be reviewed, or if any adverse effects to human participants are encountered in your research, please contact me immediately.

ASL REB member: Christopher Bracken, Faculty of Arts, Department of English and Film Studies



Member Signature

Date: 25 March, 2009

Appendix F: Ethics Application

UNIVERSITY OF ALBERTA:
FACULTY OF ARTS, SCIENCE & LAW RESEARCH ETHICS BOARD

Application to Conduct Research Involving Human Participants

Principal Investigator	Name	Alejandro Giacometti
	Department	Humanities Computing (OIS)
	Campus Address	3-5 Humanities Centre
	Campus Phone number	492-7509
	E-mail address	giacomet@ualberta.ca
Faculty Supervisor	Name	Dr. Stan Ruecker
	Department	(HuCo/English)
	E-mail address	sruecker@ualberta.ca
	Campus Phone number	492-7816

Project Title: *Texttiles* Prototype Usability Study

Funding Sources: NSERC and the Mellon Foundation

Summary of Project / Research Design. Please attach a more detailed proposal (i.e., 1-2 pages), including a description of the population from which research participants will be drawn (e.g., university students, nursing home residents) and a discussion of how research participants will be solicited. Also attach copies of research instruments (e.g., questionnaires, interview guides).

Note: As of June 8, 2004, the use of lotteries (draw for prizes, raffles, etc.) to encourage individuals to participate in research can no longer be approved due to interpretations by legal counsel that the use of lotteries by researchers without a gaming license contravenes the Alberta Gaming Act.

The *Texttiles* Browser Prototype is a rich-prospect browser designed and developed to provide a better, and more intuitive way to browse, perceive and explore large sets of

information. To test the browser's design we seek to perform a usability study involving human participants. Participants will provide us with valuable feedback to test both the efficacy of the *Texttiles* browser, and the principles used in its development.

Participants will provide us with valuable feedback to test both the efficacy of the *Texttiles* browser, and the principles used in its development.

Assessment of Risk to Human Participants:

Attach additional page(s) if necessary

There is minimal risk to participants involved in this project.

Participants will be asked to follow a set of specific tasks using the *Texttiles* browser on a computer. Then they will be asked to fill out a questionnaire about their experiences.

Description of Procedures to be Undertaken to Reduce Risk to Human Subjects. Please attach copies of consent forms and other similar documents.

This study consists of three steps. Participants will be asked a series of questions about their current research activities and the tools that they use. Then they will be presented with the *Texttiles* browser, and given a series of tasks to complete. After the tasks are completed, they will be asked a series of questions about their experience using the *Texttiles* browser.

The study will be conducted at the University of Alberta. Study participants will include approximately 15 people, including Graduate Students, Sessional Instructors, and Faculty. All participation will be voluntary and subjects may withdraw at any time.

Participants will be asked to read and sign a consent form, describing the study and outlining the tasks that they will perform. They will be able to leave the study at any point; if they choose to do so their answers will not be used. All personal information about the participants will be confidential, and their identities will remain anonymous. They will also receive a debriefing form with a detailed explanation on the purposes of the study, and their contribution, as well as my contact information.

Please see the Appendix F and G for the consent and debriefing form.

I have read the UNIVERSITY OF ALBERTA STANDARDS FOR THE PROTECTION OF HUMAN RESEARCH PARTICIPANTS [GFC Policy Manual, Section 66] and agree to abide by these standards in conducting my research.

_____

Signature of Principal Investigator Date

_____

Signature of Faculty Supervisor Date

Submit completed form and attached documents to:

Arts, Science, Law Research Ethics Board

Attention: ASL REB Administrator

Faculty Arts – Office of the Dean

6-33 Humanities Building

Email: ASLREBAdministrator@ualberta.ca

Phone: 492-4224

Appendix F: Letter of Consent

Purpose

You are invited to participate in a research study entitled *Texttiles* **Usability Study** being conducted by Alejandro Giacometti of the Humanities Computing Programme, Office of Interdisciplinary Studies, University of Alberta, with the support of his supervisor, Dr. Stan Ruecker. This study is part of Alejandro's Masters thesis involving the development of a rich-prospect browser, called *Texttiles*. The tasks you will be asked to perform and the questions you will be asked to answer regarding those tasks were designed to review the effectiveness of the interface of the *Texttiles* browser in aiding research activities while exploring a collection.

Your participation

Your participation involves answering some pre-test questions, completing some tasks that will be similar to navigating a webpage, answering a few questions after each task, and then answering some general questions about your experiences using this browser. The process should take about an hour.

Your rights

Your decision to participate in this study is entirely voluntary and you may decide at any time to withdraw from it. If you choose to withdraw from the study, your answers will be disregarded from any analysis. Your responses will remain confidential, and your name will not appear on the response materials or be associated with your responses in any way. Only researchers associated with the project will have access to the data. The results of this

study will potentially be presented at scholarly conferences or published in professional journals, but even if your comments are used, your identity will never be disclosed. The materials collected in the interview will be retained digitally on a secured external hard drive for 5 years, following which they will be destroyed.

Benefits and Risks

This research is intended to test the effectiveness of the *Texttiles* interface in aiding research activities. There are minimal risks to this study. If you should have any questions or concerns about this study, please contact Alejandro Giacometti at giacomet@ualberta.ca.

Contact information

If you have any questions or comments on the study, or if you wish a clarification of your rights as a research participant, you can contact Alejandro Giacometti, Stan Ruecker, or the Human Research Ethics Committee at the number and address below.

Alejandro Giacometti
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University of Alberta
Edmonton, AB, T6G 2E9
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e-mail: ASLREBAdministrator@ualberta.ca

Signatures

Please sign below to indicate that you have read and understood the nature and purpose of the study. Your signature acknowledges the receipt of a copy of the consent form as well as indicates your willingness to participate in this study.

_____

Name Signature Date

Appendix G: Debriefing

The *Texttiles* browser is a prototype of a rich-prospect browser. Rich-prospect browsers provide a persistent display of all items in a collection and controls to manipulate the display by organizing the items (Ruecker 2004). These principles have been evaluated in previous studies in order to identify different sorts of pills (Given et al. 2007), and conference delegates (Ruecker et al. 2006). With the *Texttiles* browser we attempt to translate those principles to collections that consist mainly of textual information. We also aim to provide more comprehensive controls on the display of such information.

Your participation in this study will help me identify which elements of this new interface are most effective at aiding research tasks while exploring a collection, and the ones that still need improvement. The final purpose of this project is to develop a tool that is both useful and friendly, while at the same time providing an accurate representation of the data.

Each of the tasks you had to complete had a particular purpose. Your answers and comments on each specific task, as well as about the browser will help us improve our understanding of the design principles behind the interface. Your contribution will help us identify and better understand the needs of users when developing these types of interfaces.

Thank you for participating in the study. I would like to remind you that everything that was discussed today will remain confidential. As you already know, I am the only one who will have access to the information you provided me with. If you have any questions at any time, about the study or just general questions related to the issues we explored here,

contact me, Alejandro Giacometti at the email below. If you wish, I can also provide you with a copy of the research report when it is available.

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References

Given, L., S. Ruecker, H. Simpson, B. Sadler, and A. Ruskin. (2007). "Inclusive Interface Design for Seniors: Exploring the Health Information-Seeking Context." *JASIST*. *58*(11), 1610-1617. 2007

Ruecker, S. (2003). Affordances of Prospect for Academic Users of Interpretively-tagged Text Collections. Diss. University of Alberta.

Ruecker, Stan, Michael Lewcio, Michael Plouffe, and Maryanne Wynne. (2006). "I never forget a face: a rich-prospect image browser for conferences." Paper presented at the Society for Digital Humanities (SDH/SEMI) conference. York University, Toronto. May 29-31, 2006.

Appendix I: Selected Quotes

This is a selection of participant's answers to some of the questions in the study. This list is not comprehensive, only quotes that were adding a new idea to the discussion were added. Many participants had similar answers, in that case, only one was selected.

Pre-test Questionnaire

q1: Please rate your use of online resources. Name and discuss the reasons for the ones that you particularly like or dislike.

Reasons to like

Simplicity. If you don't spell it right or don't know exactly what you need, Google will probably find it, integrates images (Search Engine)

They are accessible through the library and offer the same kind of information as the databases (Academic Search Engine)

It's so simple to use. Great quick reference source (Online Encyclopedia, Wikipedia)

Excellent collection of current research (Database/Periodical Index)

Excellent starting point for research about unfamiliar topics (Search Engine)

Because it consistently returns the best results. It's easy and fast (If I don't find what I need in the first page of results I reformulate my search) (Search Engine)

Zotero is great! (See Answers Below) (Online Reference Manager)

Reasons not to like

... most up to date articles are often embargoed (Library Website)

I used Zotero for a bit, but never seemed to get into using it (Online Reference Organizer)

... usually the articles are not available unless you are a subscriber (Academic Journal Website)

... results display less information that I might like (Academic Search Engine, Google Scholar)

q2: Do you have any favorite search features in the tools you use?

The ability, in some cases, to refine a search within a set of results. To discard results that aren't interesting.

Basic and advanced options, if they have a good system that lets me be lazy, I'm a happy user (i.e. google "Did you mean...")

Keyword searches, looking by types of publications or studies.

Advanced Search - I like being able to refine my searches by several different filters. I also often need to be able to search full-text, primary + secondary sources and find this very handy.

Yes, AV:, TI:, HAS:, IN:, other (xml tags)

Boolean operators, export to reference manager, result ranking, "did you mean x", suggestions to narrow search, responsiveness.

I like the "popular" feature in Delicious, and the "interestingness" feature in Flickr. Google Scholar ability to go through an article's citations is great.

feature that allows me to find the specific term searched for in the website, language translation

q3: What is the greatest problem you find in your research tools?

Too many sources. We need a meta search

I wish keywords allowed for more everyday language

They are dependent on a list of categories and definitions that aren't explicit in the tool. The net they cast returns more trash than fish.

Finding relevant, up-to date publications

Narrowing down a search when there are too many terms / finding the right search terms.

Display of results (i.e. ranking, order in general), and visualization of results (few options to visualize entries and relationships between entries)

Sometimes I don't know what is the exact keyword to use to find the right documents.

I still feel constrained in understanding the picture. I always imagine having a bunch of notes written on Post-It and how you can work with it in expanding thoughts. None of my research tools offer a parallel to this

layout/accessibility, doesn't recognize search if a word from a term is different from the one published

Not enough flexibility. Forced to use [B]oolean very often.

Finding information archived a long time ago.

q4: Are you aware of any interactive research tools available to you? Which ones?

No

Yes, but they don't seem to apply to my own field

Web search such as Google. Tools that allow reading and annotating text. Reference managers/ Citation managers.

Yes - Pubmed/Medline

Most all the tools I know follow the search engine paradigm. These are interactive in the sense that they show you results based on a query. Examples: google scholar, ACM digital library, citeseer, Library website

Visual Thesaurus is a great way to track word synonyms in a visual way. I also use Zotero for collecting info and sometimes TAPoR for Analysis.

q5: Do you currently use any tools in your research?

No

Reference managers/ Citation managers.

... mainly for storing and retrieving information, be it research papers (Citeulike) notes (evernote) or bookmarks

q6: What kinds of interactive tools would you use if they were available?

Meta search engine for academic journals

Anything that would make it easier to find sources. For example, a tool that connected the authors used in bibliographies and showed me these connections.

Perhaps a tool that would collect and allow annotation of text from a variety of sources.

Tools which have well-indexed keyword search and which allow me to search specific types of evidence.

An easy-to-use web-based timeline tool that would allow me to enter names, titles, and dates, and then put that info on a well-designed digital timeline for me

Something to help me browse in a better, less structured, more emergent way

Visualization of authority names in libraries around the world (some prototypes exist, but work is in progress)

I think the next big thing is semantic search engines.

Anything that simplifies using the University endpoint from home in data collection.

Anything that make data more tangible and easier to view in new ways.

Allowing for definition of context, quick narrowing of results, showing relations (ex. listing [results] by anything in a subject area.

... translation tool that is more accurate

q7: What kinds of projects are you working on now, and how are they influenced by the research tools that you use?

The existing tools rely on search or analysis through the use of pre-determined algorithms.

Ongoing evidence-based medicine research requires the ability to do specific searches for most recent available evidence. Tools like PubMed are very helpful in narrowing down such searches

My ability to find secondary sources is almost entirely dependent on the library database index and the databases our library subscribes to. I only rarely search for things in the wild.

Bad representation in EBSCO, so I have to dig around more. Because my research was spotty (no good single search source) I had to reform [my queries] couple of times

I think the impact of the research tools I a m using, mostly Google, is huge. It allows me to search about solutions to my problems very easily and efficiently.

Copy editing papers/manuscripts are easier/more efficient by being able to fact check, being able to find the right translation using a tool specifically created for editing in french

Tasks

Task 1

q1: What feature was the most useful to complete this task?

group by another control

visual representation of the items and their distribution on the canvas, color contrast helps

having everything on the screen at once

being able to breakdown each category, different options for search

group

playing around

tooltip, when I hover over, status meter in top right, prominent checkboxes.

controlling for group size and toolitp information

control panel/ search interface

Comments

I think the data doesn't divide very equally but it was easy to divide find this out

counts of each category would make it easy to complete

The groups and display checkboxes seemed very useful. Perhaps having the "category" box in an easier to visualize area would help

make progress bar more prominent

make group list radio buttons

I would need to use several layers of groupings

Task 2

q1: What feature was the most useful to complete this task?

display more info, re-grouped y a different variable

being able to select subgroups and switching to the unselected subset

sub-setting

layout was easy to navigate

group/switch

display and group checkboxes. Hovering over the collection items

The ability to regroup data easily and switch between the group being focus on and the group that has ben excluded

groupings controls and display at bottom of deselected tiles, history panel

the deselect tiles feature

Comments.

when I grouped by institution the institution with the longest name seemed larger than an institution with a shorter name but more items

difficult to see patterns

It was somewhat difficult to get the deselection feature

perhaps more detailed instructions a bottom instead of "click to switch selection"

maintaining grouping when switching selections would be useful

the data doesn't seem o be differentiated enough for any patterns to emerge within groupings

Task 3

q1: What feature was the most useful to complete this task?

color control and grouping and tooltip

being able to create subsets by clicking on the details being displayed

grouping visually

being able to select a different color made it easy to relocate when the search was expanded

mouseover

color coding of individual tiles and the resizing option

The color assigned to the selection persists through regrouping

Display features help me decide what is similar. History can also be used by going back to how you searched for the tile in the first place

the menu embedded colors

Comments.

Horray! this seems like the most important aspect of the interface (being able to mark selections and follow them through).

It would be useful to be able to color the entire group

Task 4

q1: What feature was the most useful to complete this task?

color, display, group and tooltip

showing more information of the subgroup

context menus (tooltips) for each tile

being able to select specific components of the file helped break down the search faster

group, seeing all the tiles at the same time

grouping controls, resizing not needed because it works well for me

grouping

group checkboxes, selecting groups and display checkboxes

marking (color coding) tiles

selecting a group of text and being able to manipulate within that group

the ability to find relationships might be limited somewhat by the categories that are available. They seem to be very standard rather than a reflection of the content of the data.

drop down menu navigation

Comments.

task not very clear

sorting/subgrouping would make this type of exercise much easier. Also, patterns may emerge without the user looking for them.

the back button was important for this task

This would be amazing for full text analysis

Display controls are secondary for me mainly because I need to use grouping first, the display features second, to refine what I'm looking at.

Post-test Questionnaire

General Comments

Selection of a range of data (time or dates). Perhaps a web organization might be useful for relationship. Texttiles right now is great for showing relationships between items in groups, but what about group <-> group relationships? It seems to me groups right now they are just alphabetical. What about grouping by multiple criteria?

I would like to be able to add the metadata based on browsing results. Beyond that, I think the usefulness of the tool depends on the complexity of the data. ... I could choose a group but not define it.

Affordance Strength Questions

q1: How easy or difficult was it to understand the detail display function?

checkboxes work well to communicate how to use it. Drag and drop may also be interesting.

I'm not clear what toggles the mouse-over with the details info

q2: How easy or difficult was it to understand the select function?

q3: Did you feel in control of how items were being displayed while using the *Texttiles* browser interface?

Having all the items re-arrange themselves looked cool. however, it felt a bit hectic and don't think I could have stopped it while it was processing. Also, progress bar was too far out of view, I forgot about it.

Grouping was intuitive. Having grouping and display allows me to divide how much I want to refine the data I'm being shown.

q4: Did you feel in control of how items were being grouped while using the *Texttiles* browser interface?

I would have liked to select multiple criteria to group by

grouping worked well, but I wanted the ability to add sub-groups. Also, a sorting option is necessary (not sure how items are sorted right now, which leads to some confusion)

Yes, though I wanted more options to group by (although I know there wasn't a lot more options with your dataset)

Given metadata present, I felt I could group in any way I might like

q5: Would you use the *Texttiles* browser?

I don't really know how it would apply to my searches

with added sub-grouping

Abso-fruit-a-lutely!

As a means of learning about a collection of texts and how they relate to each other, it would be very useful.

I like the idea of being able to see connections between resources

q6: Did you feel comfortable using the *Texttiles* browser interface functions?

controls are intuitive, however, it's a bit slow.

Once I was given a short tutorial, it was easy to see how selecting/deselecting worked, the history is great (I wish I could see the history in my library searches)

q7: Could the *Texttiles* browser be useful to your research?

No help with search terms, but maybe I just have to see it on a different collection.

full-text searching/categorizing

If it could display articles as well as my own data, that would be wonderful. I can see, given markup of my own data based on themes, questions, asked, how connections could be made <u>for</u> me.

q8: If the *Texttiles* browser were to be offered in a database that you currently use, how motivated would you be to use it instead of the tools you already use?

I would use to supplement what I currently use.

Not instead, but with the tools I use

It would be useful to see how publications relate to each other and to see how studies and study authors collaborate.

Especially if it had a function to connect the bibliographic references between articles/books.

q9: Would the *Texttiles* browser be capable of handling the research tasks that you need to do in your work?

With minor changes. (content: an article is very long so it would be hard to display, especially very large collections)

Authority lists visualization, encyclopedia entries visualization. Relationships between entities.

would be great to help you find related secondary sources in bibliography databases

A lot of my research involves reading. If the texts and articles were prepared in a way that it could be used by the browser, then the browser would be useful.

... as a data analysis tool, as well as a searching tool for literature

q10: Would the *Texttiles* browser be well suited for handling the type of collections that you need to explore in your work?

The question seems to be more one of the suitability of the data rather than the suitability of the tool

In terms of data, I have some text files, but would need to markup audio files in text format.

q11: Would the *Texttiles* browser be capable of facilitating collaboration with your colleagues?

If it had a "send to someone" option, or send citations or reference number.

I feel like it would, but I'm not sure how :)

I can't say one way or the other, but my work isn't very collaborative.

Especially due to the possibility of saving what you've browsed, assuming an export that also includes history.

q12: Describe how you would use the *Texttiles* browser.

Using a search engine has been so engrained that I would be tempted to search for the item that I'm looking for and then use Texttiles to find the specific item

I would use it to manage my large collections of ebooks and pdf papers. I would use it to manage search results in a database but only after using a search bar. Unless the collection were pre-tagged with information.

As it is right now to organize research papers. If file locations could be added, it would be great to find test files with specific attributes. Right now this is handled with a naming scheme and it is not very useful.

I'd group and display the author, keywords, titles, institutions and see which articles are most useful.

I would use it to help me discover patterns and relationships. Basically, help me find out things that I don't already know.

I would use it to get an immediate sense of relationships in data. I love how easy it is to play around with and I can anticipate making insights that I would have never thought of otherwise.

In analysis results of user studies. Being able to group them by different criteria can be very useful.

In some code analysis. If each tile is a class and the metadata has things like: author, version, includes, lines of code, test coverage, number of methods, etc.

To visualize connections between persons in literary history.

To discover patterns in full-text, and to search for secondary sources (as a tool on top of databases that I use to search literary periodicals)

... in understanding the flow of publications and medical research; in how studies and authors interact, and how ideas have flowed from one group to another

I would use it if it were a library interface. It could allow dynamic re-shelving of virtual books. It would be interesting to see which books ended up next to each other.

Research literature by keyword, author, year, titles, bibliographic references. Finding connections between text (transcribed interview) data and marked-up audio files, based on themes, responses, etc.

I wouldn't - I found the interface confusing - Nay - alienating.