A Mandala Browser User Study: Visualizing XML Versions of Shakespeare's Plays

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VISUALIZING XML VERSIONS OF SHAKESPEARE'S PLAYS

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ABSTRACT

We report the results of a small user study of a visual XML browsing prototype, called the Mandala browser, where dots representing entire documents or portions of documents are plotted around the periphery of a circle and drawn inward by colored magnets that are assigned values by the user. The result is akin to a Venn diagram that provides a visual representation of the interaction between multiple Boolean queries. In this study, eleven participants were given a pre-study interview, then asked to carry out a series of tasks where the dots represented speeches in plays by Shakespeare and finally were debriefed in a concluding interview.

We gained from this study a range of valuable insights into how details of the Mandala browser design could be improved. Participants mentioned, for instance, that they would like to retain a connection between results and the visualizations that produced them, that they would like to be able to make notes on result sets, and that they would like to be able to save subsets within results. They also asked for tools that support collaborative searching, as well as for federated searching across collections. The user feedback confirmed the potential value of the Mandala interface and provided guidance for the next iteration of development.

INTRODUCTION

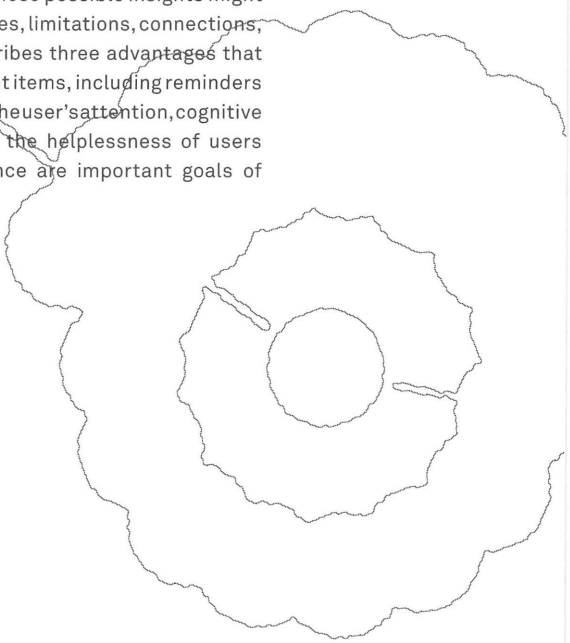
Browsing interfaces are intended for people interested in gaining some understanding of the contents of a collection, or in some cases of the set of results from an initial search retrieval. Browsing interfaces can therefore be seen as having a complementary relationship with retrieval interfaces, where the goal is to obtain a retrieval target. A typical approach to information browsing is to provide the user with a list of documents, which may be ordered according to some convention such as alphabetically by author or title, or chronologically by date of publication (sometimes called faceted browsing). A more visually complex approach is to organize documents in nested tiles where relevant information is expressed through the position, dimension and appearance of each tile (Schneiderman, 1992). Yet another approach is the Scatter/Gather browser proposed by Pirolli et al. (1996), who developed a prototype visualization where documents were represented by dots that could be grouped and subsetted dynamically by the user.

The literature includes a wide variety of examples of visually compelling browsing interfaces, including Small (1996) who proposed a 3D prospect view for browsing texts of Shakespeare's plays and Bederson (2001), who described a system for organizing thumbnails of images. More recently, designers working with public APIs (programmatic interfaces) from social networking sites like www.flickr.com have developed a number of browsing interfaces that extend Bederson's ideas through tools such as the color picker by Bumgardner (2005). Another example is the orbiting globes of information at http://dartdesign.de/, which allow the user to browse a constellation of moving representations that rotate under user control. The various crystal-based displays by Spoerri (2007) provide still further examples, and the 'dust & magnet' project by Yi et al. (2005) shows an inventive and interactive use of the magnet metaphor. In the context of rich-prospect browsing (Ruecker 2003), each of these interfaces includes some degree of meaningful representation, coupled with the provision of tools for manipulating the display. Browsing interfaces can also be used for studying parts of individual documents, such as the speeches in a play.

In addition to the discussion of browsing interfaces and their features, the literature also includes discussion of the methods of evaluation. For instance, Plaisant (2004) suggests the need for new and more comprehensive strategies for evaluating the success of browsing interface designs.

While most browsing interfaces provide both some representation of individual items and tools for manipulating the display, not all are concerned with the structural arrangement of the items (word clouds created at Wordle.org provide an example of arbitrary, though visually appealing, structural arrangements). However, in outlining their agenda for a phenomenological approach to interface design, Winograd and Flores (1986) suggest the possible value to the user of making an explicit structural coupling between the arrangement of information on screen and the underlying structure of the digital information in a collection. They suggest that this kind of coupling has the potential to provide the user with a number of insights into the nature of a collection—insights that would not otherwise be possible.

Ruecker (2003) outlines a number of areas in which these possible insights might occur, including: contents, structure, context, features, limitations, connections, trends, anomalies, navigation. In addition, he describes three advantages that accrue from the meaningful representation of content items, including reminders of the existence of items that otherwise might escape the user's attention, cognitive reassurance and reduced helplessness. Reducing the helplessness of users and increasing their sense of cognitive reassurance are important goals of information design.

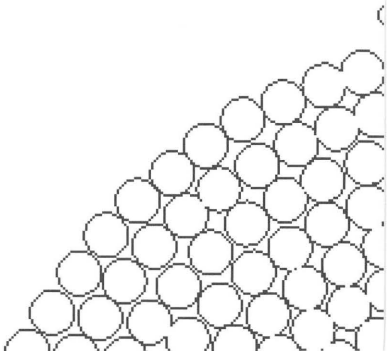


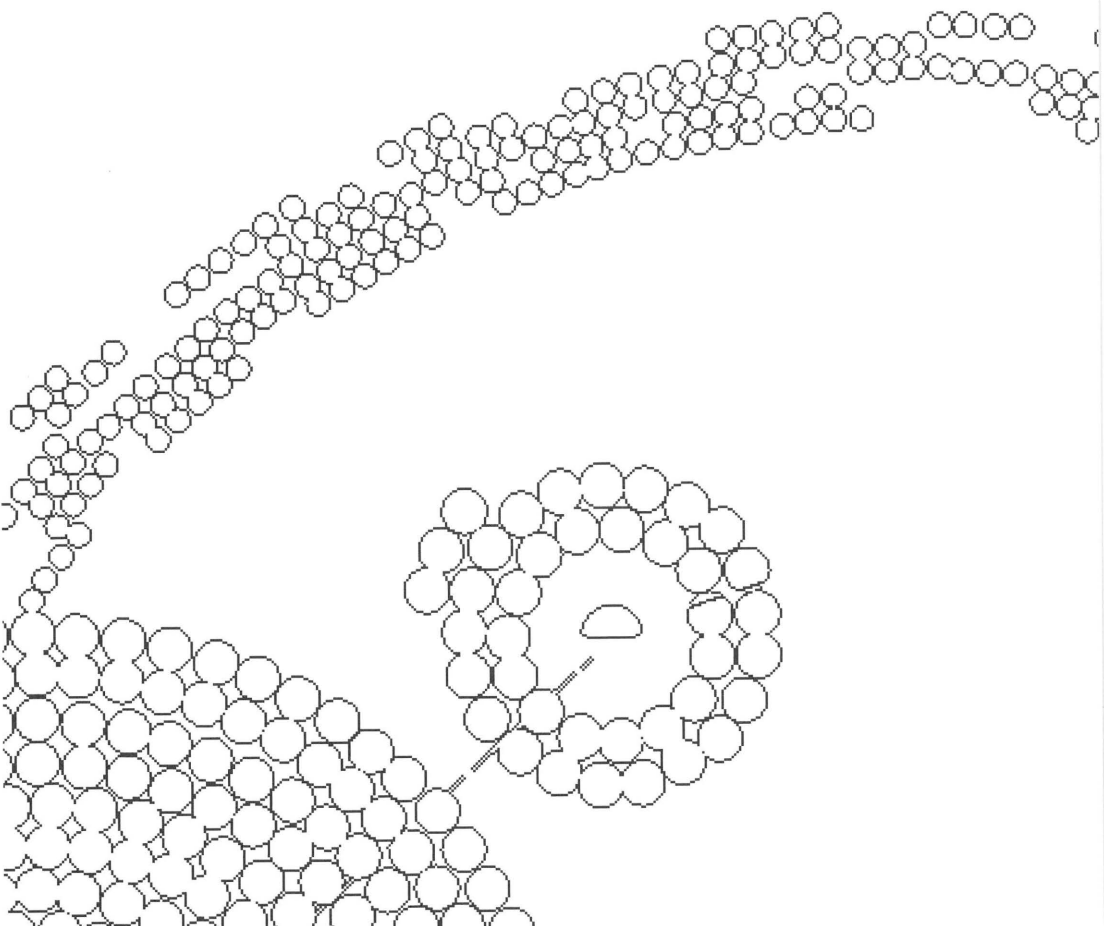
THE MANDALA BROWSER

In this project, we set out to test a new rich-prospect browsing interface, called the 'Mandala Browser' (Mandala) with the goal of developing better and more intuitive ways for users to search, perceive and filter large sets of XML information *(figure 1)*. This small-scale testing group, of only eleven people, allowed us to test the tools, assumptions and directions taking shape with this long-term and large-scale project.

The interface consists of a circular frame that is surrounded by dots, each one of which represents a collection item. The user interacts with the system by defining magnets to draw in items from the periphery. The result of the process is a kind of dynamic Venn diagram, with items falling into subsets according to the criteria the user has defined. The user can select individual items or can lasso groups of items to open on the right side of the display in the text reader. The browser can currently work with any well-formed XML-encoded document (regardless of what type of data are e
document): the only requirement is that the XPath of items—o
addresses, such as all paragraphs in a document—be defined e
arate configuration file or by the user in the interface itself.

We chose the Mandala metaphor for our design in part becaus
terested in the argument that circular forms with a central te
have a positive emotional effect on users (Cheypesh et al., 2
hoped to produce a tool that could support what Ramsay (2003
algorithmic criticism and Moretti (2005) calls 'distant reading,'
izations can support tasks such as synthetic analyses, patte
and hypothesis formulation.





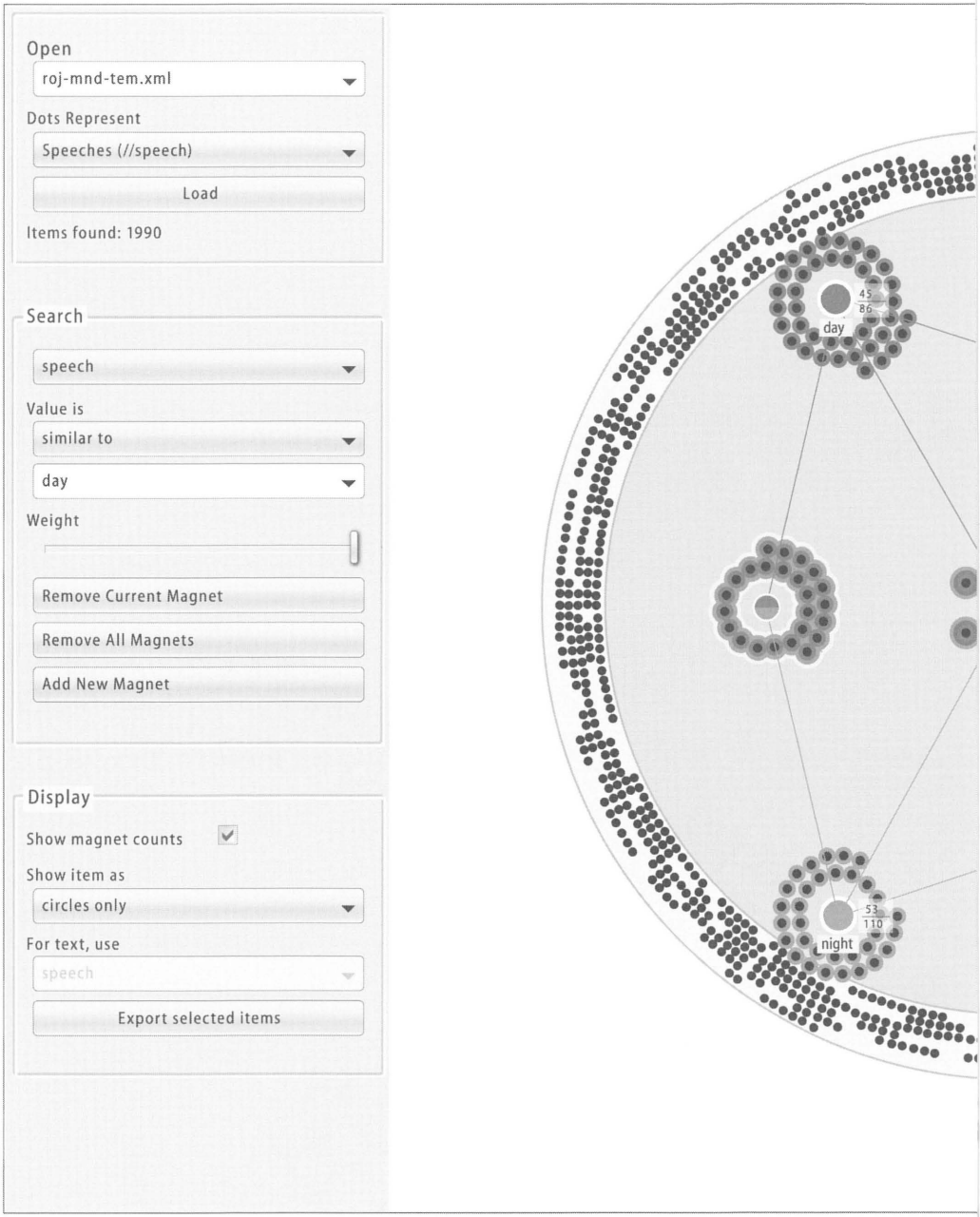
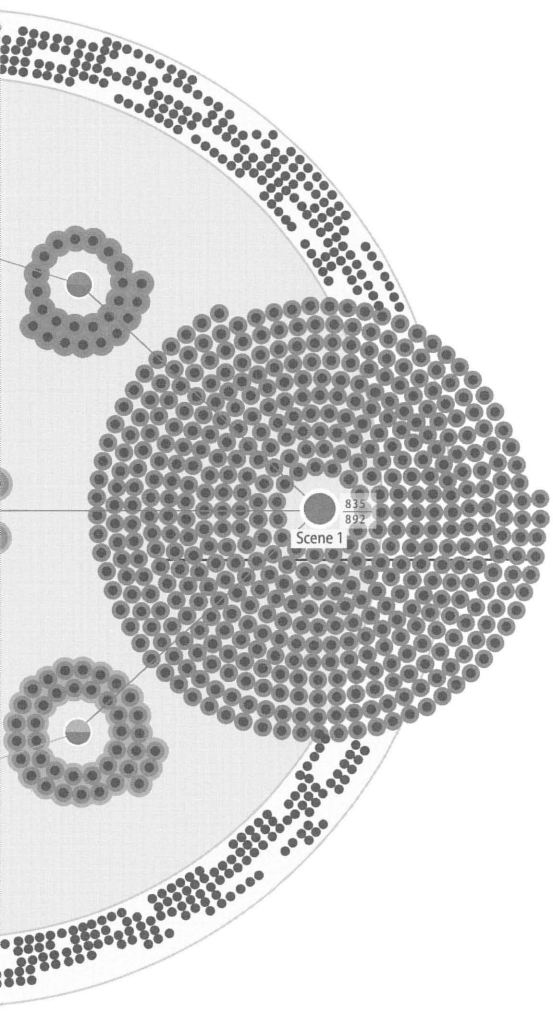


FIGURE 1
A basic task completed by one of the participants with the play Romeo and Juliet. The magnet on the left has attracted speeches containing the word 'night'; the magnet on the right has attracted speeches spoken by Juliet; and the joint magnet in the center shows speeches spoken by Juliet that contain the word 'night.'



Mandala Browser

mandala.humviz.org

by Stéfan Sinclair, Stan Ruecker, et al.

Ready to go, but never to return. O son! the night before thy wedding-day Hath Death lain with thy wife. There she lies, Flower as she was, deflowered by him. Death is my son-in-law, Death is my heir; My daughter he hath wedded: I will die, And leave him all; life, living, all is Death's.
speech@speaker: Capulet
speech@act: Act 4
speech@gender: male
speech@scene: Scene 5
speech@play: Romeo and Juliet

Yond light is not daylight, I know it, I: It is some meteor that the sun exhaled, To be to thee this night a torchbearer, And light thee on thy way to Mantua: Therefore stay yet: thou, need'st not to be gone.
speech@speaker: Juliet
speech@act: Act 3
speech@gender: female
speech@scene: Scene 5
speech@play: Romeo and Juliet

Well, get you gone: a' Thursday be it, then. Go you to Juliet ere you go to bed, Prepare her, wife, against this wedding-day. Farewell, my lord. Light to my chamber, ho! Afore me! it is so very late, That we may call it early by and by. Good night. Exeunt.
speech@speaker: Capulet
speech@act: Act 3
speech@gender: male
speech@scene: Scene 5

Items in reader: 15

METHODS

To test the Mandala browser's design, a qualitative usability study was conducted involving eleven human participants. The usability testing consisted of several steps, combining pre- and post-testing interviews, performing research tasks with the Mandala browser and written questionnaires meant to target the affordances of the browser. These data were then analyzed for themes of tool adjustments, requests for new tools, aesthetic responses to the browser and likelihood of using the Mandala as a research tool, among others, as discussed in the results section.

The participants were male and female graduate students from the University of Alberta, from a range of academic backgrounds that included computer programming, web design, library science and eighteenth century women's literature. The qualifications for participation in the study were that they were: 1) actively engaged in scholarly research and 2) currently doing research in full text databases. Participants were recruited through posters and snowball sampling and reflected a diversity of research interests and a range of research experience.

The interviews lasted approximately an hour for each participant. Recordings were made with Morae of the screen activities and the usability testing portions of the interviews, questionnaires were completed on paper and the administrator of the study took copious notes of the pre- and post-testing interviews.

The primary goal of the study was to examine user comprehension and usability of the Mandala interface. Such a usability test would provide the interface developers with valuable feedback on the usefulness of the design concept, the usefulness of specific Mandala features and insight into any learning curve users of the Mandala might face. With those goals in mind, a multi-step qualitative study was designed.

Participants were first given a research habits interview, in which they were asked a series of questions about their research needs and searching activities in using online research tools and resources. Participants were also asked about their current research projects and their research habits. Key questions to inform future directions for developing the Mandala browser revolved around the participants' favorite research tools, avoided and least-liked research tools and speculation on what their ideal, interactive research tools would look like.

Participants were then shown a prototype of the Mandala browser and a sample database of text entries. For this study, full-text from Shakespearean plays were used *(Romeo and Juliet, A Midsummer Night's Dream and The Tempest)* in order to populate the Mandala. This data was shown to participants with dots on the screen representing the speeches in the plays (texts were adapted from the Nameless Shakespeare Collection from Northwestern University). At this stage, participants were given research and analysis tasks (e.g, "Find out which family, the Montagues or the Capulets, spends more time speaking on stage").

Participants were also asked about their understanding of the system, their preferences for the various search tools embedded in the system and predictions of their ability to perform research tasks with the browser. One questionnaire targeted questions of usability (e.g., "How strongly do you agree with the statement, 'I think the Mandala would be easy to use'?"). The other questionnaire targeted questions of affordances (e.g., "Would the Mandala browser be capable of handling the kinds of searches you need to do in your work?").

Finally, a free-form post-testing interview gave time for discussion and amplification of those issues addressed and left unaddressed by the questionnaires. For example, why did some participants struggle with the magnet metaphor? Why did other participants break off their searching activities to start playing with the Mandala and its tools, while others stayed on-task? The multi-staged interview process was designed to try and capture the thoughts and reactions of our eleven participants from practical, aesthetic and playful perspectives.

Comments made by participants were analyzed to assess the viability of the interface from a usability perspective (i.e., discussing efficiency, effectiveness and satisfaction in the user's ability to access information), and to test the appropriateness of the visual grouping approach used in the design of the Mandala prototype. The requests from participants for tool changes and the problems they encountered with the Mandala, gave our developers feedback on technical or programming problems, identified problems with the tagging of the data, suggested changes to the existing tools and recommended new tools to be added. The activities of the participants also brought out an interesting commentary on the use of rich-prospect browsers. All of this is discussed further in the results section.

RESULTS

We group the results of this study into a several categories that relate both to how we carried out the research and to how the findings can inform different aspects of the design of browsing and retrieval interfaces like Mandala.

Participants' search habits

All participants recognized that needed content and good search tools are not always to be found together. Some of the participants will overcome aversion to a particular interface because they are sure a database contains needed content. One participant described how he tries to circumvent one interface by using another to locate the same content: he finds ACM content through Google (instead of the ACM website). Sometimes participants will find another resource with similar content and will use that first; for example, one participant used Library, Information Science and Technology Abstracts with Full Text rather than Library Literature and Information Science Full Text and another turned to Wikipedia instead of the Short Story Index.

Half the participants (6) said the greatest benefits of full text databases and tools are rapidity of searching and convenience. Two said the greatest benefit of full text databases is the way they are able to get a sense of the literature available in the field by using various searching and browsing tools. Three participants named the precision searching possibility in the databases. Other comments included content and the authority of the sources with such features as identification of peer-reviewed articles. One participant, in referring to internet databases and full text resources such as news sites, said he uses them to place himself in promising information neighborhoods.

There were eighteen favorite search functions named by the study participants, which reflected their varying search styles. Two participants said they had no favorite search functions other than a natural language keyword search box and that searching tools were difficult for them to navigate and use. The most popular searching tool (mentioned by four participants) was a good-quality thesaurus. Other favorite functions, too many to list here, included sorting by date, date range limiters, relevance rankings, filtering by publication type, truncation, exporting citations and faceted searching. Only one participant said she had no favorite or preferred search functions of any kind. For those study participants who identified favorite searching functions, there was little to no overlap or similarity between their answers. Each reply was highly idiosyncratic. This disparity in perceptions warrants further study.

The greatest problems the participants identified in their searching of full text databases revolved around the frustrations that occur when participants were unable to access materials contained within the database quickly and easily. Items that brought up frustration were variously identified as: tools difficult to find or understand; having to log into multiple access areas of an aggregate resource (the main library website, the electronic database, specialized resources like Refworks); and issues of display, with a participant saying "it's too much hassle" to follow multiple links to the full text of an article, when the full text should be immediately shown.

Of the ten participants who said that they have recognizable problems in their searching, six participants said their greatest problem when working with full text databases relate to worries about the results found. Whether the concern was about too few results or too many, participants expressed persistent worry that they have potentially missed useful material within a database. They attributed possible inability to source relevant material to: differences in results between natural language and controlled vocabulary searches; the fact that controlled vocabulary in an emergent scholarly field doesn't work; frustration with an inability to find the right keyword; and terms of common use within a scholarly field not being part of controlled vocabularies. Other problems included loss of search history, unclear display of search results leaving a searcher unable to evaluate relevance and identification of the variations in search terms and symbols amongst the databases. One participant's comment was that he wanted simplicity when searching, but recognized that "simple tools don't always work well."

At the end of the pre-testing interview, participants were asked, "what kind of interactive tools would you use if they were available?" While there was little overlap or similarity in the responses to the question about their greatest problems when searching, or in naming their favorite search tools, the answers to this question were immediate, frequently well-developed and contained many of the same themes. Several participants (3) asked for the application of web 2.0 tools for database searching, as seen in this answer: "Tagging. If you could tag articles, that would be good. I'd also like to see better note taking tools in databases to attach to the articles I find. I'd like to bookmark databases with a program like del.icio.us, so that I could just jump back to the article when I wanted to, whatever database it was in."

Participants also wanted federated search tools that would work across multiple databases, which would save, tag and export results and search histories. Alternatively, one participant suggested, the results export tool should tag results with the search terms used to find them and the database they came from. They asked for tools already existing in some databases to become standard, saying "all databases should allow for exporting citations"; that databases should suggest synonyms and related terms when a user is searching a term; and that they should be able to search and filter results.

Participants also suggested some new innovations, such as the visual clustering of results, visual representations of how the theoretical fields, authors, journals, etc. related to the articles retrieved, the ability to make notes within the system that are saved under your user name and the ability to develop your own subsets within your search results.

When asked about what their ideal search tools would look like, one participant ended his description of ideal tools with pessimism, saying "it [the database] only works the way it works" and that he didn't see how database tools could change. Instead it was up to him to accept that searching can be a long process and that you can miss finding relevant material within the databases.

Task events, processes, interpretations

The Mandala was designed as a possible solution to the difficulties some people experience when conducting Boolean searching. Hypothesizing that one factor might be attributable to the syntax of a search, the Mandala's system of magnets was developed to provide a visual syntax for developing search queries and seeing results. Each magnet is given a single value (e.g., a name, concept, place, expressed by a single word) by a user; connecting magnets are generated by the system to identify the subsets of items that fall between primary magnets. In this way, the highly specific language of a Boolean search is circumvented. However, it emerged in our study and is confirmed by literature in Library and Information Studies (Salton, Buckley, Fox, 1983), that the difficulties some experience when building Boolean searches is not so much about syntax, but rather about the ability to break a searching need into component parts—the logic behind the syntax. Four of our participants had difficulty with the more complex tasks given to them, as seen in the quotation below. The task assigned was to search for the themes of 'night' and 'day' in the first act speeches of the collection *(The Tempest, Romeo and Juliet and A Midsummer Night's Dream).*

Carla: "So we want...speech...night and day [typing in 'night and day']. And I think—I don't think that it's—like these three boxes [referring to the complete left hand search panel on the screen], I don't know if—like I don't know when I should, I guess I don't really understand how this thing's organized,

so when there's more than one task that I need to do, I don't know if they can be all-inclusive, like should I be searching more than one play at a time, or should I be searching a theme at a time?"

It soon emerged that our participant (Carla) understood that the three plays were in the Mandala and available to her. Her difficulty lay in breaking the search into 'Act One,' 'night' and 'day,' as the basic elements that could then be assigned to magnets. Three more participants exhibited similar difficulties in their searches.

A more common problem during the tasks was difficulty in remembering the order in which magnets were loaded and assigned values. Within the Mandala, the user is required to click on the button labelled 'Add Magnet' to add additional query terms (the first magnet appears by default); then the user is able to assign a value to that magnet. Nine of our participants had difficulty with this, and specifically requested a change to the order of the add magnet to make it so that value would be entered first and then the user would click on 'Add Magnet.' One user said his difficulties occurred because he wanted to treat the magnet "like a search function," clicking the 'Add Magnet' button in the way that another interface might require the user to click 'go,' 'search' or 'enter.' Another user seemed to summarize the general reaction to the magnet value entry order when she said, "I find it annoying." Two participants had no difficulty with the magnet order and seemed to adapt to it effortlessly.

An essential part of success during the searching tasks with the Mandala lay in understanding the visual displays built by the searches. The visual display seemed easy to understand for all participants, who were able to correctly interpret their findings. Some participants experienced some minor confusion over the fractions displayed by the system (these fractions indicate the number of items matched solely by a magnet versus the number of items matched by several magnets) and over the magnet metaphor, but this confusion did not keep them from correctly explaining the results displayed by the Mandala *(figure 2)*.

While aesthetic responses were not always positive (one participant's first response was to say that it looked "a little freaky"), the only confusion or problem with interpreting the results was if a participant had used the field 'any' instead of 'speech' when building a search (each item has multiple fields, such as 'speech' and 'speaker' or the user can specify to match values from any field). If such a mistake did occur in the building of a search, the visual display seemed to make it readily obvious to the user and such mistakes were quickly rectified. The one qualifier, however, mentioned by three of our participants, was that they had noticed problems in the coding of our data during the searches (one search had been set up to point to such possible problems, but only three of the eleven read the text-based results closely enough to notice it) and as a result they qualified their interpretations by alluding to the possible untrustworthiness of the data.

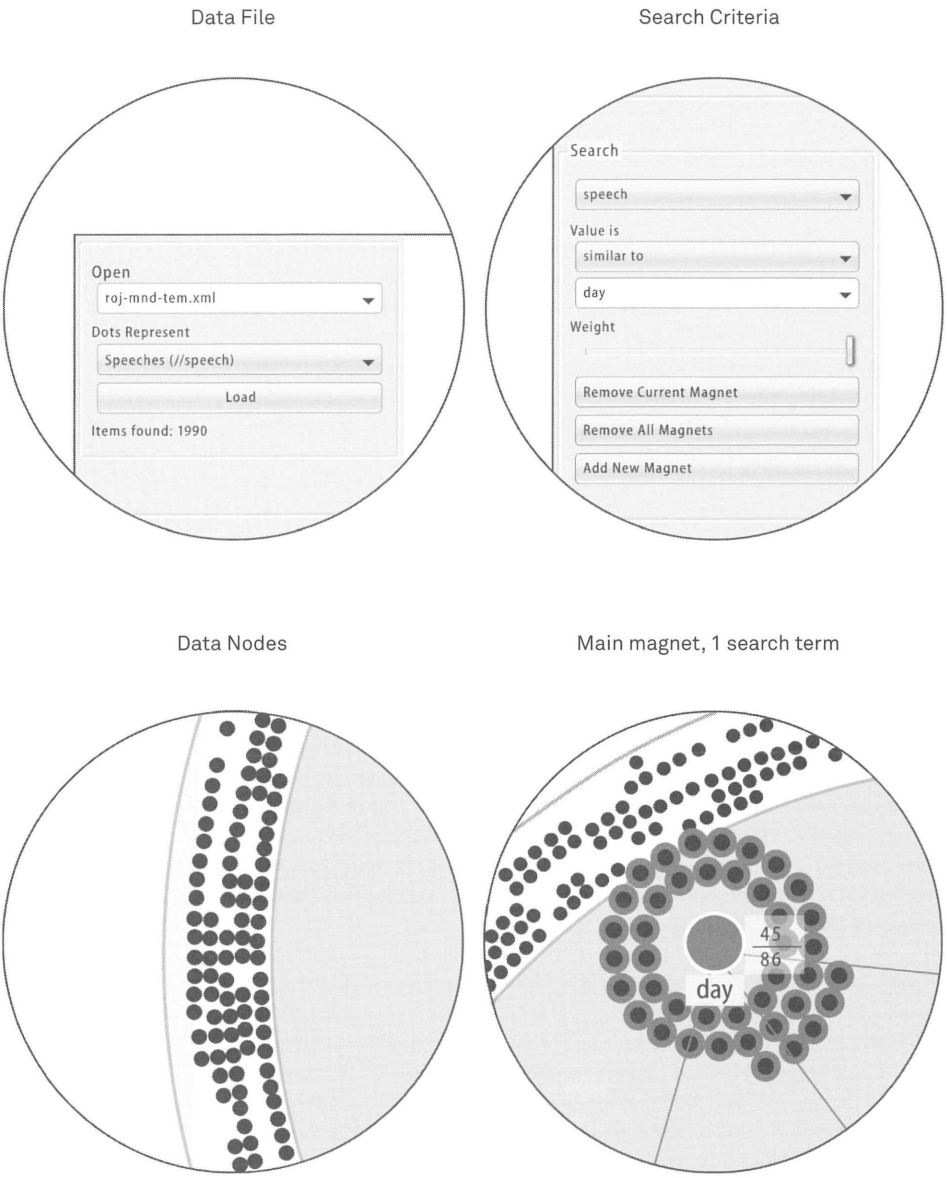
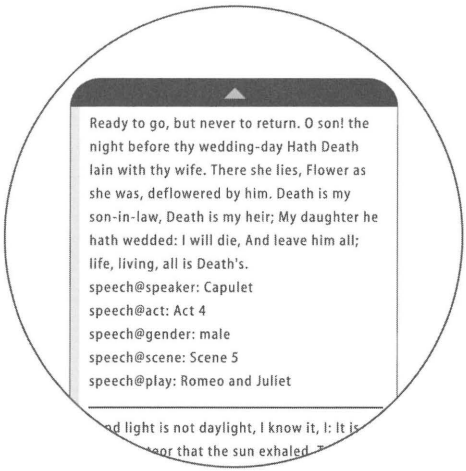


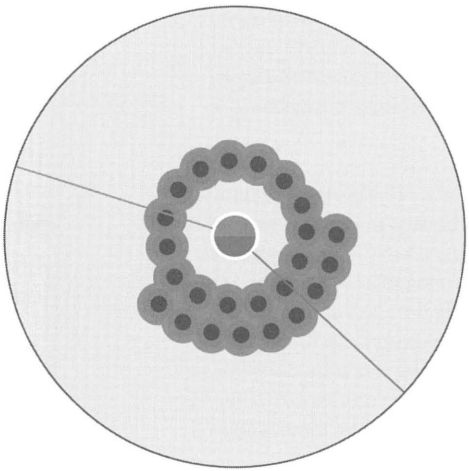
FIGURE 2.
An advanced task completed by one of the study participants using the three Shakespearean plays in the data set. Here primary magnets have identified speeches given in the first scenes of the plays, speeches that contain the word 'night,' speeches that contain the word 'day' and the joined magnets generated by the Mandala show those speeches that contain two or more of those magnet elements.

Display Options

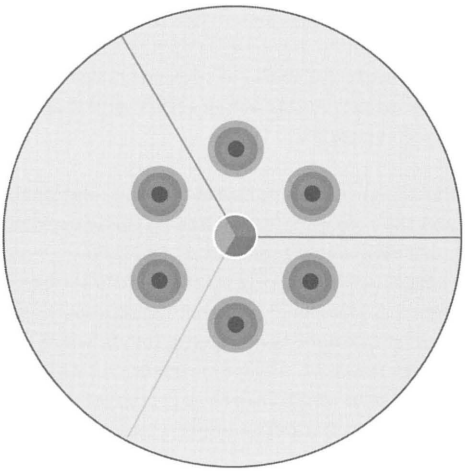
Text Reader



Joint magnet, 2 search terms



Joint magnet, 3 search terms



Requests and Reactions

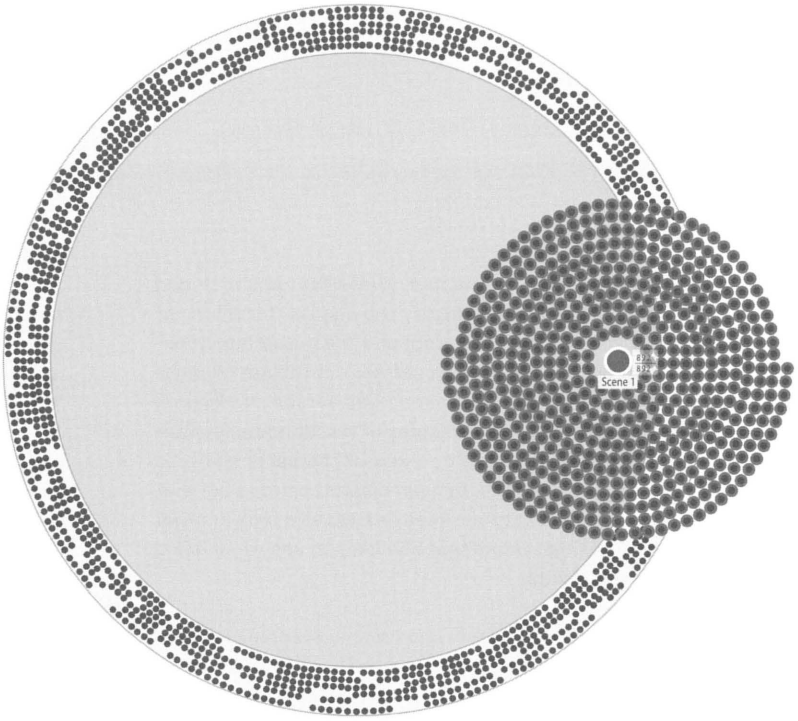
As the participants performed the study tasks, they verbalized some basic reactions to the Mandala, as well as some requests. These requests included asking for some improved searching functions and the implementation of some standard search tools seen in other interfaces. The reactions of the users to the Mandala metaphor, its appearance and its animation were varied, although most of the Mandala users showed a willingness or interest in experimenting (even playing) with the display.

All of the study participants had requests that reflected their desire for improved searching tools within the Mandala browser. The primary improvement was the 'add magnet' order, as already discussed. Other features that users thought would improve the Mandala included changing the language of the field and value entry boxes, since the Mandala had used some cryptic language for those features (reflecting the complexity of the underlying XML syntax), for example, 'speech@play.' 'speech@gender.' They also suggested adapting the magnet weight tool, which was designed to allow users to visually move the location of items drawn to a magnet, even so far as temporarily turning off the magnet altogether without removing it entirely. Participants felt it might be more useful as a relevance ranking tool. They also requested that we add the ability to click and drag results out of the Mandala and store them away from the active screen and that we also introduce a way to store search histories.

Participants also indicated that the relationship between the visual display and the side panel text-based display needed to be shown in some way. In the screen shots provided of the Mandala, each speech in the three plays is represented by a dot with these dots attracted by magnets. If any of these dots are selected, the speeches represented by the dots are shown in text form in the right hand results panel (which allows closer inspection of the items). However, which dot represents which speech in the results panel (or, conversely, which speech is represented by which dot) is not shown. It became clear that participants wanted such a relationship to be displayed in some way.

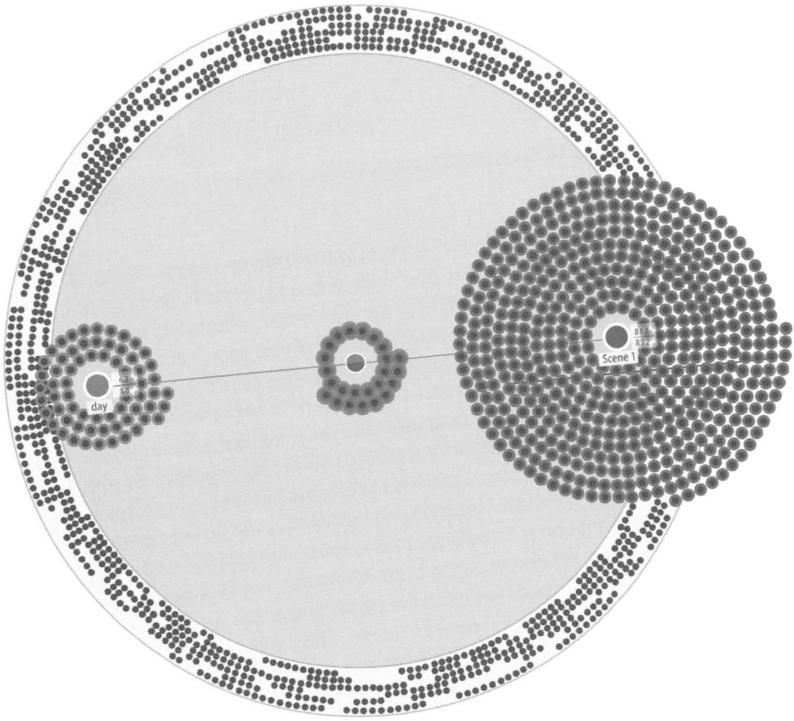
Adaptable display features were also requested. These features included the ability to enlarge fonts, the ability to magnify the display (for a further discussion of affordances, please see further on) and the possibility of exporting images of the Mandala's visual display of search results (what is contained within the Mandala circle only), as a recorded version of a search history. Most participants liked the colorful display of the Mandala, but another adaptable display feature requested by three of the participants is the ability to assign colors to the magnets. One participant pointed out that users with color blindness would like and perhaps need such a tool; another said she has her own color ranking system that she likes to use when doing research, in order to code her results.

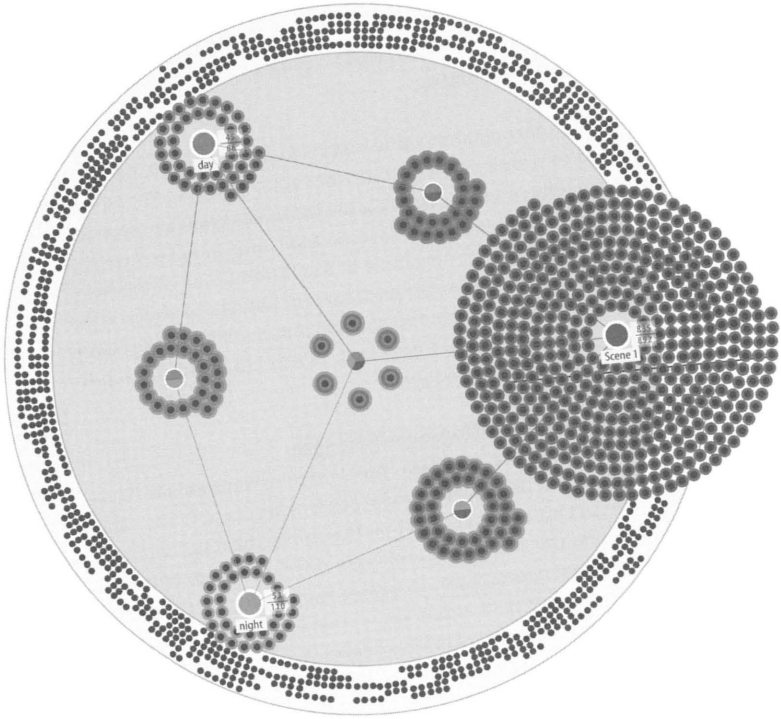
There were also requests that searching tools commonly available in other interfaces be made available in the Mandala browser. These tools included a help feature to better understand system affordances, better tools for the results panel, such as deletion of some results while saving others and that the system should pop-up suggestions for the searcher as field values are typed in. Interestingly, a couple of participants thought that the suggested values provided in a drop-down menu were someone else's search history. Seven of the eleven participants asked for better formatting in the results panel: the way it was set-up, it was breaking words, was small and difficult to read and there were not enough values displaying—for example, the information denoting where the speech is located in the play (act, scene) was not always shown.



Adding magnets, 1, 2 and 3 search terms

FIGURE 3
Selected details from the interface show how the user sets up a search and sees the results both as a visualization of magnets and dots and also in the text reader.


day
Scene 1


day
Scene 1
night

Reactions to the Mandala in terms of its conception (the metaphor, its possibilities, appearance and the desire to play with it) during the tasks were varied, so varied that it becomes impossible to generalize about whether it was liked or disliked. Some liked it, and some did not, while others were neutral. Three participants could not understand the magnet metaphor used in designing the Mandala. One participant went so far as to say that she was not 'scientific' and did not understand 'the science of magnets' and as a result could not understand the basic principle of magnetic attraction within the Mandala. Several participants also asked questions, when the tasks were finished, about possible uses of the Mandala, having difficulties seeing how it could be successfully applied in research situations. Two participants were enthusiastic about the Mandala's visual design, while one participant disliked it. Another participant called the design 'wasteful,' because of all the white space that will surround a circle displayed on a rectangular computer screen. That white space, he said, could be usefully employed. Another participant wrote on her questionnaire that she liked the clean display provided by the white space. Only one participant disliked the animation, saying that the dot movement while she was typing was 'distracting,' while another participant loved the animation as terms were entered, explaining that she has had problems with spelling all her life. This was the perfect tool so that she could check her spelling as she searched, recognizing that if she misspelled a word while typing it, the dots would move back into the outer ring of the Mandala.

At the end of the tasks, participants were invited to play with the Mandala. Almost all of them did so. Three of the participants voluntarily started to play with Mandala in the middle of tasks, ignoring the tasks set them by the interviewer, instead feeling compelled to explore on their own (please note this does not include any exploration or play done at the introduction of the Mandala or during the first task, when some participants needed to explore the tools in order to understand the system tools). Such play seems to underscore the responses of users to rich prospect browsers, which are designed to provide affordances for undirected interaction.

Questionnaires on Usability and Affordance Strength

Following the tasks set with the Mandala, participants were asked to respond to two questionnaires, one of which related to usability, and the other to affordances. While participants seemed positive about the helpfulness of the animation, they found the Mandala potentially difficult to use and were uncertain as to its potential usefulness. As has already been discussed, reactions to the visual appeal of the Mandala were divided, with rankings from respondents ranging from very positive to very negative, finally averaging out on our scale of 1 (strongly disagree) to 5 (strongly agree) at 3.5, neutral to mildly positive. Participants did not find the Mandala easy to use, nor did they believe others would find it easy to use, frequently commenting that the

Mandala was not 'intuitive' and that the format of the Mandala would appeal only to 'users who are visual learners.' Their comments included "not super intuitive," "it's very cool, but I struggled at first" and "it really depends on individual learning styles."

Despite the belief that the Mandala would be challenging to use, some participants (7) agreed that the Mandala could be helpful when searching full text databases. "I like being able to see the entire data set....I often suspect I am missing important components simply because of structural blindspots." There was near-unanimous agreement (8 participants) that the animation of the Mandala was helpful in interpreting results, although their comments indicated that the participants did not find the movement as immediately intuitive as we would have liked. For example, Carla commented, "Although the animation was visually appealing, it took several minutes before I understood what it meant."

The affordance strength questionnaire was developed to address the system's ability to convey its possibilities to potential users in relation to their needs. The components of a person's perception of the strength of an affordance are: awareness – the potential of the object is perceived; motivation – the need for and then seeking out the object: ability – building on awareness and motivation, the ability of the perceiver to recognize and use the object; preference – deals with established preferences, such as aesthetic preference; and contextual or agential support—sources of assistance in using the object (Ruecker, 2006).

Responses to the affordance strength questions varied widely. Two participants gave the Mandala very negative reviews, yet two other participants were very positive about the possibilities of the Mandala browser in their work. Other participants fell into the middle of the spectrum. As an example of these divergent viewpoints, in response to the question, "Would the Mandala browser be capable of handling the kinds of searches you need to do in your work?" Thea wrote, "probably not....the Mandala lacks the precision that I need," while Anthony wrote, "If it could be adapted to novels instead of drama I would use this at the beginning of every project if I could find patterns or reinforce my idea that they exist. This would really be useful in a project like my thesis where I'm studying a theme across 6 different novels." The responses indicate that we need to develop the Mandala search functions to make them more intuitive and flexible.

SUMMARY

To sum up, basic reactions included a liking for the color and animation and the layout. The users also demonstrated a willingness to play and a belief that the visual display is a valuable aid to understanding the content of the database and the results of their searches, which indicates that the Mandala is appealing to use. However, users appeared lukewarm to mildly negative in their belief that the Mandala can be a useful tool to them in their research, suggesting that we may need to provide further help, training and examples. Participants indicated that they want increased flexibility in searching and results display; that tools need to be added to and improved, including relevance ranking, expanded search features, better sorting of results and customizable screen features.

A couple of fundamental problems with the Mandala design were exposed that will require more thought and study, namely a) the use of search function: difficulties breaking down tasks, order of adding magnets and defining what they represent, the limit on the number of possible magnets etc; and b) the magnet metaphor: difficulties understanding it, problems with the weighting feature and trying to visualize applications for this tool while researching in full text databases.

Qualitative small scale studies can provide serendipitous discovery of information that can enrich projects in surprising ways. The responses of participants to questions about their ideal search interfaces, for example, gave us food for thought as we considered how best to develop the Mandala's effectiveness as a searching tool. This study, despite the small sample, has illustrated again that rich prospect browsers can be useful in encouraging people to explore collections. Furthermore, it has demonstrated not only further support for the contention that the difficulties in Boolean searching lie in cognition and logical thought rather than syntax (Salterton, Buckley, Fox, 1983), but also that the process of searching is as idiosyncratic as learning and thought processes: one participant is a visual learner who recognizes and builds on patterns and likes the visual display of a rich prospect browser, while another cannot bear the disciplined thought required by any kind of Boolean searching, but instead prefers the serendipity of a natural language keyword search and considers the precision of other search tools confining and frustrating.

The results of this study will be used to enhance our understanding of online information browsing activities and provide valuable data for creating improved computer interfaces to support effective use of complex software tools for collection and document analysis by scholars. The next iteration of the Mandala browser is already in development, taking into account the feedback we have received from this study.

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