The State of Information Visualization in Academic Libraries

As more collections in academic libraries become digital in nature, and as academic libraries begin to store and work with datasets, search and discovery services will need to go beyond providing a list of text results to satisfy the needs of current-day information seekers. A turn to a greater implementation of information or data visualization will be required to keep up with the information needs of patrons and with the immense flows of data that they must navigate. Although there will be some growing pains in this transition, information visualization fundamentally aligns with the overall role of academic libraries. Information visualization could become just as important a gateway into library materials as the information mediators currently in place: the library catalogue, librarians themselves, the online interfaces of databases and other digital materials, and the ability to simply browse open stacks. Like these information mediators, information visualization helps to distinguish the signal from the noise, and thinking about the role of information visualization in academic libraries today is not simply about looking at visualization as another, supplementary interface to a library’s information resources; rather it is a pathway to considering the evolution of the academic library in the 21st century and in the age of Big Data.

In what follows I will analyze current trends in library practices and recent findings in library research which focus on utilizing information visualization as a tool for discoverability
and for improved search behavior. I will also take a look at databases and other e-resources which are already doing innovative work with visualization and see how those visualization practices could transfer over to the development of “nextgen” catalogues. Finally I will examine how visualization is even shaping the architecture of new academic libraries like the James B. Hunt Jr. Library at North Carolina State University.

THE IMPACT OF BIG DATA AND A NEW GENERATION OF DIGITALLY NATIVE STUDENTS AND SCHOLARS

One way to put the age of Big Data into perspective is to consider that “90% of the world’s data has only been produced within the last two years” (Little, 2012). This incredible surge in available data is increasingly becoming central to the research activities of faculty and researchers, and academic libraries can play a pivotal role in the field of Big Data. Geoffrey Little has emphasized how the work of librarianship has already been impacted by Big Data and has caused a transformative shift from the task of information literacy to that of “data literacy”¹: everyone is producing files and librarians are being called on to help manage, curate, preserve, and facilitate access to them. While many of us work in libraries where a colleague is responsible for social science data, including statistics, census information, and large analog or computer datasets, the rest of us may be fielding requests for data for the first time or we may find ourselves dealing with increasing expectations from our faculty and students in terms of what the library can offer in terms of data services.

(Little, 2012, p.263)

¹ A term coined by Michael Witt of Purdue University (Witt 2012).
James G. Neal similarly advocates for a greater digital curatorial role for librarians:

> When scientists map the universe, investigate the gene, monitor the environment, they create massive data sets that require management and structure. They want new tools for curation/findability and for extraction and application. As part of multidisciplinary teams, they increasingly care about distribution and collaboration and they seek sophisticated capabilities like visualization and simulation… Can the research library add value to these processes?… We must raise the level of awareness and understanding. We must advance new approaches and standards for long-term digital data curation. (Neal, 2011, p. 71)

Adding further pressure to the need to adapt to this role of data curation is the emerging generation of digital-native undergraduates currently in the university system. These students are “primarily visual learners” and “very concerned about saving time” (Weiler, 2005, pp.51-52). They are precisely the type of students who might benefit from the wider implementation of information or data visualization across all of a library’s web properties. Being able to meet the challenges of the future of academic libraries will largely depend on how well libraries engage their patrons on the information visualization front.

WHAT IS INFORMATION VISUALIZATION?

So, what is information visualization? Information or data visualization encompasses a number of concepts, but fundamentally it operates on the understanding that a majority of

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2 But just because they are immersed in a visual culture does not mean such students possess “visual literacy.” In fact the need for visual literacy is being actively addressed by educators and librarians, which can be seen in the new *Visual Literacy Competency Standards for Higher Education* issued by the Association of College and Research Libraries (Hattwig et al., 2013).
learners are visual learners (around 65% of the population is a commonly cited statistic (Madera et al., 2013)) and that comprehension and retention of concepts is improved when a visual aspect is incorporated into the presentation of those concepts. It has also been suggested that the brain processes visuals 60,000 times faster than text.³ Some research has proposed that vision is directly tied in with cognition (Connor and Browne, 2013), suggesting that information visualization taps into an especially important sensory input for learning. Information visualization thus leverages our innate inclination toward visual media for the purpose of accelerating learning and helping us capture the “big picture” at a glance. Ben Shneiderman has noted that “the purpose of visualization is insight, not pictures” and visualization is of particular value when considering information-seeking inquiries (Shneiderman, 2008, p.3). He considers “the heart of information visualization [to be] the well-designed user control panel and interaction techniques that enable users to generate task-related comprehensible coordinated windows (selections in one window produce highlighting or new contents in related windows).”

³ This is supposedly based on research done at the 3M Corporation, but the actual citation for the original research has not been found. See here for more information: http://cogdogblog.com/2012/07/06/60000-times-question/

A common principle in the design of information visualization tools is “Overview first, zoom and filter, then details on demand” (Shneiderman, 1996, as cited in Shneiderman, 2008). Following this principle, information visualization tools can be an important method for information discovery when browsing through hundreds or thousands or millions of resources, or when trying to get an overview of the relationship between sources. In the rest of this paper I will be looking at information visualization tools that have been employed in academic research software, databases, library catalogues, and in physical installations at libraries. This brief survey
should give a good idea of the potential that information visualization has for helping to tackle the information challenges facing librarianship today and in the future.

**INNOVATIVE EXAMPLES OF INFORMATION VISUALIZATION TOOLS**

Since the mid-2000’s a number of online search engines dedicated to academic research have sprung up, most prominent among them Google Scholar. A competing product is Microsoft Academic Research (http://academic.research.microsoft.com) and much like Google Scholar it has offered a free search engine of academic articles but has supplemented its search engine with a number of interesting visualization tools: Citation Graph, Coauthor Graph, Coauthor Path, Publication Trends, Academic Map, and Organization Comparison. Of these tools, the most interesting are Citation Graph, Coauthor Path, and Publication Trends. Citation Graph (Figure 1) maps out the relationship between an author and the authors most cited by that author. Paper Graph (Figures 2 and 3) does the same except at the level of the article. This visual representation allows the viewer to quickly see the relationships between various articles and authors, and provides a tool for discoverability, since by clicking on a new author or article, the map rearranges itself around the citational relationships provided by that article or author. Coauthor Path (Figure 5) allows you to choose any two authors and then see how the two authors are connected via coauthorial relationships. Finally Publication Trends (Figure 6) visualizes the

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4 The various visualization tools are explained in detail by Microsoft Research here: [http://academic.research.microsoft.com/About/Help.htm#3](http://academic.research.microsoft.com/About/Help.htm#3)

5 Microsoft Academic Research is not alone in seeing the value in visualizing these relationships as a tool for the discovery of new sources. As a part of its database offering Web of Science has long provided a Citation Mapping service which simultaneously maps out forward and backward citations for an article (i.e. backward citations are the sources used by the article; forward citations are other articles which cite the article in question as a source)(see Figures 21 and 22).
amount of research published in different subject domains over time, letting the user see how research in particular domains have grown, shifted or diminished over the twentieth century.

The enhanced discoverability provided by these visualizations could be transferrable to the world of library catalogues. Over the last three decades academic and public libraries have successfully transitioned from card catalogues to online search engines, and, inspired by services like Google, academic libraries are increasingly using federated search engines to provide easy access to all their web properties from one search box (Crowley and Spencer, 2011). The next jump in the transformation of library catalogues is likely to be in the form of a greater implementation of information visualization in order to improve discoverability of information resources. The current model of displaying a text list of relevant results works well when searching for specific resources, but not as well when it comes to the task of discovery, especially when the potential search results are in the thousands and millions. A variation on the discovery methods employed by Microsoft Academic Research can be seen in the word clouds utilized in nextgen library catalogues like Aquabrowser from SerialsSolutions (http://www.serialssolutions.com/en/services/aquabrowser). These word clouds are generated to the side of the search results (Figure 8) and offer keywords that can help the user “Search Discover Refine” (Crowley and Spencer, 2011, p.224). A similar approach is taken by Visual Thesaurus (http://umich.visualthesaurus.com.proxy.lib.umich.edu) which uses a dynamic node-link structure to help users discover and explore synonyms and alternate meanings to words (Figure 9). Research has shown that visualization tools which generate keywords while performing a search can lead undergraduates to spend more time brainstorming possible searches and can
prompt them to try more searches and different search strategies (Connor and Browne, 2013). Such improved searching behavior confirms the utility of embedding visualization more deeply into library search engines.

Innovative libraries and library database vendors have already begun the process of embedding visualization into their services and products, or have created new products and services entirely on the basis of visualization. One such offering is Kindred Britain (http://kindred.stanford.edu/) from Stanford University’s Library which visualizes relationships between historical figures in British history (Figures 10, 11, and 12). Individuals are represented as circular, colored nodes, and dragging one node over the other prompts the software to generate a representation of the connections (by marriage, lineage or sibling relations) between the two persons. Colors are used to differentiate gender and to denote the nature of the connection between individuals. Further filtering and selection can be achieved by manipulating the Timeline and Geography panels. Kindred Britain does not just simply visualize relationships - it prompts the researcher to rethink how they approach their subject matter and consider how familial ties influenced historical outcomes and situations. What previously would have taken lengthy, painstaking research into the biographies of numerous individuals is now completed in mere seconds, allowing researchers to quickly discover familial connections that might otherwise have gone unnoticed.

Philanthropy In/Sight (http://philanthropyinsight.org.proxy.lib.umich.edu/) is a database offering from The Foundation Center which connects grant data with Google Maps to better

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6 This research was conducted using a word cloud tool from Google called Wonder Wheel (now used as an internal tool to generate ad keywords) and EBSCO Visual Search (now deprecated) which generated a column of general subject terms that could populate a more specific set of subject terms in a new column to the left until the searcher gets to an acceptable level of specificity. Under each column would be links to articles related to those subject terms.
identify geographical regions in need of donors or regions which are already saturated by donors (Figure 13, 14, 15). By providing this service potential donors can quickly search out grant recipients in need of aid, compare total philanthropic giving by regions, view important demographic data, and identify funding partners. By basing the database on maps rather than a list of search results, donors can quickly move through large amounts of data and identify areas of need that might have otherwise gone overlooked in a large list of results. But scholars might also find this rather simple mapping utility beneficial: for instance, they could quickly compare grants in the United States related to “poverty” (Figure 16) and grants with the keyword “wildlife” (Figure 17) and at a glance see sharp distinctions in philanthropic priorities across different areas of the country.

One of the most interesting developments in visualization technologies is the installation of physical spaces or labs in academic libraries expressly dedicated to the work of visualization. The new James B. Hunt Jr. Library at North Carolina State University has created a Teaching and Visualization Lab which is designed liked a theater that includes “includes immersive projection on three walls, with 3D capability; a professional-zoned audio system, and cameras for real-time video capture, broadcast, and collaboration” (Schwartz, 2013) (Figure 18). Projects that have already utilized this space include “a recreation in 3-D of the 17th-century cathedral where John Donne preached, earth science students experiencing the birdsong audible in a nearby wild environment, and a simulator to train naval ROTC midshipmen to operate the bridge of a modern warship.” (Schwartz, 2013).

The Hunt Library also uses visualization as a means of providing a traditional stack browsing experience to student. Because all of the library’s books are in storage beneath the
building and accessible only via “bookBots” which mechanically retrieve requests within five minutes (Figure 19), the library offers Virtual Browse, a large touch screen that displays the books as if they were organized by subject in a traditional library stack (the books are actually stored in 18,000 bins and organized by height) (Figure 20). Information visualization of this sort can thus recreate the environment for the serendipitous discovery of materials previously only available by browsing the stacks.

**CONCLUSION**

Not only is the importance of visualization clear in terms of the financial investments and infrastructure dedicated to it by the Hunt Library, its importance also comes across in its incorporation into the library’s mission statement: “At the core of the vision for the Hunt Library is the ability of our students, faculty, and partners to immerse themselves in interactive computing, multimedia creation, and large-scale visualization—tools that are enabling revolutionary ways to see and use information” (NCSU Libraries, n.d.). This mission statement clearly signals the vital role visualization will play in the future of libraries, whether in a library’s physical or digital spaces. We are on the cusp of a revolution in how academic libraries facilitate the interaction between patrons and collections, and information visualization is bound to be a major factor in whether or not that revolution succeeds in meeting the information needs of current and future students and scholars.
REFERENCES


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See Young Rieh
2002
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To see publication trends, select a field of study. To see the top authors in that field, use the sliders to select a date range.

To see publication trends, select a field of study. To see the top authors in that field, use the sliders to select a date range.

Top Authors in Arts & Humanities (2003 - 2012)

Ron A. Roschina
Utrecht University

Stephen Weiner
Weizmann Institute of Science

Theodore R. Sider
Rutgers, The State University of New Jersey

Daniel Montrallo Flickinger
University of Texas Arlington

Ivan A. Sag
Stanford University

Carl Pollard
Ohio State University

Ann A. Copestake
University of Cambridge

Terry Harrig
Uppsala University

Tommy Garling
University of Gothenburg

Michael P. Richards
Max Planck Gesellschaft

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Obama: a life in politics.
Allegro Corporation; c2013.
"Follows Barack Obama's remarkable journey to the White House. Starting with his inspiring keynote address at the 2004 Democratic Convention...

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"The biography of America's hottest political superstar- -Barack Obama - -from a journalist who has been covering his career since his...

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Obama: the historic journey / by Jill Abramson, Abramson, Jill, 1954-
Callaway, c2009.
Photographs and text adapted from "New York Times" articles trace Barack Obama's journey from his birth in Hawaii, through his political...
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Kindred Britain is a network of nearly 30,000 individuals — many of them iconic figures in British culture — connected through family relationships of blood, marriage, or affiliation. It is a vision of the nation's history as a giant family affair.
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