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One of the joys of being all digital is that color images no longer break the budget of the *Bulletin*. We can now do justice to topics like visualization and visual search, which are the subjects of this month's special section sponsored by ASIS&T Special Interest Group/Visualization, Images and Sound (SIG/VIS). Guest editor Diane Neal has assembled five articles under the general heading: *Visual Representation, Search and Retrieval: Ways of Seeing*, including contributions on visual search, visualization services in libraries, film analysis and visualization in self-surveillance. They range from reports of current projects in libraries and archives to speculation about the future of image metadata and search technology. Since there are few areas of research in our field that are as important and challenging as working with images and visualizations, we hope you will find something here that is interesting and inspiring.

Another major challenge is the change in cataloging theory, practice and systems that will result if libraries adopt Resource Description and Access (RDA), the proposed replacement for the Anglo-American Cataloging Rules (AACR). Shawne Miksa, who is the current chair of the American Library Association's RDA Implementation Task Force, compares the approach taken by the two codes and suggests topics for further research generated by the adoption discussions.

Turning to the interests of ASIS&T itself, ASIS&T president Donald Case reports on recent Board decisions about the future of ASIS&T publications in his President's Page. Phillip Edwards, one of this year's James Cretsos Leadership Award winners, discusses the responsibility of the Society in developing its future leaders. ■

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Good News, Bad News – Or Not

You know the old joke about the good news, followed by the bad news.

All of the announcements in this column are about ASIS&T publications, and you have probably already heard the good news. Now it is time for the not-as-positive news. However, the reality is that, in the long run, it is likely to be good news as well.

The initial good news – truly excellent, very, very good tidings – was last fall's announcement of the new publishing contract with Wiley-Blackwell. That has brought new funds into the Society, as well as making the *Journal* more available to members.

The more difficult publication issue was addressed in an ASIS&T publications retreat last November. At that time members of the Publications Task Force, selected Board members and our publishing consultant got together with representatives of Wiley-Blackwell to discuss what to do about the *Annual Review of Information Science and Technology* (*ARIST*). We had preceded this with discussions with Information Today, Inc., the current publisher of *ARIST*, which has generously supported a publication with declining sales for a number of years.

I think that most of us present hoped that some way could be found to either keep *ARIST* alive in its present form or at least continue to produce similar chapters in an electronic format. *ARIST* has had a laudable history going back to 1966, and many of us spoke of our emotional attachment to those bound volumes on our shelf. However, after examining the economics of the publication, along with worsening issues surrounding the soliciting and successful submission of the chapters, we all agreed that a different model needed to be found.

Given that one thing that predicts high impact factors among journals is the presence of review articles in those journals, it seemed like the best alternative was to fold shorter versions of *ARIST* reviews into the *Journal of the American Society for Information Science and Technology* (*JASIST*) itself. This not only keeps *ARIST* alive (albeit in a shorter and serial version), it should also help *JASIST* raise its impact factor. The Society's flagship *Journal* faces increasing competition from other publications, and old competitors that are improving.

We realize that the discontinuance, in 2011, of bound *ARIST* volumes will not please some members of the Society. But circumstances have changed a great deal in our field over the 43 years of *ARIST* publication, and maintaining the status quo was simply not wise any longer. *Information Today* will publish the final two volumes over the next 18 months.

Finally, another decision that is somewhat related to the above: *JASIST* will also be discontinuing the Perspectives section. Perspectives, while rigorously edited, were not refereed, and their inclusion in a top-ranked scholarly journal was sometimes criticized. On the positive side, the *Bulletin* is no longer bound by the legal restrictions that limited the size and nature of its articles in the past and frequently carries special sections on similar topics. We hope it will be able to fill some of the gap left by the more formal publication.

The Society would also like to take this opportunity to thank our Perspective's editor, Lois Lunin, for her many years of dedicated service to the Society and its publications. Perspectives issues have been published under her tireless supervision and leadership since 1981, with her final Perspectives to the published this year. The literature of our field is much richer for them. ■

Inside ASIS&T

ASIS&T Reacts to ALA Accreditation Report

In mid-April the ASIS&T Board of Directors sent a letter to the Office of Accreditation of the American Library Association (ALA) expressing organizational concern regarding a recent report of the ALA Library Education Task Force.

The Board is concerned that the report advocates a regressive narrowing of the curriculum of LIS programs at a time "when the need for information professionals is burgeoning in all areas of human enterprise." The letter notes that some 30% of LIS graduates do not pursue library jobs, yet the "emphasis on specific competencies will displace content that addresses on-library-related knowledge and skills." According to the ASIS&T letter, this portion of the report is inconsistent with ALA's longstanding commitment to diversity and liberal thinking.

Other concerns of the ASIS&T Board are that the requirements for faculty educated in LIS and library-centric curricula undermine the diversity and interdisciplinarity of LIS programs; the changes proposed in the report are prescriptive rather than dynamic; and changes proposed do not consider the interests and perspectives of organizations allied with ALA.

To review the entire letter, visit www.asis.org/news/ALA_COA_response.pdf

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Thriving on Diversity: Information Opportunities in a Pluralistic World

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MEETING NEWS

5th Annual European Information Architecture Summit

EuroIA, the European version of the highly popular Information Architecture Summits sponsored by ASIS&T, will visit Copenhagen, Denmark, for its fifth meeting, September 25-26. Exploring the theme *Beyond Structure*, EuroIA will focus on the new level that websites have reached.

Any random page can now be accessed by Google. Pages themselves may consist of information from many sources. And even the concept of a "page" is changing. In other words, we've moved beyond the traditional site map and into a new era of web development.

Organizers suggest several ways that "structure" can be considered:

- Mash-ups, tagging and emergent structures (e.g., wikis) change the way we conceive site design.
- Semantic technologies become more widespread and bring new possibilities for structuring content and showing relationships in information previously not known.
- The way that design teams are structured, as well as business models and businesses themselves, deeply affects the quality and success of the user experiences created.

Visit the EuroIA website at www.euroia.org/ for updates on meeting plans.

EuroIA follows on the heels of the successful 10th anniversary IA Summit held in Memphis, Tennessee, March 18-22, at the Peabody Hotel. And it precedes the 2009 ASIS&T Annual Meeting, to be held this year November 6-11, in Vancouver, British Columbia.

MEETING NEWS

2009 ASIS&T Annual Meeting

The Annual Meeting theme is *Thriving on Diversity – Information Opportunities in a Pluralistic World.* Meeting organizers note that we live in a culture where countries, organizations and individuals have never been so closely linked politically, economically and socially. These linkages are founded on rapid and efficient information transfer and access. Yet we also co-exist in a world that displays its rich cultural diversity and relies upon information sharing to reinforce its plurality. The 2009 Annual Meeting will give participants the opportunity to explore how information research and practice can promote global communication while maintaining diversity.

Keep up with the plans for the 2009 ASIS&T Annual Meeting by checking the website regularly.

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Recent ASIS&T Chapter Activities

The Northern Ohio chapter of ASIS&T (NORASIST) featured **Jared Bendis** discussing *Non-Linear Thinking and New Media Literacy* at a recent evening meeting. Bendis, award-winning artist, photographer, filmmaker and teacher from Cleveland, is currently creative director of new media in the Freedman Center of Case Western Reserve University. He specializes in photograph, virtual reality and computer graphics.

The Los Angeles Chapter of ASIS&T (LACASIST) centered its annual workshop around the topic of *Accessibility: Are you Reaching Everyone?* The program focused on the accessibility and usability of websites and web-based products and services. Given the fine line between accessibility and usability in today's realm of information technology, the two terms are often intertwined. Yet fundamentally, *accessibility* refers to the general availability of products and services; the mere availability of an accessible technology does not ensure its usability. Ultimately, when users with disabilities cannot use a product or service – regardless of its accessibility – it becomes a usability issue that should be addressed. Among the scheduled speakers were **Rhea Joyce Rubin**, librarian; **Gerry Hanley**, executive director of MERLOT; **Patrick Burke**, UCLA Disabilities and Computing Program; and **Susan Cullen**, CSUN Accessible Technology Initiative.

Susanne Humphrey Retires

After 43 years at the National Library of Medicine (NLM), longtime ASIS&T member Susanne Humphrey, information scientist in the Lister Hill Center (LHC), retired on January 2, 2009.

Susanne performed research in the area of knowledge-based systems for indexing and retrieval and lead the Journal Descriptor Indexing (JDI) project. The JDI system automatically indexes documents according to a set of Medical Subject Headings (MeSH) descriptors used for indexing journals according to discipline in the list of journals indexed for MEDLINE. Prior to JDI, she developed MedIndEx (medical indexing expert), a knowledge-based, computer-assisted indexing prototype.

Susanne joined NLM in 1965 as a medical literature analyst in the Division of Library Operations (LO). For 15 years she worked under LO in various phases of NLM's MEDLINE indexing and retrieval system (known as MEDLARS in the beginning), including indexing, searching, database management, user training and thesaurus management, the last 10 years in the MeSH section. She joined LHC in 1981.

Susanne Humphrey receives 1988 Best *JASIST* Paper Award.

She has authored numerous publications on her research as well as a textbook, *Databases: A Primer for Retrieving Information by Computer* and has contributed chapters to several books. She received the 1988 Best *JASIST* Paper award for a paper on MedIndEx.

Among Susanne's ASIS&T activities, she was primary founder of the SIG/CR (Classification Research) Workshop, held as a pre-conference at the ASIS&T Annual Meeting; she was primary editor of the first volume of *Proceedings of the SIG/CR Workshop*, which won the Best SIG Publication Award in 1991, and she was 1990 chair of SIG/CR. ■

The International Calendar of Information Science Conferences (http://icisc.neasist.org/) is a nonprofit collaboration between the Special Interest Group/International Information Issues (SIG/III) and the European (ASIST/EC) and New England (NEASIST) chapters of the American Society for Information Science and Technology, with the additional support of Haworth Press.

Introduction

by Diane Neal, Guest Editor of Special Section

Visual Representation, Search and Retrieval: Ways of Seeing

While most of us still read print media, the widespread existence of visual information in our culture is undeniable. Today's visually oriented society demands further development in the area of visual representation, search and retrieval. Websites such as *Flickr* [1] and *YouTube* [2] contain millions of visual documents, but it is not always easy to find the exact video or photograph you "just know" exists on one of these sites. Increasingly, major websites such as *cnn.com* and *msn.com* provide video and still images to supplement or replace text-based articles, although there is no useful way to search for them. *Google Earth*'s [3] ability to overlay user-supplied geographic information, photographs and other data onto maps is revolutionary, but finding the appropriate files to display what we want to see can be tricky. The newspaper *USA Today* [4] is known for its striking visual representations of quantitative data, but it is difficult to find them again after publication.

The increase in the volume of digital visual information is certain to continue. Digital still and video cameras are the norm, and photograph storage services such as *Flickr* and *Shutterfly* [5] continue to grow at amazingly fast rates. Increasingly, people are watching television shows and films through on-demand websites such as *Netflix* [6], *Joost* [7] and *Hulu* [8]. Worldwide, cultural institutions are undertaking digitization projects to allow people to view their collections online; the *Library of Congress Photos on Flickr* project [9,10] is only one of many. Over 4 million people use *Fitday* [11], a website that allows dieters to track progress toward their weight loss goals visually. The trend toward online visual information is expected to continue: recent research has demonstrated that Millennials, or people born approximately between the years of 1982 and 2001, prefer to learn visually, and 93% of American teenagers use the Internet. Given the wealth of visual information in existence and the assured continuance of this trend, it is essential for information science professionals to develop better ways to organize, store, access and retrieve it. This need fuels the motivation behind this special section about visual representation, search and retrieval, sponsored by ASIS&T's Special Interest Group/ Visualization, Images and Sound (SIG/VIS).

Diane Neal was an assistant professor in the School of Library and Information Sciences at North Carolina Central University at the time she created this special section. She will join the Faculty of Information and Media Studies at the University of Western Ontario on July 1, 2009. She can be contacted at the following email address: diane_neal<at>sbcglobal.net.

Defining the Concerns

When you look at a visual document, such as a photograph, a film or a graphical depiction of quantitative data, what happens? Think about whether any of these apply to you:

- You do not necessarily know how to describe all aspects of it in words.
- You understand the gist of the document rather quickly, but deeper interpretation sometime takes additional time.
- You have emotional reactions to it.
- You notice things about it that others do not notice.

For example, consider Leonardo da Vinci's famous painting the *Mona Lisa* (Figure 1).

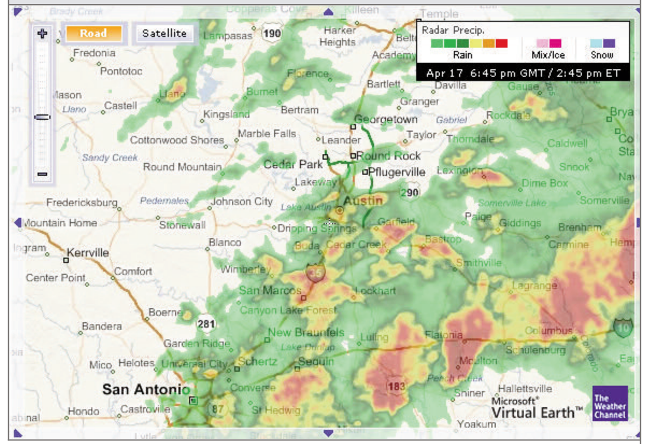
FIGURE 1. Leonardo da Vinci's *Mona Lisa* (http://en.wikipedia.org/wiki/File:Mona_Lisa.jpg)

You can explain in words that the painting features a woman with straight dark hair, dark eyes and dark clothing. But how do you define the look on her face? How is her gaze leading her thoughts? Where is she, exactly? How does she make you feel? Is the background filled with mountains, trees or something else? Would a friend viewing it with you online or standing next to you in a museum answer these questions with the same responses? Deliberations such as these are central to this special section on visual search and retrieval.

There are actually two separate issues within the topic. First, describing and searching for visual materials themselves, such as photographs, films or graphical depictions of quantitative data, is difficult for several reasons. Words cannot be automatically extracted from visual documents to be used as search terms. If we want to search visual materials using words, we must assign the terms manually, which is a time-consuming and subjective process. Additionally, since visual materials are not words, and vice versa, we can be assured that something gets lost in the translation between the intellectual content of a visual document and the words we use to describe it. If words are not always the optimal method in which to search for and retrieve visual documents, then what other methods of representation and retrieval are available to us? Researchers and practitioners in the area of visual information representation and retrieval are actively seeking to answer this difficult question.

The second issue relates to visual displays of quantitative information. According to research on human vision and cognitive processing, humans process visual information, such as pictures, much faster than text-based information. Think about how quickly you can scan a page of thumbnail images on sites such as *Google Images* or *Flickr* to determine whether the one you want to see is displayed; compare that to how long it takes you to look at a list of search results in a text-based search engine. This principle is demonstrated in data displays as well. Visual displays of quantitative information allow us to process deceptively large amounts of data very quickly. Consider how difficult it would be to display – and understand – the data in the following two graphics if they were represented textually in a tabular spreadsheet or other non-graphical format:

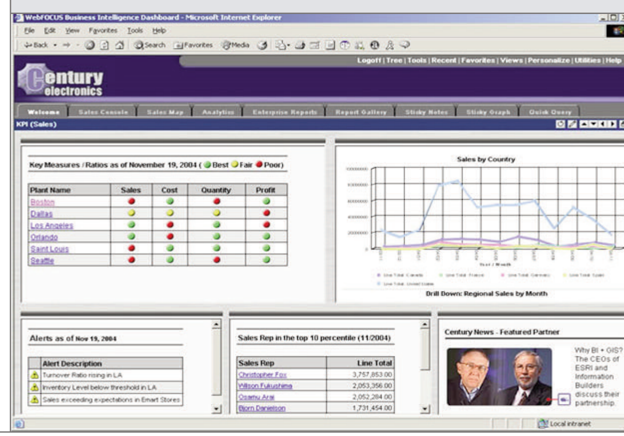
FIGURE 2. Local interactive weather radar map from *Weather.com* for Austin, Texas, for the afternoon of April 17, 2009.



1. A local interactive weather radar map from *Weather.com* [12] for Austin, Texas, from the afternoon of April 17, 2009, is illustrated in Figure 2. Weather visualizations, which are common both online and on television news broadcasts, allow us to quickly determine whether we should pack an umbrella, a jacket or a bottle of sunscreen as we head out for the day. The amount of data in this graphic would be staggering in a text-based, tabular format.

2. A sample business intelligence (BI) dashboard from *InformationBuilders.com* [13] is displayed in Figure 3. BI involves using organizational data to guide business decisions. Visually oriented intelligence dashboards such as this one allow businesspeople to analyze key performance indicators (KPIs), sales statistics and other BI information at a glance.

FIGURE 3. Sample business intelligence dashboard from *InformationBuilders.com* www.informationbuilders.com/products/webfocus/enlarge/enl_portals.html



Representation

Every visual document is a representation or a surrogate of an actual object. A photograph is a surrogate of the particular point in time and place that is captured in the photograph. A painting is a surrogate of a scene, whether it existed physically or in the artist's mind. A data visualization represents a dataset.

Visual documents, which are surrogates by nature, require their own representation in a search and retrieval system. Without effective and appropriate representation, search and retrieval, attempts will likely be unsuccessful. The method of desired representation depends on a variety of factors. For example, are the users experts on the collection or is access geared toward casual browsers? What formats are included in the collection is also important; films, photographs, works of art, data visualizations, gaming environments and so on call for different representation approaches. These classification and description issues are important to consider in any document collection, but the subjective nature and the lack of native metadata in visual documents compound the concerns.

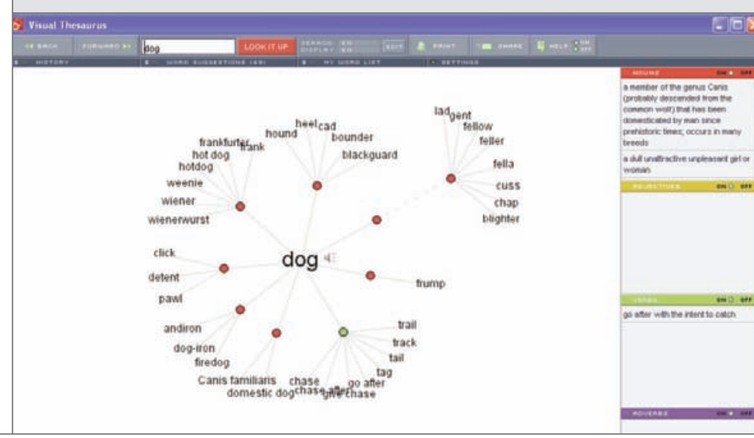
Concept-based image retrieval, or the use of human-assigned words to describe, search for and retrieve images, is the most prevalent method in library practice as well as in library and information science education and research. A variety of methods have been implemented to achieve this approach. For example, controlled vocabularies that list the terms that can be assigned to a document, such as the *Library of Congress Subject Headings* (*LCSH*) [14] and the *Art and Architecture Thesaurus* (*AAT*) [15], are used in many libraries' collections. At the other end of the spectrum, folksonomies present on social websites such as *Flickr* and *YouTube* allow users to contribute their own keywords with no restrictions placed on their choices. As discussed above, while words are useful for describing certain aspects of a visual document, words cannot capture some essences of them, because meaning is lost in the translation. The concept-based image retrieval approach, which focuses on semantics, has not yet been successful in utilizing pictures to describe pictures. This area is definitely in need of research.

Computer scientists develop algorithms that allow images to describe other images, although these products are mostly limited to creating relationships between the physical aspects of an image, such as colors, lines and shapes, and patterns present in the picture. The technique is known as content-based image retrieval. Several approaches exist, but most commonly, users can identify one picture in the search engine after completing a traditional textual search and then indicate that they want to find "more like this," using a technique called *query by example* (QBE). A commercial example is available at *like.com* [16], which allows users to shop for clothing based on similar features (satin black dresses, as opposed to cotton blue pants, for example). QBE is useful in this context, but does not necessarily meet the needs of all users' information-seeking contexts.

Representation present in data visualizations calls for separate consideration. Data visualization techniques, as developed by icons in the field such as Edward Tufte [17] and Ben Shneiderman [18], are certainly a welcome relief to analyzing raw forms of textual tabular data. The applications of these basic techniques are being extended and refined to solve other information problems creatively. For instance, visualization can be used to represent relationships between words and meanings or word-based searches. *VisualThesaurus* [19] helps us find related words through spatial associations, such as the example for the word *dog* in Figure 4.

In the case of visual search engines, the surrogate is a copy of the web page itself. In this example, the user can scroll through snapshots of the actual

FIGURE 4. Spatial associations with *dog* from *VisualThesaurus*.

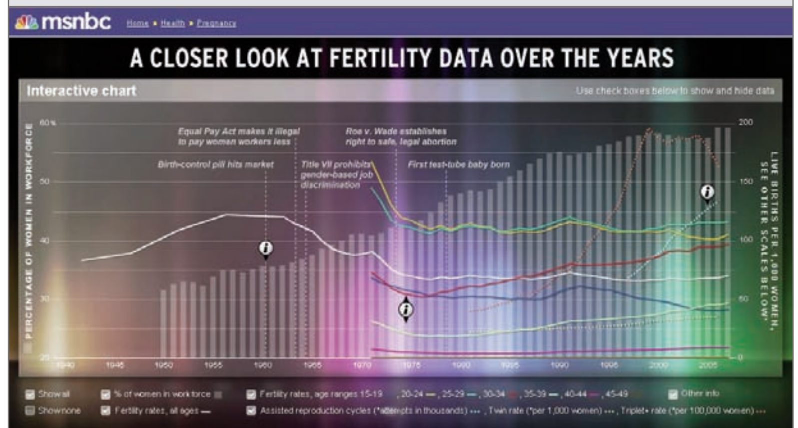


websites, rather than read a list of text-based surrogates for the pages, as in traditional search engines such as Google. Like traditional search engines, a search for the rock band U2 in the visual search engine *searchme.com* [20] displays the most popular or relevant websites first, with *U2.com*, U2's *last.fm* page and U2's *Myspace Music* page as the top results (Figure 5). The links at the top of the *searchme.com* page allow users to limit their searches by formats such as video, images or music or by subtopics such as Christianity, tickets, forums.

FIGURE 5. Results for a search on "U2" on the visual search engine *searchme.com*.

However, future work is needed to ensure that data surrogates within the visualization itself make intuitive sense to the viewer. Standard methods of visualization, such as line graphs, histograms and scatter plots, all contain abstract representations of the data, which may call intuitive conveyance of information into question. Graphics such as "A closer look at fertility data over the years," from *MSNBC.com* [21] (Figure 6), provide examples of how visualizations can sometimes contain too much information. The fact that a solid green line represents fertility rates of women aged 30-34, a dotted green line indicates twin birth rate per 1,000 women and so on, might cause cognitive overload for many viewers.

FIGURE 6. "A closer look at fertility data over the years" from *MSNBC.com* (www.msnbc.msn.com/id/19031210/)



The Glass Engine, which allows users to serendipitously access and listen to music by the composer Philip Glass [22] (Figure 7), presents a different type of visual representation problem. The tiny blue vertical lines each represent a work, and the lines comprise large sliding bars that the user can individually manipulate to select a work. The small white squares outlined in black indicate the amount of *joy*, *sorrow*, *intensity* or *density* present in the currently selected work. Are these representations intuitive to most users?

Issues such as these still present translation issues in some contexts of data visualization and point the way for a new generation of interface design development.

FIGURE 7. The Glass Engine from *PhilipGlass.com* (www.philipglass.com/glassengine/)

The Future

Given the increase in the existence of digital visual information, the indicators pointing toward a continued trend in this direction and the relative newness of the area, additional research and development is greatly needed from all areas of information science. Information behavior researchers and usability professionals might consider gaining a better understanding of how people want to find and process visual information in various contexts. Metadata experts can develop new approaches to describing and organizing visual documents. Information technology professionals who design BI reporting tools and other visual displays of quantitative information could explore new ways of conveying that information. Web designers and search engine programmers can evaluate the few existing visual search engines and consider how they could be further improved.

Visual immersion is an exciting pathway to follow in the future of visual information. Members of the research team Prometheus (of which this author is a member) have found that a therapeutic, immersive video game may decrease the symptoms of Attention Deficit/Hyperactivity Disorder (AD/HD) in children without the use of medication. Researchers Pattie Maes and Pranav Mistry of the MIT Media Lab are developing a "sixth sense" tool that would allow us to interact with our environment and information that enhances it in seamless, unprecedented manners. As we continue to develop our existing methods of visual information – and plunge into the untested waters of immersive visual environments – we must not forget to evaluate the human risks and benefits of every approach and design accordingly.

In This Section

The articles in this special section provide a spectrum of perspectives on the problem of visual search and retrieval. Practitioners, researchers and visionaries allow us to ponder current implementations and future directions and inspire us to consider how we might advance the area in our own professional contexts.

"Information Visualization Services in a Library? – A Public Health Case Study" by Barrie Hayes, Andrés Villaveces and Hong Yi, all of the University of North Carolina at Chapel Hill (UNC-CH), presents a real-life solution to an information visualization need and demonstrates true collaboration in action. Dr. Villaveces, a researcher at UNC-CH's Gillings School of Global Public Health, wanted to visually see the relationship between injury occurrence and interventions. He worked with Dr. Yi, a programmer with the Renaissance Computing Institute (RENCI), a collaborative North Carolina-based organization that promotes the fusion of technology, research and visualization tools, to create the necessary software. UNC-CH's Health Sciences Library partnered with RENCI to acquire a large display wall for visualization applications, which is housed in the library.

Courtney Michael, Mayo Todorovic and Chris Beer describe the "Visualizing Television Archives" project in the Media Library and Archives at WGBH, Boston's Public Broadcasting Service television station. In their efforts to make their vast multimedia archive available online via innovative visual access techniques to both the general public and academic researchers, they found very different user needs. The general audience enjoys browsing using thumbnails of the archived materials and utilizing a targeted search tool. The researchers desire deep access to the detailed metadata linked to each document. The article describes the development undertaken to give researchers the access they desire to the cataloging data as well as visualization tools, such as a results bar, facets, a mosaic and a relationship map. Their effort demonstrates a rare application of user needs analysis to innovative technology implementation.

In "Surveillance: Personal Edition," Jodi Schneider and Nathan Yau show us how we can track personal information in useful ways using visualization tools, either online or on our desktops. For example, we can enter data about our exercise and diet habits, our moods or how much we drive our cars and view the trends in our behavioral patterns via graphs, charts and newer forms of visualization. It is also possible to view group-based trends in this manner, since many companies store and track our personal data for us. While this method of personal surveillance definitely has its advantages, we must be careful with what and how we disclose our personal information online in order to maintain our self-defined security and privacy boundaries.

Richard Anderson and Brian O'Connor present original research addressing the representation issues inherent in describing film in

"Reconstructing Bellour: Automating the Semiotic Analysis of Film." In an effort to recreate Raymond Bellour's frame-based structural analysis of Alfred Hitchcock's film *The Birds* using digital technology, the authors analyze the color values in frames extracted from the Bodega Bay sequence of the film and the semiotic or semantic meaning of the frames. They conclude that a "separate, complementary" relationship exists between the physical structure and the semantic meaning. This research leads us toward the necessary but unrealized combining of content-based retrieval with concept-based retrieval to describe, search for and retrieve visual documents using other visual documents as surrogates and descriptions.

Ray Uzwyshyn provides a look toward the future of image searching as well as visual search engine design in "An Arbitrage Opportunity for Image Search and Retrieval." In the Google Image Labeler, user-assigned semantic descriptions for images are collected and implemented via a game-oriented format using human processing theories. He also discusses efforts to move the image search paradigm past the "photographic contact sheet" of thumbnails retrieved via a targeted text-based search, such as Cooliris, a search engine that displays results in a 3D "film reel" format. He believes that humans and machines can leverage or "arbitrage" from each other's strengths to produce a synergy that will move the field forward.

Acknowledgements

Former SIG/VIS chair Diane Neal would like to thank SIG/VIS chair Chris Landbeck for his support of this publication. ■

Resources Mentioned in the Article

[1] *Flickr.com*: http://www.flickr.com

[2] *YouTube*: www.youtube.com

[3] *Google Earth*: http://earth.google.com

[4] *USA Today*: www.usatoday.com

[5] *Shutterfly*: www.shutterfly.com

[6] *Netflix*: www.netflix.com

[7] *Joost*: www.joost.com

[8] *Hulu*: www.hulu.com

[9] *Library of Congress' photo stream*: www.flickr.com/photos/library_of_congress/

[10] Springer, M., Dulabahn, B., Michel, P., Natanson, B., Reser, D., Woodward, D. & Zinkham, H. (2008, October 30). *For the common good: The Library of Congress Flickr Pilot Project*. Washington, DC: Library of Congress. Retrieved April 22, 2009, from www.loc.gov/rr/print/flickr_pilot.html

[11] *Fitday*: www.fitday.com

[12] *Weather.com*: www.weather.com

[13] *Information Builders*: www.informationbuilders.com

[14] Library of Congress. Cataloging Policy and Support. (2007). *Library of Congress Subject Headings*. (30th ed.). Washington, DC: Library of Congress Catalog Distribution Service.

[15] Getty Research Institute. (2009). *Art and Architecture Thesaurus Online*. Los Angeles, CA: The J. Paul Getty Trust. Retrieved April 22, 2009, from www.getty.edu/research/conducting_research/vocabularies/aat/.

[16] *Like.com*: www.like.com

[17] Tufte, E. R. (1983). *The visual display of quantitative information*. Cheshire, CT: Graphics Press.

[18] Card, S.K., J.D. Mackinlay, & B. Shneiderman. (1999). *Readings in information visualization: Using vision to think*. San Francisco: Morgan Kaufmann.

[19] *VisualThesaurus*: www.visualthesaurus.com

[20] *SearchMe*: www.searchme.com

[21] *MSNBC.com*: www.msnbc.com

[22] *Glass Engine*: www.philipglass.com/

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Resources for Further Reading

Arnheim, R. (1969). *Visual thinking*. Berkeley, CA: University of California Press.

Card, S.K., Mackinlay, J.D., & Shneiderman, B. (1999). *Readings in information visualization: Using vision to think*. San Francisco: Morgan Kaufmann.

Chu, H. (2001). Research in image indexing and retrieval as reflected in the literature. *Journal of the American Society for Information Science and Technology, 52*(12), 1011-1018.

Findlay, J. M., & Gilchrist, I. D. (2003). *Active vision: The psychology of looking and seeing*. New York: Oxford University Press.

Glass Engine. www.philipglass.com

Greisdorf, H., & O'Connor, B. (2002). Modeling what users see when they look at images: A cognitive viewpoint. *Journal of Documentation, 58*(1), 6-29.

Howson, C. (2007). *Successful business intelligence: Secrets to making BI a killer app*. New York: McGraw-Hill.

Intraub, H. (1980). Presentation rate and the representation of briefly glimpsed pictures in memory. *Journal of Experimental Psychology: Human Learning and Memory, 6*(1), 1-12.

Jörgensen, C. (2003). *Image retrieval: Theory and research.* Lanham, MD: Scarecrow Press.

Kherfi, M. L., Ziou, D., & Bernardi, A. (2004). *Image retrieval from the World Wide Web: Issues, techniques, and systems*. ACM Computing Surveys, 36(1), 35-67.

Mackworth, N. H., & Morandi, A. J. (1967). The gaze selects informative details within pictures. *Perception & Psychophysics, 2*(11), 547-552.

Marr, D.C. (1982). *Vision: A computational investigation into the human representation and processing of visual information*. San Francisco: Freeman.

Maes, P., & Mistry, P. (2009). Unveiling the "Sixth Sense," game-changing wearable tech. Retreived April 22, 2009, from www.ted.com/index.php/talks/pattie_maes_demos_the_sixth_sense.html

Neal, D. (2007, October/November). Introduction: Folksonomies and image tagging: Seeing the future? *Bulletin of the American Society for Information Science and Technology, 34*(1), 7-11. Retrieved April 22, 2009, from www.asis.org/Bulletin/Oct-07/Neal_OctNov07.pdf

Neal, D. (2008). News photographers, librarians, tags, and controlled vocabularies: Balancing the forces. *Journal of Library Metadata, 8*(3), 199-219.

New ADHD therapy. (2008, April 6). Australian Broadcasting Company. Retrieved April 22, 2009, from www.abc.net.au/7.30/content/2007/s2265178.htm

O'Connor, B. C., & Wyatt, R. B. (2004). *Photo provocations*. Lanham, MD: The Scarecrow Press.

Pew Internet & American Life Project. www.pewinternet.org

Rorvig, M. E., & Wilcox, M. E. (1997, September). Visual access tools for special collections. *Information Technology and Libraries, 16*(3), 99-107.

Rorvig, M. E., Turner, C. H., & Moncada, J. (1999). The NASA Image Collection Visual Thesaurus. *Journal of the American Society for Information Science, 50*(9), 794-798.

Springer, M., Dulabahn, B., Michel, P., Natanson, B., Reser, D., Woodward, D. & Zinkham, H. (2008, October 30). *For the common good: The Library of Congress Flickr Pilot Project*. Retrieved April 22, 2009, from www.loc.gov/rr/print/flickr_pilot.html

Tufte, E. R. (1983). *The visual display of quantitative information*. Cheshire, CT: Graphics Press.

University of Sydney. Prometheus Research Team. (2007-2008). *Lifespan psychology, mental health & technology*. Retrieved April 22, 2009, from www.prometheus.net.au

Tversky, A. (1977). Features of similarity. *Psychological Review, 84*(4), 327-352.

Yarbus, A. L. (1967). *Eye movements and vision* (L. A. Riggs, Trans.). New York: Plenum Press.

Information Visualization Services in a Library? A Public Health Case Study

by Barrie Hayes, Hong Yi and Andrés Villaveces

The role of information visualization in enhancing communication, understanding and discovery of ideas is well documented [1]. While information visualization capabilities have existed in some form for centuries [2], providing these capabilities in an academic library is new. At their best, visualization applications are powerful explanation, decision-making and discovery tools for researchers. The library is a logical hub of information expertise for researchers to be able to access and utilize these resources. In 2004 the Health Sciences Library (HSL) at the University of North Carolina at Chapel Hill (UNC) [3] partnered with the Renaissance Computing Institute (RENCI) [4] to build and provide visualization infrastructure and expertise as one of the keystone services of its new Collaboration Center.

The center opened in July 2005, the first of a network of (now) seven RENCI "engagement sites" across North Carolina. At HSL and the other engagement sites, researchers can consult and collaborate with visualization experts to develop custom applications to render data in ways that communicate information, answer questions, support analysis, reveal patterns and facilitate new questions or discoveries. Surrounded by the five UNC health professional schools and UNC hospitals and with biology, biochemistry and computer science buildings in close proximity, the HSL offers a collaborative, neutral visualization venue central to UNC's extensive biomedical campus.

The center's visualization resources include a display wall (Figure 1) with a 10 ft. x 8 ft. rear-projection display screen capable of 12.5 million pixel resolution (4,096 x 3,072 pixel native resolution). The RENCI-HSL wall is compatible with both Linux and Windows applications, thereby broadening its accessibility to common researcher platform preferences. The ability of researchers to interact with very high-resolution imagery inches from the screen on the display wall provides opportunities for new collaborative applications.

Researchers' data visualization needs vary in their complexity. In some cases, researchers may wish to utilize existing open source or proprietary visualization tools installed on the display wall server to view and analyze their data on the large-scale, high-resolution screen in order to enhance visibility and detail. Often, however,

FIGURE 1. RENCI-HSL display wall in the UNC Health Sciences Library Collaboration Center

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researchers have specialized data and visualization needs that require collaboration with Collaboration Center staff, particularly the HSL-based RENCI visualization researcher, to develop a custom application to render their data. The center's recent project with Andrés Villaveces of the UNC Department of Epidemiology and the Injury Prevention Research Center exemplifies this latter, optimal utilization of HSL-RENCI visualization resources.

A Data-Visualization Need

The visualization application development project with Dr. Villaveces arose from his need to show longitudinal injury-prevention data in alternative ways. Specifically, he wanted to be able to see a more dynamic view of the changes in injury occurrence over time given a specific intervention or a set of interventions.

The original idea of visualizing his injury data in a different way occurred to Dr. Villaveces when he learned about software created in Sweden by Hans Rosling, a professor of global health at the Karolinska Institutet. This software, originally known as the "World Health Chart," used an interactive view to demonstrate changes in selected health variables over time, by country and by World Health Organization regions of the world. For example, one could plot infant mortality rates with several socioeconomic indicators, such as gross domestic product (GDP), and see how each of these variables changed dynamically in a graph as time (in years) advanced. One could compare changes in a health variable like infant mortality over time within a single country, among countries within a region of the world or in selected countries. The World Health Chart software incorporated a pre-loaded set of variables for users to view. A later version allowed users to import limited information. Subsequent developments of this software led to the creation of the Trendalyzer® software owned by *Gapminder.org* [5]. This package was free software when Google purchased it in March 2007.A simple version, included as a Google gadget [6], currently exists and is called the "Google Motion Chart®."

As a researcher interested in injury prevention and working for the World Health Organization in 2002, Dr. Villaveces found that the Trendalyzer software would be useful for looking at trends in injuries over time and by country, even though the original Trendalyzer data set contained no injury data. Unfortunately, successful gathering of this injury information was slow and the opportunities to upload the available injury data into Trendalyzer's existing structure were difficult to arrange with *Gapminder.org*. In addition, for the purposes of his research, Dr. Villaveces was interested in more flexibility than this application provided at the time. For example, earlier Trendalyzer versions displayed data by country only and could not display data within countries or by other categories of comparison. Time units were also limited to years.

Dr. Villaveces approached the HSL Collaboration Center and RENCI about his data visualization interests in March 2008. In April, he began working with Hong Yi, the RENCI visualization researcher at the center, on a project to create software that emulated the superb visual characteristics of Trendalyzer while providing the greater flexibility in variable selection that his specific research data required. Specifically, Dr. Villaveces needed to be able to select any of his injury-related data variables for plotting and visual display over various units of time and to compare these data not only across countries or territories of the world as provided by Gapminder's Trendalyzer software, but also across institutions, days of the week or a number of other meaningful categorical units. The DataVIZ3Dapplication was born out of this data visualization need and the resulting collaboration.

Development of the DataVIZ3DVisualization Tool

Given Dr. Villaveces data visualization needs and his experience with early versions of Trendalyzer, he and Dr. Yi determined in their initial meeting that extension of this software would be a good starting point for this collaborative project. The Trendalyzer software was originally open source, but after its acquisition by Google in 2007, the source code was no longer available even though the software is freely available via *Gapminder.org* to use and view various statistical world health charts and economic indicator trends. Google also published the API (application programming interface) of this visualization software for web developers to incorporate this visualization-software gadget into their own web applications.

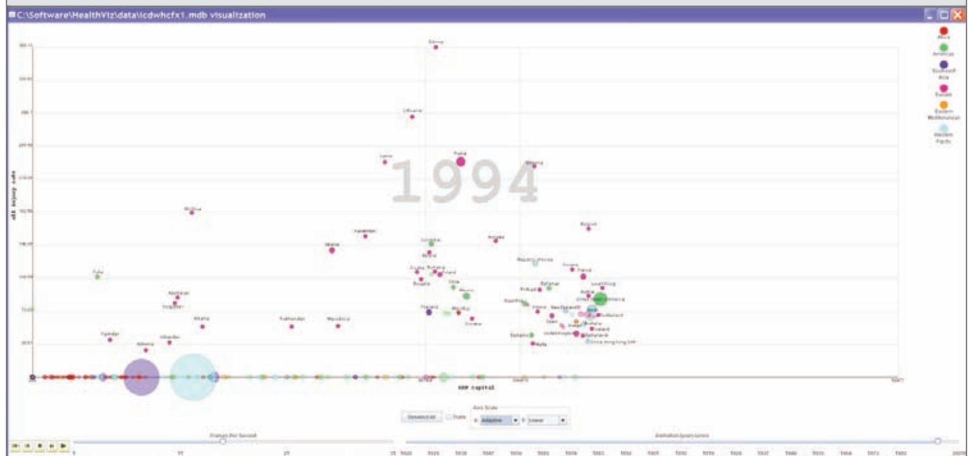
Fortunately, Dr. Villaveces had downloaded an old 2003 version of Trendalyzer software prior to its acquisition by Google. However, this old version written in Flash Action Script only included partial source code. While this older version could serve as a visual model for tool development, the limited source code was far from sufficient to extend its functionality. Consequently, Dr. Yi developed a data visualization tool from scratch that not only included the visualization functionality of Trendalyzer, but also provided much greater flexibility and freedom for the users to customize any visualization variables according to their specific needs. From the outset, a fundamental design principle for this data visualization tool was to make the tool as generally applicable as possible to any statistical data without limitation to any particular type of data.

Development of the DataVIZ3D visualization tool has progressed iteratively. After obtaining initial injury datasets from Dr. Villaveces, Dr. Yi designed and developed an initial prototype. This prototype strictly adhered to the design principle of general data applicability described above. Based on the initial datasets to be visualized and the general visualization needs outlined by Dr. Villaveces, the initial prototype referenced Trendalyzer's time-varied dynamic bubble visualization format (Figure 2) while providing the user much greater flexibility to customize how variables were presented. For example, in the dynamic bubble visualization display of data, users can customize which data variables are represented by any of the visual presentation motifs including bubble names, bubble colors, bubble grouping variable, correlation variables and animation axis variable (not being restricted to a time variable). In addition, every color used in the visualizations can be customized and modified by users to accommodate their aesthetic preferences.

In addition to the original Trendalyzer bubble visualization format, DataVIZ3D also includes a new more static time series curve and line-based visualization format. Rather than using a dynamically moving image or bubble to compare variables over time, this format allows the user to compare variables in different categories over time by manually moving the cursor back and forth through the time series. This time series format can depict risk estimates and confidence intervals and simultaneously incorporate measures such as interventions or additional variables of interest so that viewers can see changes in risk estimates linked to a group of interventions. A typical use could be to dynamically evaluate the progress of an epidemic over time, given a set of interventions (Figure 3).

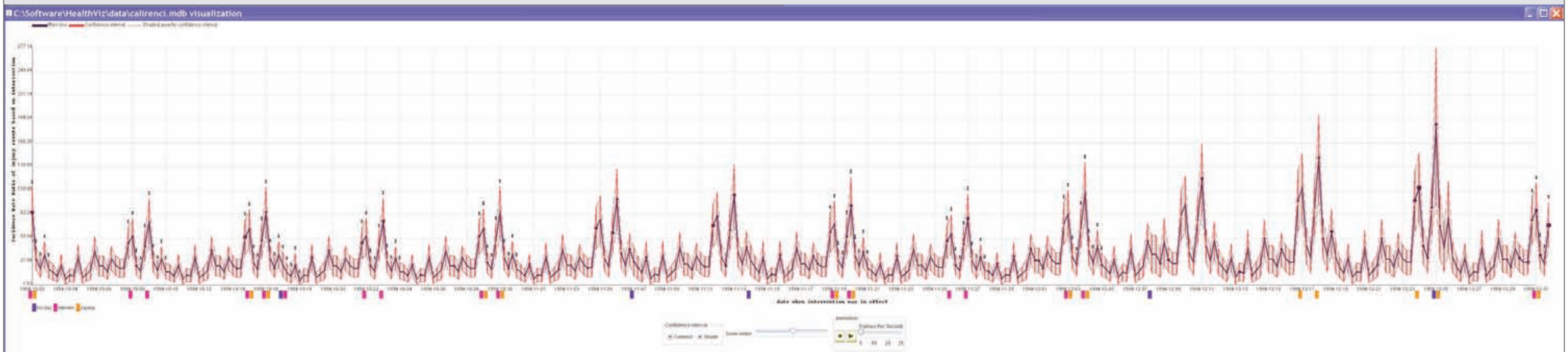
With these two data display options in place, the initial prototype was demonstrated for Dr. Villaveces on the HSL Collaboration Center display wall. Dr. Villaveces was very pleased and excited to see his data visualized for the first time, and he provided a great deal of constructive feedback to further improve the visualization tool's ability to effectively present his data. Dr. Yi incorporated all of Dr. Villaveces' feedback into the next version of the DataVIZ3D tool prototype and demonstrated the improvements in a subsequent review meeting.

FIGURE 2. Dynamic bubble visualization of data: "All Injury Rates with GDP per Capita for Countries in Different WHO Regions." Presents how these variables change over time (years).



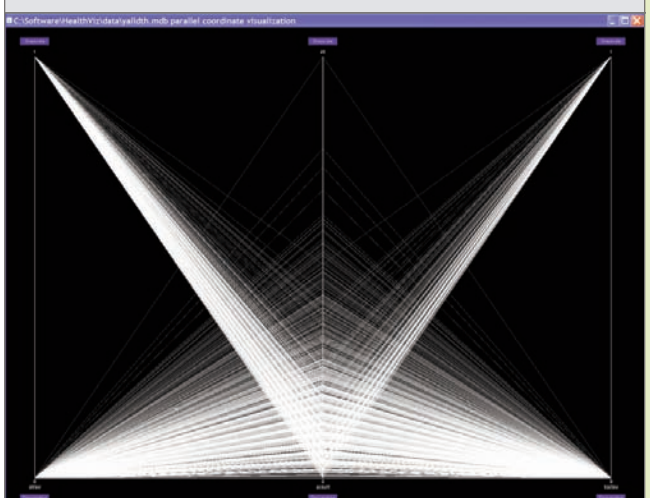
How this visualization represents data: Each bubble represents a country. Bubble size indicates population size. Bubble color indicates WHO (World Health Organization) region that country belongs to. Current year is indicated in the background. Vertical axis is injury mortality rate per 100,000 population; horizontal axis is GDP per capita. Visualization can be "played" forward or backward in time (by years) and bubbles/countries will change position on the graph indicating changes in injury rate (y position) and GDP per capita (x position) and will change in size as their populations change over time. Visualization can select single or groups of countries and trace their trajectories over time.

FIGURE 3. Longitudinal time series visualization of data: "Incidence rate of fatal firearm injury events per 100,000 person-years for the general population at different points in a 24 hour period and at various intervention points"



How this visualization represents data: Time intervals on the horizontal axis; incidence rate on the vertical. Visualization includes display of data confidence intervals and intervention times, and covers a period of approximately 90 days in this view. Pink boxes represent interventions; blue, holidays; and orange, paydays.

FIGURE 4. Two-dimensional parallel coordinate visualization of data: "Statistical impact of implementing administrative license revocation law"

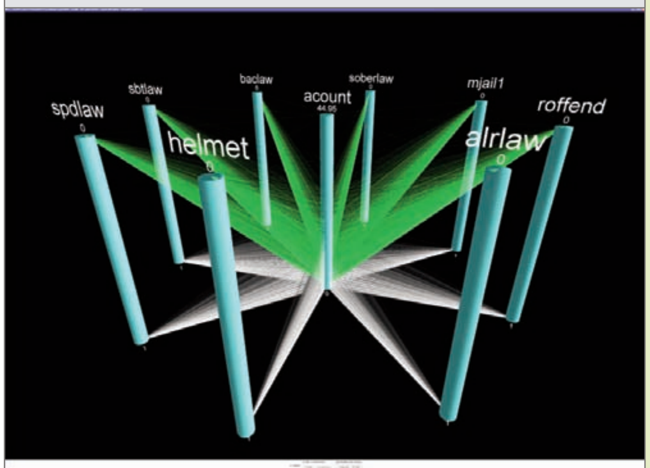


How this visualization represents data: The left and right axes show whether a state in the United States has implemented an administrative license revocation law (alrlaw = 0 or 1 on the left axis) or a blood alcohol concentration law (baclaw = 0 or 1 on the right axis). The central axis (acount) shows the count of alcohol-related fatal motor vehicle injuries, which is generally lower when states have implemented both laws and generally higher in years these states do not have these laws in place.

This iterative development process continued for several rounds until Dr. Villaveces determined that the DataVIZ3D tool prototype satisfied his requirements. During latter stages of this iterative process, a visualization technique called "parallel coordinates" in both its standard two-dimensional (2D) form and the extended three-dimensional (3D) form was also incorporated into the DataVIZ3D tool to allow users to look at general overall statistical correlations between multiple variables. Parallel coordinates, in its standard 2D form, is a technique used for analyzing multivariate data by mapping each data variable to parallel axes so that each multivariate data item is displayed as a series of connected line segments intersecting all axes. This simpler visualization format allows viewers to compare correlations of rates that have changed over time. A typical application would be to see in a general way how rates change before and after a specific intervention or policy is implemented in an institution, city, state, country or any other meaningful category of comparison (Figure 4).

The parallel coordinates technique can also be extended to 3D to allow simultaneous one-to-one relation analysis between the data variable mapped to a central cylindrical axis and each of other data variables mapped to peripheral cylindrical axes arranged along a circumference at equal distances from the central axis. For example, the 3D parallel coordinates visualization technique in the DataVIZ3D tool allows Dr. Villaveces to simultaneously look at the statistical impact of the implementation of each of 8 different laws on alcohol-related fatalities (Figure 5).

FIGURE 5. Three-dimensional parallel coordinate visualization of data: "Simultaneous view of the statistical impact of implementing each of eight specific alcohol-related laws (peripheral axes) on injury events (central axis) in the United States"



How this visualization represents data: The visualization shows that all eight law implementations reduce alcohol-related fatalities. In this graphic the "0 = no law" case is at the top of column and the "1= law-implemented" case is at the bottom. The white lines therefore represent the count of alcohol-related fatal motor vehicle injuries with a particular law in place and the green, without it.

From initial design and prototype construction through sequential demonstration-feedback-improvement cycles, our iterative and collaborative process has been a successful approach for this DataVIZ3D tool development project. We have found that researchers usually can better explicate their specific requirements and needs after seeing their data visualized and animated in an initial prototype. In addition, discussions during a prototype demonstration are much more effective and typically generate more specific feedback and subsequently more fruitful outcomes than solely abstract idea-based discussions. Another key success of this DataVIZ3D tool development process has been to establish the design principle of generalizability prior to development to provide the necessary foundation for the later tool development and extension. This fundamental design principle enables the DataVIZ3D tool to be extended to work with diverse data sets with different visualization needs and gives users flexibility to fully customize all visualization variables to fit their specific requirements and preferences.

Next Steps

Initial next steps for the DataVIZ3D software include expanding the same iterative process used for development beyond the development team through presentations of the tool to large audiences of researchers and other potential users. Our goal is to gather more feedback about useful and desirable improvements to the software's functionality and visual display quality, as well as about potential data applications for the tool. One example of additional functionality that we expect may significantly strengthen the tool is the inclusion of statistical analysis capabilities alongside DataVIZ3D's didactic data presentation functions. We will explore the desirability and usefulness of building such capabilities into the tool through demonstration-based discussions with Dr. Villaveces' public health colleagues and other researchers. Another extension to the tool's functionality we would like to discuss with potential DataVIZ3D users is expanding the tool's compatibility with other data formats besides Microsoft Access, such as Excel or delimited text (Table 1). These sorts of functional and compatibility enhancements, as well as aesthetic improvements to the data presentation and visual display, provide an endless source of development possibilities.

TABLE 1. DataVIZ3D Current Technical Specifications

Programming language	Java
Input formats	Currently Microsoft Access database (mdb), but can be extended to a variety of other formats such as Excel and other database formats.
Platform	Platform-independent and should run on Windows, Mac and Linux. However, since Microsoft Access database format can only be accessed on Windows, this input format constraint restricts the tool from running on other platforms. This restriction can be overcome by supporting other data input formats that work on multiple platforms.

To realize many of these enhancement possibilities with the DataVIZ3D tool, we will pursue grant funding to support extended post-prototype development activities. In the near future, we plan to submit grant proposals for internal funding opportunities provided through both the Injury Prevention Research Center and the Gillings School of Public Health where Dr. Villaveces is a faculty member. Beyond internal funding opportunities, we will also investigate external funding opportunities with federal agencies such as the Centers for Disease Control and the National Institutes of Health.

Ultimately, the DataVIZ3D software was developed to aid researchers and users in their understanding and use of data via visually creative formats that can facilitate better understanding of public health and other information at a local, regional, national or global level. Like the Gapminder Trendalyzer tool it draws and improves upon, the DataVIZ3D software is intended to be entirely free and open source. With some additional enhancements, we expect to make it available for use and improvement by others. The DataVIZ3D software has the potential to become a highly useful pedagogical tool. Our hope is that it will fulfill that potential by facilitating enhanced understanding of research data and other scientific findings through effective visualization. Finally, it is also our hope that the tool successfully demonstrates the power of visualization tools to aid in information communication and discovery and engages UNC researchers to take advantage of visualization services and resources at the HSL and elsewhere on campus. ■

Resources Mentioned in the Article

[1] Card, S., Mackinlay, J., & Shneiderman, B.(1999). Information visualization. In S. Card, J. Mackinlay & B. Shneiderman, *Readings in information visualization: Using vision to think* (pp. 1-10). San Francisco: Morgan Kaufmann.

[2] Tufte, E. R (1983). *The visual display of quantitative information*. Cheshire, CN: Graphics Press.

[3] Health Sciences Library Collaboration Center at University of North Carolina at Chapel Hill: www.hsl.unc.edu/collaboration

[4] Renaissance Computing Institute: www.renci.org

[5 Gapminder: www.gapminder.org

[6] Google Motion Chart: http://code.google.com/apis/viualization/documentation/gallery/motionchart.html

Resources for Further Reading

Gershon, N., Eick, S.G., Card, S. (1998, March/April). Information visualization. *Interactions, 5*(2), 9-15. DOI: http://doi.acm.org/10.1145/274430.274432

Moore, M.E., Vaughan, K.T., Hayes, B.E., & McLendon, W. (2005). Developing an interdisciplinary collaboration center in an academic health sciences library. *Medical Reference Services Quarterly, 24*(4), 99-107. DOI: 10.1300/J115v24n04_08

Johansson, J., Ljung, P., & Cooper, M. (2007). Depth cues and density in temporal parallel coordinates. *Eurographics/IEEE-VGTC Symposium on Visualization.* Retrieved April 13, 2009, from http://staffwww.itn.liu.se/~jimjo/papers/eurovis2007/paper.pdf

Johansson, J., Cooper, M., & Jern, M. (2005). 3-Dimensional display for clustered multi-relational parallel coordinates. *Proceedings of the Ninth International Conference on Information Visualization*, 188-193.

Visualizing Television Archives

by Courtney Michael, Mayo Todorovic and Chris Beer

This article will outline efforts by the WGBH Media Library and Archives (MLA) and the WGBH Interactive team to create online access points into our multimedia archive using innovative visualization techniques that create visual alternatives to traditional search, browse and faceted navigation and that highlight WGBH's rich media collections. The main objective in this effort is to allow scholarly researchers to access the collections, search and pinpoint useful records and discover related items they may want to explore. It has been an interesting challenge to strike a careful balance between allowing for targeted search and passive browse while also providing for serendipitous discovery opportunities. The depth of metadata essential for our expert audience led to our use of linked data in our cataloging processes, which enabled further experimentation with visualization.

Background

WGBH, Boston's PBS station, produces over one-third of nationally broadcast PBS television programming. The WGBH archives, therefore, hold hundreds of thousands of hours of moving image content, as well as thousands of linear feet of related documentation and still images. Not only do researchers find finished documentary films from our flagship productions (Frontline, NOVA and American Experience), but also all of the production elements that went into the making of these films.

This scale of acquisition makes for an extremely robust and yet complex set of collections. Like other media archives, the barriers to access for researchers in the WGBH collections include intellectual property constraints, unreadable or fragile media carrier formats and unfamiliar access tools. While the WGBH MLA has experimented with offering traditional finding aids, media collections are not well served by this hierarchical, text-based and largely linear format. Internally, the MLA operates through item and shot-level databases, but these tools are not useful to external researchers without a steep learning curve and significant investment of time. Therefore the MLA has experimented with repository-based sites that bring together the searchability of an electronic finding aid and the multi-dimensional orientation necessary to understand our collections.

In 2006 the WGBH MLA launched *Open Vault* [1], a searchable and browsable site that highlights four television series in our archives. This site includes video clips and transcripts from the elements that went into the making of the series and is aimed primarily at educators and the general public. As the central presence of the archives online, it has also greatly increased the WGBH archives' visibility to scholarly researchers.

The MLA has found, however, that the scholarly research audience has very different needs from those of the general public and educators. At the most basic level they seem to want it all, rather than to be hand-held or guided through a collection. They want to see an entire collection in order to ensure that their research is thorough and want to view full-length archival videos, not just pre-selected or curated clips. In short, they want to do the data mining and curation work for themselves.

In 2008, with funding from the Andrew W. Mellon Foundation, the MLA and WGBH Interactive developed a small-scale prototype [2] to discover how academic researchers would like to find and use our materials. A password-protected site was shared with selected scholars in order to

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FIGURE 1. Results bar and facets

The mosaic. As can be seen on the homepage of our current *OpenVault* site, we sought to communicate visually the diversity of materials within our unique collection. As shown in Figure 2, our mosaic design uses the thumbnail images representing individual videos within the collection. On rollover the user can discover additional metadata about each record and can click on the image to go directly to the record. Initial reactions to this design were very positive as it is colorful and playful and does the job of communicating the idea that the WGBH archives has a wealth of interesting materials.

solicit their feedback, and further user tests continue. The lessons the WGBH team is learning through this experiment in communicating large amounts of data to humanities scholars could well inform others facing similar challenges.

Visualizing our Data

The first visual technique we employ to communicate the depth of the data is a subtle one. In an attempt to orient researchers to the collections and to the diversity of our materials, we expose the faceted navigation system provided by the Solr search index. This view allows users to see not only the results of their search but also the underlying information about their aggregate result. They can then select different facet attributes to narrow their results set. While facets are not generally perceived as data visualization, they orient the user through visual cues to enhance understanding of the content.

Results bar. To the faceted navigation we have also added a visual results bar (Figure 1) that acts as a breadcrumb trail through the evolving found set. As the user applies additional facets, our results bar compares the relative size of the resulting set to the user's original search results and allows the user to remove previously applied attributes in non-linear order. In this way the user is acclimated to the scale of our collections and encouraged to interact with and learn about them even as they mine them.

Faceted classification works well for the WGBH collection because the materials are multi-leveled and multi-faceted. It allows users to narrow and expand their found sets within increasingly familiar frameworks. What the faceted navigation lacks, however, is a multi-dimensional view that illustrates the relationships between materials and provides a visual representation of the media archive.

FIGURE 2. Mosaic

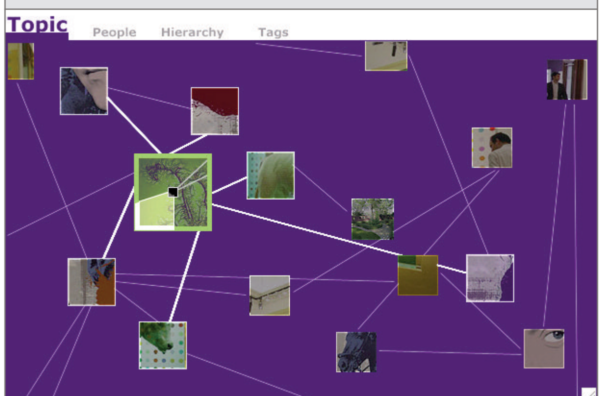
Academic researchers, however, seem to want something more structured and useful to their work. While they appreciate the aesthetics of the mosaic, they want additional information up front. When shown a different mosaic categorized by people, place and television series they reacted positively because it communicated more information. We took it one step further, however, when they shared with us their goal of quickly making time management decisions regarding archival research.

The relationship map. Scholars want to quickly find out what we have, how they can access it and if a particular record is worth their time to follow through. For example, a researcher searching for information on President Kennedy's actions during the Cuban Missile Crisis may be excited to come across an hour-long interview with Robert McNamara, but they might soon be frustrated or even angered when they spend an hour listening to the recording only to discover he never mentioned the event.

Responding to this need, we developed a visual graph we call a "relationship map" illustrating the depth of content in each asset and the explicit and implicit relationships among assets. While we are still working to implement aspects of the map and to collect the necessary metadata, the prototype's functionality of relating items and displaying these relationships has proven exciting to our users and is many steps closer to communicating the multi-dimensional aspect of our materials than the mosaic.

Figure 3 depicts the design concept for the map. The highlighted thumbnail image indicates the central record or the record the user is interested in. The user can see the connections from segments of the content within the pertinent record to other records, represented by the other thumbnails.

FIGURE 3. Relationship map

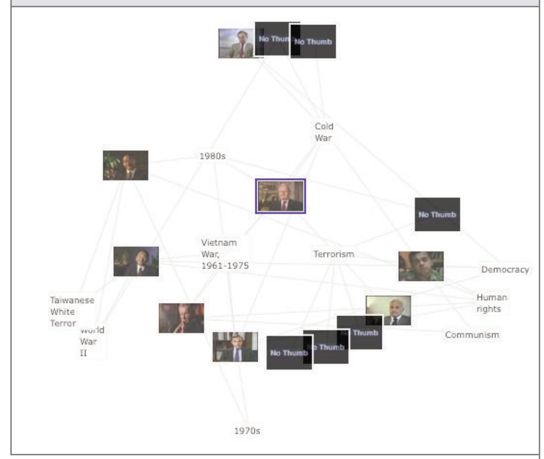


Our objective here was to visually dissect the video record, for example, into the different topics (or people or places) it covers. The segments of a pie chart (as represented in the highlighted thumbnail) represent the percentage of the video that address a specific topic. In this way, a researcher can understand visually the breakdown of topics within a record and make informed decisions about how much time to invest in an individual record. This functionality, not yet fully implemented, will be enabled by an additional cataloging process where we segment or chapterize video transcripts and assign topics and timecode to the chapters. We can then calculate the extent of the total video length from the associated timecode to construct the pie chart.

From the design concept, we have built a dynamic radial graph using the JavaScript Information Visualization Toolkit. The radial graph illustrates the relationships among and between records through the lenses of people, topic and hierarchy or collection context (Figure 4).

In this example, the central record is an interview with former National Security Advisor Robert McFarlane. Users can see that he discusses terrorism, Vietnam, the Cold War and the 1980s in general. They can go one step further and see what other records in the collection touch on these same topics. They can click on each thumbnail or topic to re-center the map and explore the relationships, and they can also zoom in and out to discover records located farther afield.

FIGURE 4. Radial graph



The intensive cataloging that enables a map like this one presents challenges as well. Records are cataloged to varying degrees, which may skew their relevancy and therefore their proximity values on the map. For example, a record for which we have little data may not appear on the map at all, giving the researcher a false picture of the collection. On the other hand, a record that has been fully cataloged may connect to dozens of other records, making for a crowded and hard to use map display. We are currently experimenting with automatically pruning certain ill-defined relationships in order to avoid overcrowding and overlapping data.

While we originally were excited about the relationship map serving as both a browse tool and a homepage feature, we have found that it tends to intimidate users when we reveal it up front on the homepage. The last thing we want to do is turn users away from the collection because they don't understand the homepage. As Jared Spool recently explained at the IA Summit 2009 [3], we need to minimize the "tool time" – or the time it takes a user to figure out functionality and get their bearings – and maximize "goal time" – in our case the time allotted for finding value in the content. We may still incorporate the map into the homepage in a less intimidating way, but we recognize it should not be the first feature users encounter.

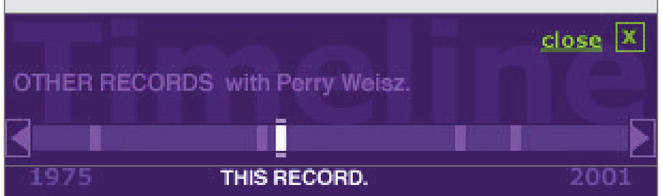
Another challenge we have pinpointed regarding the relationship map is a lack of contextual information. The user often gets lost within the map. We need to better communicate the relationships (the significance of the connecting lines) and the relevancy (or proximity) of one record to another. In some ways these challenges stem from too much data, in other ways they might be solvable with continued experimentation and refinement.

The lesson here is that, for our scholarly audience, the attractive yet random mosaic was "pretty" but not substantive enough. Yet the working relationship map, while it has the possibility of being very interesting, is not intuitive as currently implemented. We need to spend more time striking a balance between utility and usability for this feature.

All of these visualizations are made possible by the depth of cataloging we have for our prototype record set. We have cataloged to the item level and sometimes have gone farther to tag people, places, dates and topics within the content of a record. In the Robert McFarlane example above, a PBCore record describes the interview media asset, while a TEI-encoded transcript provides the links into the video content itself [4].

Other visualization possibilities we can explore with this depth of data include tag clouds, maps and timelines. We are looking into placing records in context along a timeline of life or collection dates that would look something like what is illustrated by Figure 5.

FIGURE 5. Timeline



This tool would serve two functions: it would allow users to see related records and would also show them the date range of similar records. In the example above, the user has found an interview with Perry Weisz. From this timeline the user can see that the archives contain four other records related to Perry Weisz, spanning from 1975 to 2001.

Conclusion

One of the first discoveries we made working with humanities scholars was the intense level of contextual information they require about a particular archival resource. We translated this need into a high level of cataloging at the item and even sub-item or shot-log level.

While they want this density of information made available to them, the scholars also want to be able to quickly pinpoint the exact content that will enhance their work. This paradox of "give me all your information" versus "give me only what I need" led us to experiment with alternative methods of communicating our metadata.

Sophisticated data-visualization techniques ideally allow us to save our users hours of time reading through pages of text. We have found that senior scholars, accustomed to spending those dedicated hours mining an archive, are intrigued and yet skeptical of some visualization techniques. As we continue to improve our website and refine our visualization tools, we anticipate that the next generation of digital natives, said to be more visually oriented and more extractive in their research behaviors, will embrace these tools as part of their research, analysis and scholarly production workflows.

Acknowledgements

This work was funded in part by the Andrew W. Mellon Foundation and the Institute for Museum and Library Services. The authors also wish to thank Karen Cariani and Peter Pinch, co-principal investigators, and our advisors, Drs. John Dower, Peter Winn, James Blight and Janet Lang. ■

RESOURCES on next page

Notes and Resources for Further Exploration

[1] The WGBH Media Library and Archives' OpenVault website: http://openvault.wgbh.org OpenVault for Researchers (closed prototype): http://openvaultresearch.wgbh.org

[2] The prototype is built on a Fedora repository architecture (www.fedora-commons.org/) and uses Solr, an open source search server (http://lucene.apache.org/solr/). The relationship map uses techniques from the JavaScript Information Visualization Toolkit (http://blog.thejit.org/javascript-information-visualization-toolkit-jit/).

[3] Jared Spool presented these ideas during his talk on "Revealing Design Treasures from the Amazon" on Saturday, March 21, 2009. Find an overview of his talk at http://iasummit.org/2009/program/presentations/revealing-design-treasures-from-the-amazon/ or read about Goal and Tool time at www.uie.com/brainsparks/2006/04/20/dividing-user-time-between-goal-and-tool/

[4] PBCore is an XML schema originally designed for the exchange of public broadcasting materials. Learn more about PBCore at www.pbcore.org/ and www.pbcoreresources.org/. TEI or the Text Encoding Initiative is also an XML standard used for encoding texts. We are primarily using elements from the "Transcriptions of Speech" guidelines. Learn more about TEI at www.tei-c.org/

The *Visual Thesaurus* uses relationship mapping to illustrate language connections: www.visualthesaurus.com/

The Many Eyes project allows users to play and experiment with data sets and multiple ways of visualizing them: http://manyeyes.alphaworks.ibm.com/manyeyes/. Also explore Martin Wattenberg's personal site highlighting his other data visualization projects: http://bewitched.com/song.html

Jonathan Harris' *Ten by Ten* illustrates news stories organized by date from three sources through image mosaics: www.tenbyten.org/

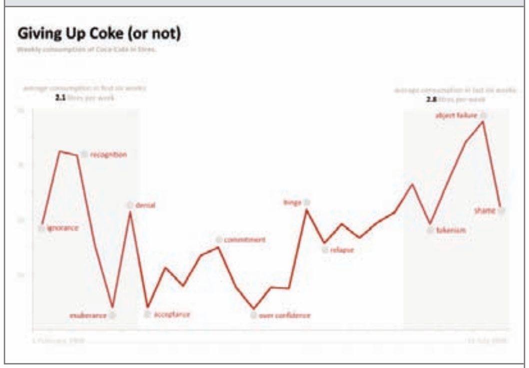
Self-Surveillance

by Nathan Yau and Jodi Schneider

Visual Representation, Search and Retrieval: Ways of Seeing

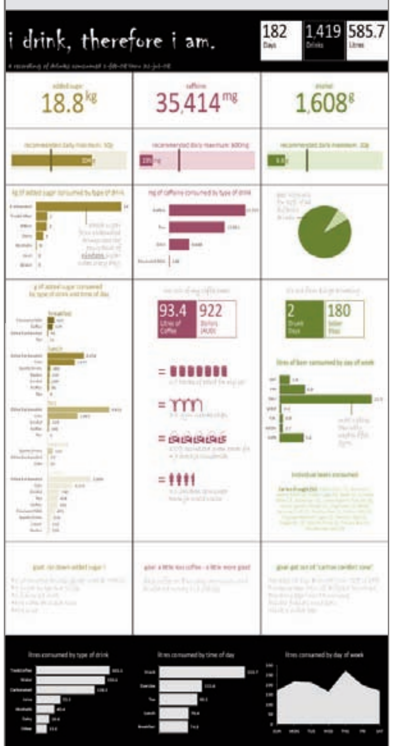
Have you ever kept a calendar, tracked what you eat or saved receipts? Simple data, like how much soda you drink, can tell a story:

FIGURE 1. "Giving Up Coke (or not)" by Tim Graham



In fact, what you drink can tell *several* stories. Here's a more elaborate example, also by the same person:

FIGURE 2. "I drink therefore I am" by Tim Graham



This kind of activity is what we call self-surveillance.

What is Self-Surveillance?

What exactly do we mean by self-surveillance? It is essentially collecting data about your personal behaviors and surroundings to gain a better understanding of how you live and what goes on around you. People already upload digital pictures to *Flickr* [1], post what they are doing on *Twitter* [2] and share personal information on social networks like *Facebook* [3]. What if, in addition to these more social types of data, you were to post what you eat and drink, your blood sugar or what time you go to sleep every night? It is easy to see how such short entries about your daily habits can show behaviors over time and perhaps even a way to change the way you live for the better. We make small choices every day about what to eat, how to get to work, whom we talk to and whether to work hard or not or turn off the light when we leave a room. These tiny choices turn into habits that add up to become behaviors. Self-surveillance is a way to shine a light on these otherwise obscure and seemingly mundane aspects of our lives.

Self-Surveillance on the Web

While pen and paper work well for self-surveillance, many online applications have emerged over the past couple of years that allow individuals to collect data about themselves. Diabetics can use *SugarStats* [4] to track, monitor and share their blood sugar levels; parents can use *Trixie Tracker* [5] to collect data about their child's eating, sleeping and diaper changes; and gamers can use *Wakoopa* [6] to discover new games based on those already played. A quick survey of the available tools reveals the wide breadth of areas that self-surveillance covers as well as potential applications. Visualization is at the heart of many of these applications. It is best to keep in mind that many who log data about themselves are not data professionals. Visualization, if done right, lets users understand their data properly.

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Jodi Schneider is web librarian/assistant professor at Appalachian State University and an editor for the *Code4Lib Journal*. She follows emerging trends in visualization and the web. She can be reached at jschneider<at>pobox.com

Physical health. Self-surveillance naturally lends itself to tracking physical health and biometrics. If we think of our bodies as fine-tuned machines, then it is perhaps best we pay close attention to how we take care of them with a healthy lifestyle. Numerous studies have shown that the food we eat and the amount of time we exercise plays a major role in how we feel, and preliminary research suggests that self-monitoring increases awareness, which leads to better decisions.

In addition to the previously mentioned *SugarStats*, there are plenty of other applications to help people track metrics other than blood sugar levels. *Traineo* [7], *FitDay* [8] and *FatSecret* [9] let people keep track of their exercise routines as well as share and converse with others who are working towards common health and fitness goals. Users can track calorie consumption, weight-lifting repetitions and sets, and cardiovascular exercise time and/or distance. Weight can also be logged, as it is often the response variable that many personal trackers are most interested in. As might be expected, users can then monitor their progress via time series plots and compare their performance against others in the online community.

One common theme among *Sugar Stats*, *Traineo*, *FatSecret* and *FitDay* is that they all are manual. When someone wants to log her data, she has to go to a computer, visit the website and enter some numbers. This means that there is a gap between the action and recording. That is to say, a person will do something, write it down on a piece of paper or try to remember it and then record it on a website. But there are applications that let users log exercise data automatically. *MotionBased* [10], for example, is a product from Garmin that lets users log data with a mobile global positioning system (GPS) device that automatically uploads the data to a central server for further analysis. Nokia has a similar piece of software, *Sports Tracker* [11], which runs in the background as you go for your morning jog. Carry the phone with you as you run from point A to point B, and when you are done, view where you ran, how far and for how long from your phone or a PC. The immediate benefit is a performance report, but it should not be hard to see how *MotionBased* and *Sports Tracker* can be used to view improvement over time.

FIGURE 3. *MotionBased* (http://motionbased.com). Example from http://trail.motionbased.com/trail/invitation/accept.mb?view=dashboard&key=MTYwMg=

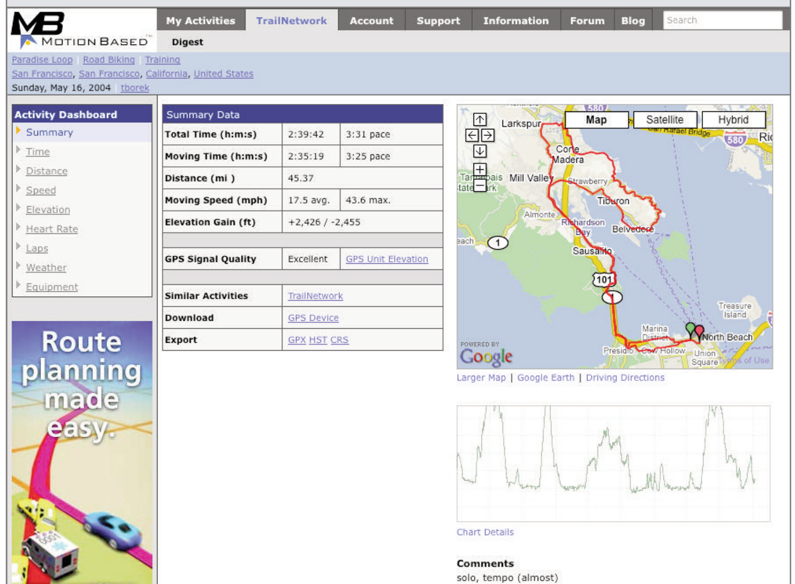
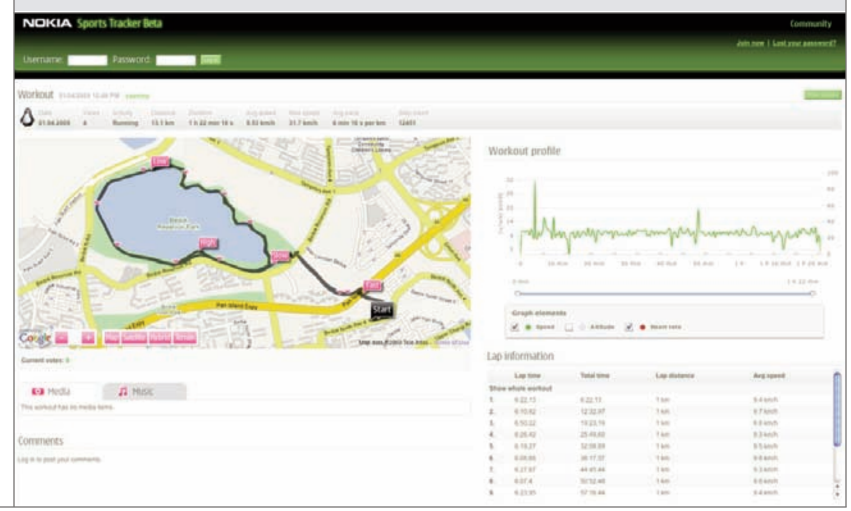


FIGURE 4. *Sports Tracker* (http://research.nokia.com/research/projects/sportstracker/). Example from http://sportstracker.nokia.com/nts/workoutdetail/index.do?id=810126

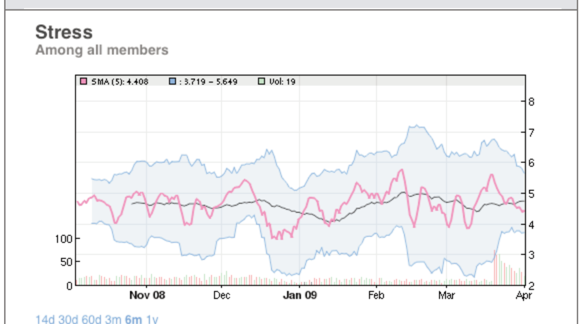


Mental health. Our choices often reflect how we feel and vice versa, so it is only natural that there are personal trackers to monitor mental health, or more specifically, our emotions. Developers are challenged with the quantification of something that is innately non-numeric. What numeric value do we put on *happy*, *sad* or something in between? A few applications, while not perfect, have attempted to measure and visualize the complexity of human emotion. *Moodstats* [12] and *Lifemetric* [13] use a collection of sliders and gauges to let users put numeric values on their emotions.

Moodstats looks and works a lot like a sound equalizer. Move the switches up and down for mood, stress levels and creativity along with some non-emotional metrics like number of emails sent, exercise and achievements. Users can also enter diary entries, which is really a form of annotation. As the user looks at past emotions, the diary can be used to make inferences about what causes certain levels of mood. *Lifemetric* is similar but also applies a social aspect to self-surveillance. Users move a scroll bar all the way left if they are sad and to the far right if they are happy and then anything in between. On any given day, users not only see how they feel, but also how the rest of the *Lifemetric* community feels.

FIGURE 5. *Moodstats* (www.moodstats.com/) (from desktop client)

FIGURE 6. *Lifemetric* (http://lifemetric.com/). Example from http://lifemetric.com/metrics/3?period=6m

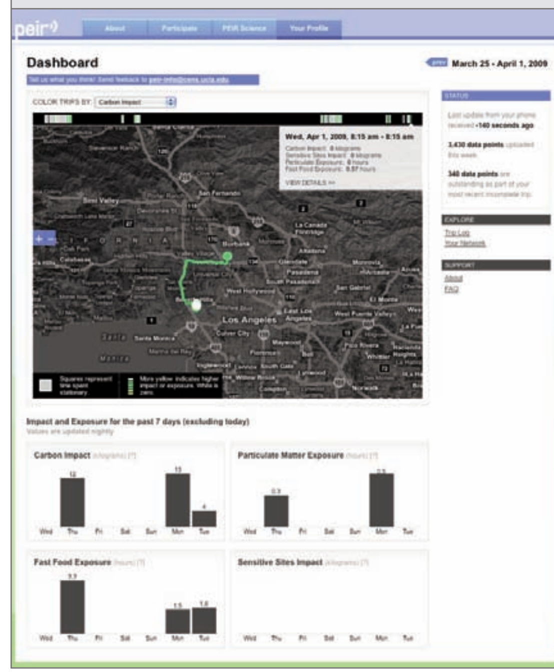


Interaction with environment. Self-surveillance does not always have to be aimed inward. Sometimes it can be aimed outwards to the relationships we have with our surroundings. *The Personal Environmental Impact Report* (*PEIR*) [14] is one example. We have a give-and-take relationship with our environment that we are not always aware of. What quantity of natural resources do we consume, how much energy do we use and what effects do we have on the environment? The answers come back to the tiny choices we make every day. Do we turn the lights off when we leave a room? Do we combine driving trips to reduce travel time? These questions can go unanswered even though they can collectively have a huge impact on the environment.

PEIR allows users, based on their travel patterns, to see how they personally affect the environment in terms of carbon impact and particulate matter exposure. Users collect GPS data with their mobile phones, and *PEIR* processes the data using established micro-environment models to show users how they affect the environment and how the environment affects them.

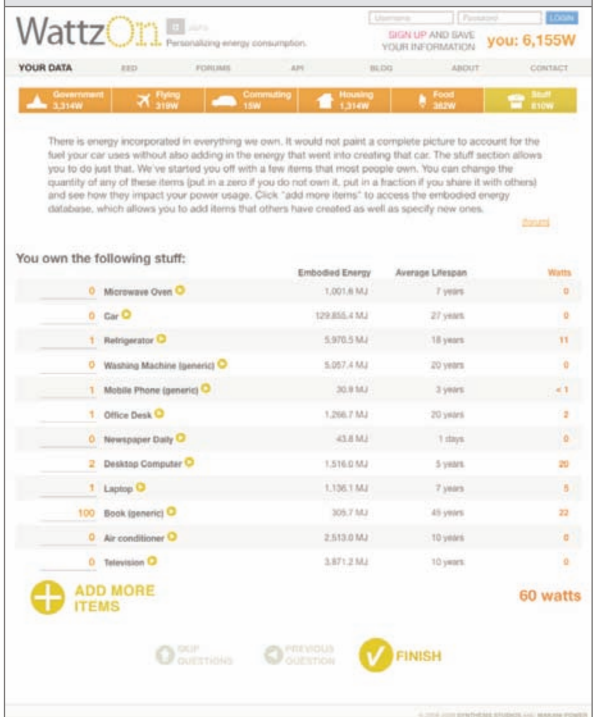
To a similar end *WattzOn* [15] uses a detailed questionnaire to estimate energy consumption. Users answer questions like how many times they fly per year on average and what kind of car they drive. Results can then be compared against others and national averages for context.

FIGURE 7. *PEIR* (http://peir.cens.ucla.edu/). Example from https://peir.cens.ucla.edu/protected/private/ (login with demo/demo)



Generalized self-surveillance. Perhaps the main point so far is that if you want to track something about your life, there is probably an application that will help you do it. *Me-trics* [16], *Daytum* [17] and *Your.flowingdata* [18] are three generalized trackers that let you log data for whatever you want. Start a dataset and add to it incrementally via your PC or short messaging service (SMS) device. Some data streams are automatically logged, like number of bookmarks to the social bookmarking site *delicious.com*, while other datasets can be manual like those of the previously mentioned applications. These generalized self-surveillance tools bring several data streams into a single location, which makes it much easier to infer patterns and outliers.

FIGURE 8. *WattzOn* (www.wattzon.com/)



The reader should notice that all the mentioned applications use visualization to present users their data. Visualization helps users, who are not necessarily data professionals, interpret their data and hopefully make educated decisions based on what they see. As a result, visualization designers have a responsibility to communicate personal data clearly in the same way that journalists have to report the news accurately. Visualizing self-surveillance data is a lot like telling a very personal story to the story's main character.

It's Getting Easier

The popularity of self-surveillance is growing. As data collection and visualization advance and users become more comfortable with data, personal data collection could become common practice.

Easy data collection. Data collection technology has improved a great deal over the past couple of years – especially in the mobile arena – and our digital footprints have spread across many different streams. Our credit card bills and bank statements can be accessed online; web browsing and Google searches are stored in data logs; and grocery stores keep track of products we purchase. All these data are passive in that users do not have to actively collect it. On the flip side, there are a number of tools that let users play an active role. *Carchip* [19] lets users collect driving patterns by plugging a device into a car's On Board Diagnostics II (OBD-II) port; *SleepTracker* [20] monitors waking moments with a watch; and *Fitbit* [21] measures your physical activity through the course of the day. While these tools are specifically

FIGURE 9. *Daytum* (http://daytum.com/). Example from http://daytum.com/emoore

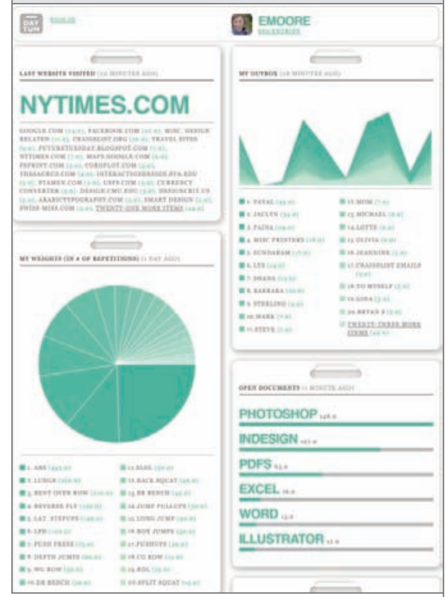
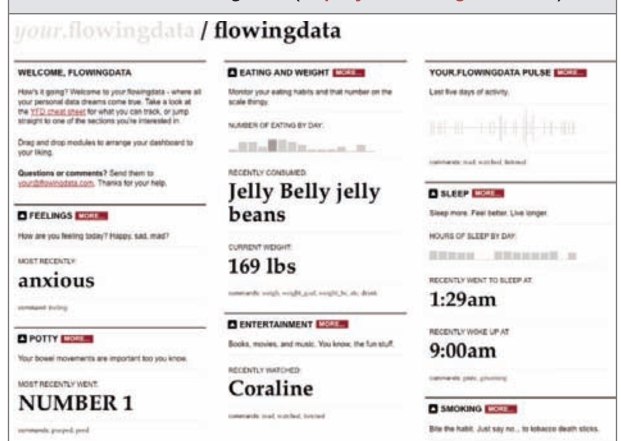


FIGURE 10. *Your.flowingdata* (http://your.flowingdata.com/)



designed for data collection and analysis, we can also add mobile phones to the list. Millions of people own mobile phones with cameras, GPS and SMS capabilities. It is easy to see how we can repurpose devices as personal sensors.

Advances in visualization. As data collection has advanced and different streams of different data types have developed, so have the visualizations. Visualization has moved from static bar graphs and dot plots to interactive and animated visualizations. These changes, of course, have not always been for the better, but when done right, these new formats allow users to explore their data and see patterns without any formal training in analysis. Tools like *Processing* [22] and *Flash* [23] have grown more robust so that developers have more options available to them, and as a result, those who have data, have more opportunity to visualize and make inferences. Online applications like *Many Eyes* [24], from the IBM Visual Communication Lab, make visualization accessible to non-professionals.

We also see a trend in collaborations between art and science to make visualization both scientifically accurate and emotionally engaging. Works from groups like Stamen Design [25] and designers like Jonathan Harris [26] are quickly bridging the gap between design and statistics. Such works encourage users to dig deeper and attract those who once looked at data with a skeptical eye. Works like the streamgraphs [27] [28] from Jeff Clark and Lee Byron and bestiario's social networks [29] let users explore their digital selves and have been well received with hundreds of thousands of views.

FIGURE 11. *Many eyes* (http://manyeyes.alphaworks.ibm.com/manyeyes/)

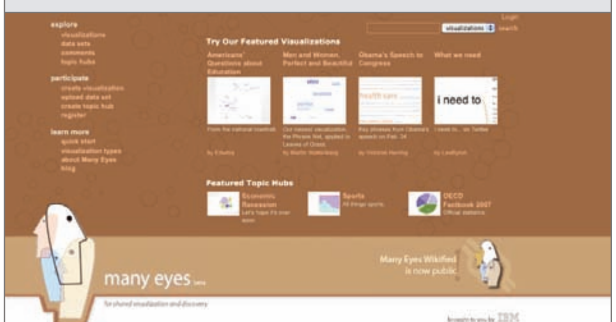


FIGURE 12. Lee Byron's last.fmstreamgraph [30]

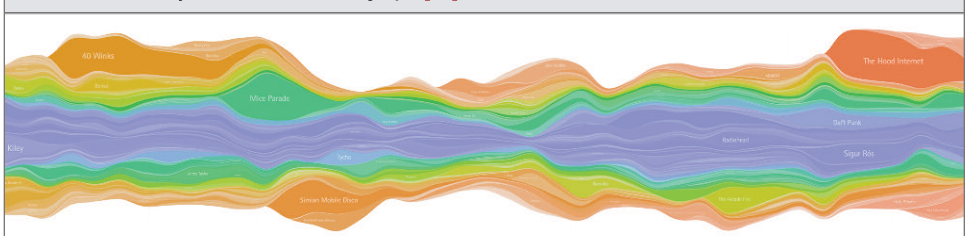
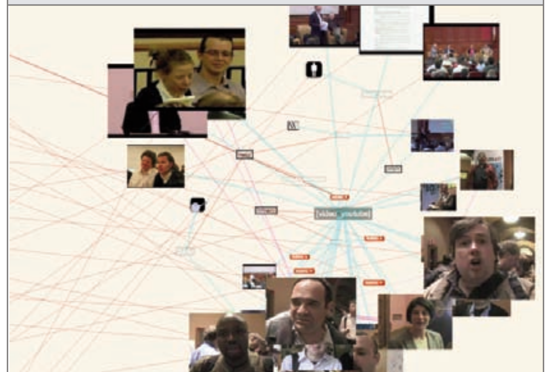


FIGURE 13. Bestiario's social networks (www.bestiario.org/)



Data comfort-level. Data visualization can advance all it wants to, but not much is gained if users are not comfortable with the interface. However, we can see many examples of good design on the web. Stamen Design constantly preaches data visualization as interface and has seen much success in collaborations with sites like *Digg* [31] and *Twitter*. Most notable perhaps is *The New York Times*' willingness to try new visualization techniques. In September 2008 the *Times* graphics department produced a tree map to show market loss by major companies [32]. In August 2008 they published a weighted network graph that showed Olympic medal counts by country and year [33]. In May 2008 American spending was visualized with a Voronoi Tree Diagram [34].

FIGURE 14. Tree map showing A Year of Heavy Losses (www.nytimes.com/interactive/2008/09/15/business/20080916-treemap-graphic.html)

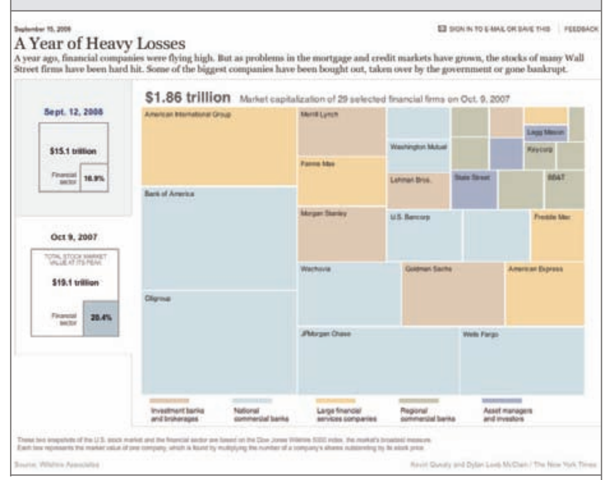


FIGURE 15. Voronoi tree diagram illustrating A Map of Olympic Medals (www.nytimes.com/interactive/2008/08/04/sports/olympics/20080804_MEDALCOUNT_MAP.html)

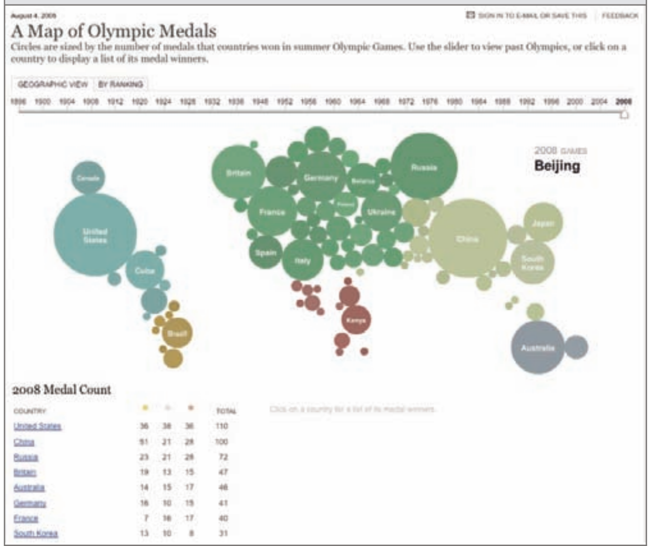
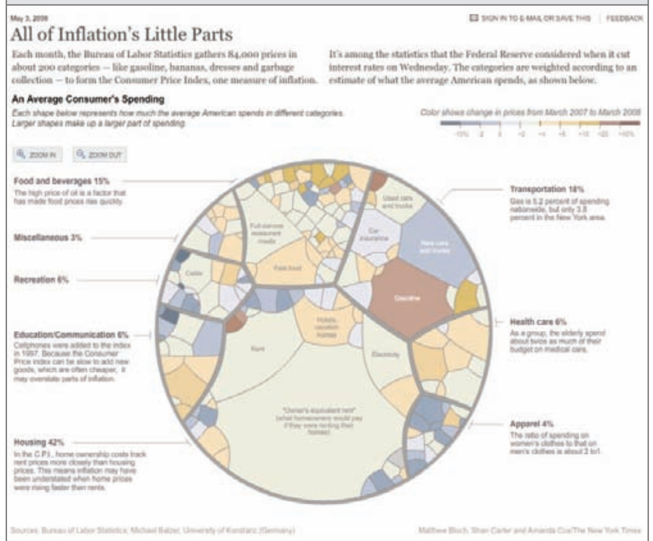


FIGURE 16. Weighted network depicting All of Inflation's Little Parts (www.nytimes.com/interactive/2008/05/03/business/20080403_SPENDING_GRAPHIC.html)



portability is extremely relevant to anyone using Web 2.0 applications.

Second, information professionals can help form ideas of how self-surveillance can be used. Librarians, web developers and information designers are among those collecting and sharing their own data; this experimentation can be shared with others. We have related uses of self-surveillance in changing habits, monitoring mood, improving health and tracking our interactions with the environmental. As visualization of personal data becomes more commonplace, generalized tracking and visualization tools can be used in a variety of other ways. How? That's up to us. New ideas will come not only from our own experimentation but also from observing how data is used in other fields.

Our third role is as intermediaries. Information professionals can help cross-pollinate ideas among various communities collecting, using and visualizing data. Core concepts from library and information science, such as controlled vocabularies and taxonomies, may be relevant when summarizing data. We can share techniques from fields like statistics, e-science and cyber-infrastructure, informatics, geographic information systems and design.

Visualization techniques once reserved for research conferences are finding themselves in national publications, and readers are saying good things about them. More importantly, though, people are exploring datasets and talking about their findings; this shows huge promise for personalized visualization. Preliminary studies show that users are more engaged when they relate to the data, and you cannot get much more personal than self-surveillance.

A Role for Information Professionals?

Information professionals can have several roles in the development of self-surveillance: advocacy, idea-generation and cross-pollination. First of all, we can advocate privacy. As individuals collect more information about themselves, often online, they rely on the safeguards and ethics of intermediaries. Information professionals can raise awareness about privacy lapses. We can also advocate for explicit data protections. For example, data

Ideas to Try

Want to learn more? Try out self-surveillance for yourself. It could be as simple as writing down how much soda you drink each day this week. If you'd like to try software, but don't want to put data online, Moodstats is a good place to start: Mac and Windows users can download desktop software, create a profile and graph up to six variables. Decline synching, and check out graphs of your data after inputting numbers for three previous days. ■

RESOURCES on next page

Resources Mentioned in the Article

[1] *Flickr*: www.flickr.com

[2] *Twitter*: http://twitter.com

[3] *Facebook*: www.facebook.com

[4] *SugarStats*: www.sugarstats.com/

[5] *Trixie Tracker*: http://trixietracker.com/

[6] *Wakoopa*: http://wakoopa.com/

[7] *Traineo*: www.traineo.com/

[8] *FitDay*: http://fitday.com/

[9] *FatSecret*: www.fatsecret.com/

[10] *MotionBased*: http://motionbased.com/

[11] *Sports Tracker*: http://research.nokia.com/research/projects/sportstracker/ and http://sportstracker.nokia.com/

[12] *Moodstats*: www.moodstats.com/

[13] *Lifemetric*: http://lifemetric.com/

[14] *PEIR*: http://peir.cens.ucla.edu/

[15] *WattzOn*: www.wattzon.com/

[16] *Me-trics*: http://me-trics.com/

[17] *Daytum*: http://daytum.com/

[18] *Your.flowingdata*: http://your.flowingdata.com/

[19] *CarChip*: www.davisnet.com/drive/products/carchip.asp

[20] *Sleeptracker*: www.sleeptracker.com/

[21] *Fitbit*: http://fitbit.com/

[22] *Processing*: www.processing.org/

[23] *Flash*: www.adobe.com/products/flash/

[24] *Many Eyes*: http://services.alphaworks.ibm.com/manyeyes/home

[25] *Stamen Design*: http://stamen.com/

[26] *Jonathan Harris*: www.number27.org/

[27] Clark, J. (2009) *TwitterStream*. Retrieved April 12, 2009, from www.neoformix.com/Projects/TwitterStreamGraphs/view.php

[28] Byron, L. (2008). *Last.fmstreamgraphs*. Retrieved April 12, 2009, from www.leebyron.com/what/lastfm/

[29] *Bestiario*: www.bestiario.org/

[30] Byron, L, & Wattenberg, M. {2008). Stacked graphs – Geometry and aesthetics. *IEEE Transactions on Visualization and Computer Graphics, 14* (6), 1245-1252. Also retrieved April 12, 2009, from www.research.ibm.com/visual/papers/leebyron_stackedgraphs_byron_wattenberg.pdf

[31] *Digg*: www.digg.com

[32] A year of heavy losses. (2008, September 15). *New York Times*. Retrieved April 12, 2009, from www.nytimes.com/interactive/2008/09/15/business/20080916-treemap-graphic.html

[33] A map of Olympic medals. (August 4, 2008).*New York Times*. Retrieved April 12, 2009, from www.nytimes.com/interactive/2008/08/04/sports/olympics/20080804_MEDAL COUNT_MAP.html

[34] All of inflation's little parts, (May 3, 2008). *New York Times*. Retrieved April 12, 2009, from www.nytimes.com/interactive/2008/05/03/business/20080403_SPENDING_GRAPHIC.html

Resources for Further Reading

Heer, J. &Agrawala, M. (2008). Design considerations for collaborative visual analytics. *Information Visualization Journal, 7*(1), 49-62.

Hesse, M. (2008, September 9). Bytes of life: For every move, mood and bodily function, there's a web site to help you keep track. *Washington Post*. Retrieved April 12, 2009, from www.washingtonpost.com/wp-dyn/content/article/2008/09/08/AR2008090802681.html

Text messaging may help children fight off obesity. (November 12, 2008). *Science Daily*. Retrieved April 12, 2009, from www.sciencedaily.com/releases/2008/11/08111114 2602.htm

Warren, J-B. (December 8, 2008). The new examined life. *Wall Street Journal*. Retrieved April 12, 2009, from http://online.wsj.com/article/SB122852285532784401.html

Reconstructing Bellour: Automating the Semiotic Analysis of Film

by Richard L. Anderson and Brian C. O'Connor

In 1981, film theorist Bertrand Augst asked (personal communication), "Why can't we use a computer to measure and speak of filmic structure in the same way we can for verbal text?" Augst's question arose in a conversation on the difficulties for film studies that arise from the "literary metaphor." This is not to say there is no discourse mechanism at work in films; it is that attempts at one-to-one correspondence between the frame and the word or the shot and the sentence or similar impositions of the verbal form onto the image form failed. Films are not textual documents. Films do not have a rigidly defined grammatical structure. Images are not words. Shots are not sentences [1, p.224]. Films are generally viewed at a set rate of presentation and linearity. The technology used in the production and viewing of film has changed considerably since Augst posed his original question; however, there has been little change or advancement in film theory as a result of better and more efficient technology [2].

The Structure of Moving Image Documents

It has been common in both film description and film analysis to use the "shot" as the base or minimum unit. However, there is no definition of shot that specifies any specific set of parameters for any particular attribute – no specific number of frames or type of content. Bonitzer [3] refers to definitions of *shot* as "endlessly bifurcated." Similarly, the terms *close up* (CU), *medium shot* (MS) and *long shot* (LS) are used in film production textbooks and film analyses; however, there is no specification of how much frame real estate is occupied by some object or portion of object in the frame to be a CU rather than MS, for example. For our purposes, we use the frame and measurable attributes of the frame in order to speak specifically and to avoid the difficulties presented by "endless bifurcation."

The signal or the information of a film is presented in small units – frames – that are in themselves self-contained signals. In many instances they are even used as messages – for example, an individual frame may become a movie poster. However, the film and other time varying signal sets such as music and dance are signal sets of their given sort precisely because of their temporality. We see or hear the signal set (document) as a set of changes over time.

It could be said that one can stare at a painting or sculpture for a few seconds or an hour from differing viewpoints, thus making the viewing a time-varying experience of the signal set. It could probably be argued that artists of various sorts construct signal sets that demand attention for a long time in order to see all the intended variations in the signal set. It can even be argued (and we have so argued) that the digital environment gives viewers reader-like control over temporality and depth of penetration into films. However, it remains the case that the majority of film produced for commercial consumption assumes playback at a standard rate and linearity.

Much of what is taught in film schools and much of what has transpired in film analysis relates to variation in the temporal aspect of the film. Eisenstein [4] and Vertov [5] and some others spoke eloquently of time and its relation to structure. Structural commentary from reviewers tends to be less precise. For example, LaSalle [6] describes *The Legend of Zorro* as a "130-minute adventure movie that overstays its welcome by about 80 minutes,"

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and Addiego [7] describes *Domino* as "[a] psychedelic action picture that hammers away at the audience with a barrage of editing tics and tricks."

We are seeking a way to speak of the structure of a film precisely in order to enable a more productive examination of the meanings of the message for various viewers under various circumstances. In looking to previous work on the examination of the filmic message or signal set, we noted Augst's 1980 [9] comment on Bellour's analysis [10] of Hitchcock's *The Birds* [11]:

> It remains exemplary in the rigor and precision of the analysis performed and, to date, it is still the best example of what a genuine structural analysis of a filmic text could attempt to do. One must turn to Jakobson or Ruwet to find anything comparable in literary studies.

A comment by Augst [8] on Bellour's response to criticism of his work as pseudo-scientific and not sufficiently in touch with aesthetic aspects of film analysis addressed our particular concerns with devising an accurate and transferable means of describing the signal set: "[criticisms] continue to be leveled at any procedure that in any way exposes the gratuitousness and arbitrariness of impressionistic criticism."

Bellour's work elaborated on Metz's semiotic notions of film [11], particularly the concept of syntagmas, by introducing levels of segmentation greater and lesser than Metz's. This enabled structural analysis of filmic signal sets of any length and, eventually, of any sort, not simply the set, say, of classic American Hollywood features.

Difficulties for Bellour

We identified two difficulties with Bellour's signal set analysis. The first was the time-consuming nature of its practice. Simply locating the proper portions of film, timing them, re-photographing frames for analysis and publication, to say nothing of commentary or analysis, took days and weeks.

The second is that Bellour conducted his work too early – for the remarkable precision of Bellour's analysis, without digital technology he did not have a precise system of description at the frame level. He could write of contents of the frame and of relationships holding among frames, but not with deep precision – for example, the shades of various colors and their changes from frame to frame.

The digital environment enables us to address both issues. Grabbing all the individual frames from a digital version of a film requires only seconds, not days. Also, pixels enable addressable analysis of the red, green, blue and luminance components of any point in the frame, as well as comparisons of values at the same point or set of points across time. The mechanics of the practice of film analysis which once would have required enormous resources of time, funding and technology are today essentially trivial.

However, the technical ability to address and measure points within and across frames does not address Augst's earlier question; nor does it, in itself, provide a "genuine structural analysis of filmic texts." We have the technology – but what should we do with it? Techniques for analyzing the structure of moving image documents are well known and mature. In 1995 Dailianas, Allen and England [12] reviewed a number of techniques for the segmentation of video including techniques for measuring the absolute difference between successive frames, several histogram-based methods, as well as the measurement of objects within frames. These techniques proved to be robust when compared against human observers; however, all techniques were prone to false positives. They note that

> [b]ecause all the methods studied here have high false-identification rates, they should be thought of as providing suggestions to human observers and not as an ultimate standard of performance. [p. 12]

Structure and function have a complementary, but independent relationship. In order to advance the state of both structural and theoretical analysis, the relationship between structure and function must be taken into account. In other words, an analysis that takes both structure and function into account is greater than the sum of its parts. Kearns and O'Connor [13] provide a strong example of this approach in their demonstration of the relationship between the entropic structure of television programs and the preferences of a group of viewers.

The approach taken here combines an algorithmic structural analysis of the Bodega Bay sequence of Hitchcock's *The Birds* with the expert analysis of Bellour. Our hope is that a heuristic will emerge that will lead toward a solution to the problems identified both by film theorists and those who wish to analyze moving image documents for the purposes of indexing and retrieval.

Binary Systems of Structure and Function

We are using the technical definition posited by Claude Shannon and we state strongly our support of Warren Weaver's comment in his introduction to Shannon's *Mathematical Theory of Communication* [14]:

> The word *information*, in this theory, is used in a special sense that must not be confused with its ordinary usage. In particular information must not be confused with meaning. [p. 8]
>
> The concept of *information* developed in this theory at first seems disappointing and bizarre – disappointing because it has nothing to do with meaning, and bizarre because it deals not with a single message but rather with the statistical character of a whole ensemble of messages, bizarre also because in these statistical terms the two words *information* and *uncertainty* find themselves to be partners. [p. 27]

However, it is the very distinction between information and meaning that provides a theory base and descriptive tool-kit for the description and analysis of film. For Shannon, information is the amount of freedom of choice in the construction of a message. This concept was ordinarily expressed as a logarithmic function of the number of choices. What is important is Shannon's assertion that the semantic aspects of communication have no relevance to the engineering aspects; however, the engineering aspects are not necessarily irrelevant to the semantic aspects.

Shannon's notion of information is a binary system. Message and meaning are separate, but complementary notions. This system bears a strong resemblance to the distinction between signifier and signified in semiotic theory, as well as the separation of topography and function in the behavior analytic theory of verbal behavior (see Skinner [15] and Catania, [16]) and Wittgenstein's notion of a language game [17] [18].

Our model for analysis assumes such a binary relationship. The structural analysis was conducted by measuring the changes in color palette across frames in the Bodega Bay sequence of Hitchcock's *The Birds*. The functional analysis comes from Bellour's analysis of the same sequence of the film.

Functional Analysis "System of a Fragment," Bellour

Behavior analysis is an empirical and functional way to examine questions involving human behavior. Skinner [19] describes the logic of a functional analysis:

> The external variables of which behavior is a function provide for what may be called a causal or functional analysis. We undertake to predict and control the behavior of an individual organism. This is our "dependent variable" – the effect for which we are to find the cause. Our "independent variables" – the causes of behavior – are the external conditions of which behavior is a function. Relations between the two – the "cause-and-effect relationships" in behavior are the laws of a science. A synthesis of these laws expressed in quantitative terms yields a comprehensive picture of the organism as a behaving system. (p.35)

Why is this logic important to our seeking a conceptual framework and set of tools for structural analysis of film? Our question concerns the relationship between the physical structure of the Bodega Bay sequence of *The Birds* and Bellour's description of the structure of the sequence. In other words, what physical attributes of the sequence prompted Bellour to make the statements he made about the film?

The notion of a binary system is so fundamental, we re-make an earlier statement: a behavior analytic account of verbal behavior is a binary system. The structure or topography of a particular instance of verbal behavior has a complementary, but separate, relationship with the function or meaning of that particular instance. The behavior analytic account is similar in many respects to the separation of message and meaning in Shannon's work as well as semiotic theories of meaning. Behavior analysis provides an analytical language and framework that is appropriate for the problem at hand.

Catania [16] defines a *tact* as "a verbal response occasioned by a discriminative stimulus." A discriminative stimulus is a stimulus that occasions a particular response and is correlated with reinforcement. In this particular case, the tacts or verbal responses of interest are the statements about the Bodega Bay sequence made by Bellour in *The Analysis of Film* [20]. The discriminative stimuli are the physical dimensions of the film that prompted Bellour to make the statements he did in *The Analysis of Film*. The reinforcement in this case is assumed on the grounds that *The Analysis of Film* is considered to be a seminal work in the film theory community and Bellour and others applied the same types of analysis to other films.

Functional Analysis of Bellour's Verbal Behavior

We sought a means of structural analysis in turning to the expertise of Raymond Bellour. We selected a piece of his rigorous analysis, System of a Fragment: On *The Birds* (originally "les Oiseaux: analyse d'une séquence" [9]) using it as a record of his engagement with the signal set of a portion of the Hitchcock film. We captured the frames from the sequence for a data set of 12,803 frames. We then decided to determine how much of Bellour's response could be accounted for by one element of the data – the distribution of color across each and every frame. That is, we did not account for sound, for edge detection or for previous knowledge.

The sequence is, on the face of it, rather simple. A young woman, Melanie Daniels, sets out in a small motorboat with a pair of lovebirds in a cage. She crosses Bodega Bay to leave the birds as a gift to catch the attention of a young man, Mitch Brenner. She enters the Brenner's house, leaves the birds and returns to the boat to go back across the bay. Mitch spots Melanie crossing the bay. Mitch drives around the bay to the pier where Melanie will be arriving. A sea gull strikes Melanie and cuts her head before she reaches the pier. Mitch helps Melanie out of the boat and they walk toward a shop to tend to the wound.

When Melanie is on the bay, Bellour points out, we are presented with a classic Hollywood form, alternation – we see on the screen Melanie looking, then that at which she looks, then Melanie again. This form continues until she arrives at the house. While she is in the house we simply observe her behavior, except for a brief look out the window at the barn. Bellour sees this scene in the house as a "hinge" in the design of the film. It disrupts the pattern of alternation, while it also takes Melanie off the water.

As Melanie returns to the boat, we see what looks rather like the beginning of her trip – she is getting into the boat and heading off. However, Mitch sees her; then she and Mitch acknowledge one another. Bellour refers to the scene in the house (the hinge) and the double act of seeing as the "two centers" of the Bodega Bay sequence.

As an integral portion of his analytic writing, Bellour includes photographic frames from the Bodega Bay sequence – key frames. Ordinarily, these are the first frames of each shot in the sequence. However, this is not always the case. The difficulties of defining "shots" seem to be manifested here. We will discuss this point at greater length; for now, "shot" is ordinarily understood to be a mechanical unit – all the frames from camera original film (or a working copy) left in by an editor. Thus, all the beginning frames, where the camera comes up to speed, the director shouts, "action" and the miscues before usable footage is available, are cut out. Then a set of frames – each a still image representing approximately 1/30th of a second – shows the portion of the action desired by the director. Then a cut – in film, an actual mechanical cut; in video, still a cessation of a particular stream of data – is made and another shot appended. The process is repeated until the end of the film.

Ordinarily, especially in older films, there is a close correlation between the mechanical cuts and the data within the shot. However, there is a problem here for the definition of shot – data may change even in one run of the camera or one stream of frames between cuts. The camera may remain still while various objects come and go in front of it; the camera may move and present different views of the same objects or even different objects; the camera may remain still, but have the length of its lens changed during a shot; or various combinations of these may take place. For the viewer, whether several objects or views are shown in different shots or one shot may be of little overt consequence. However, in attempting do critical analysis, one is faced with finding a unit of meaning or, at least, a unit of address and measure that provides precision of description.

In our analysis, we operate at the level of the individual frame (29.97 frames per second.) We refer to Bellour's shot numbers and to his two primary divisions: "A" for Melanie's trip across the bay, her time in the house and her return to the boat; "B" for her return trip in the boat.

According to Bellour's analysis and textual description of the Bodega Bay sequence, then we should expect to find the following tacts (verbal responses to the film) in the physical document: key frames and key frame sets, alternation, two centers – the "hinge" sequence and a second center.

In summary, Bellour identified the following features in the physical document: key frames and key frame sets, alternation, two centers – the "hinge" sequence and a second center when Melanie and Mitch see each other. The question is: Can we identify elements in the physical structure of the film that could have stimulated his verbal responses (tacts)?

Structural Analysis of the Bodega Bay Sequence

There are several approaches that could be applied to the structural analysis of a film. Salt [21] advocates an approach based on the notion of the "shot" and the statistical character and distribution of "shots" within a moving image document. O'Connor [22] and Kearns & O'Connor [13] employed an information theoretic approach to the analysis of film. O'Connor [22] used a technique that measured the change of the size and position of objects or, more accurately, pixel clusters within a film. Dailianas, Allen and England [12] reviewed a number of automated techniques for the automatic segmentation of films that included the analysis of raw image differences between frames, a number of histogram based techniques and an edge detection based approach.

In choosing a technique for structural analysis of a film, the nature of the question one hopes to answer must be taken into account. An information theory approach such as that taken by Kearns and O'Connor [13] measures the structure of an entire film or message in Shannon's [14] terms. Bellour described the Bodega Bay sequence in fairly microscopic detail. An information theoretic approach would not be granular enough to adequately match Bellour's description. It should be noted that Kearns' concept of "entropic bursts" [23] might provide a finer grained information theoretic appropriate for the task at hand. Salt's (1992) statistical approach based on the analysis of shots is limited in a number of respects. The previously discussed conceptual problems with the "shot" as a unit of analysis makes Salt's approach untenable. In addition, Salt's analysis examines the statistical character and description of shots over the course of a complete film or collection of moving image documents. Like the information theoretic approach, Salt's approach is macroscopic. Finally, the phenomena addressed by Salt's methods are not congruent with elements of the moving image document that Bellour addresses in his analysis. The segmentation techniques reviewed by Dailianas, Allen and England [12] provide the level of detail necessary for the detection of key frames and frame sets in Bellour's analysis; however, they would not be appropriate for detecting alternation or detecting the centers within the sequence as identified by Bellour.

Our ultimate goal in analyzing the structure of the Bodega Bay sequence was to find the elements of the physical structure of the moving image document that prompted Bellour to make the statements (tacts) he did about the film. To accomplish this task, it was necessary to look at the structure of the segment on at least two levels. First, Bellour breaks the sequence into "shots" or frame sets and selects key frames. This requires an examination of individual frames. Second, Bellour describes alternation between the frame sets, the unique character of the "hinge," the two centers and the gull strike. These tacts are descriptions of the relationship between frame sets.

We sought precise, repeatable, numeric and graphical representations of the signal that would enable discussion of filmic structure – the message, in the terms of Shannon and Weaver. We sought the means by which we might discuss message structure, so that discussions of meaning would have a significant touchstone. It might be said that we sought a method of fingerprinting the frames.

In standard digital images each and every color is composed of a certain amount of red, a certain amount of green and a certain amount of blue – with black being the absence of any red, green or blue and with white being maximum of each. In the frame images we captured there is a possibility of 256 shades of red, 256 shades of green and 256 shades of blue for a possible palette of over 16 million colors. Deriving a histogram of each of the RGB components or the aggregated values distributed across an X-axis of 255 points (the zero origin being the 256th) yields a fingerprint – a color distribution map – of each frame.

Perhaps one of the most appealing aspects of mapping color distribution is that it is an entirely software-based process. There is no necessity for human intervention to determine and mark what is to be considered the "subject" or how many pixels (what percentage of the frame area) make up some viewer-selected object. Not that these are not useful for some sorts of analysis, but using just the color palette enables an essentially judgment-free analytic process.

Method

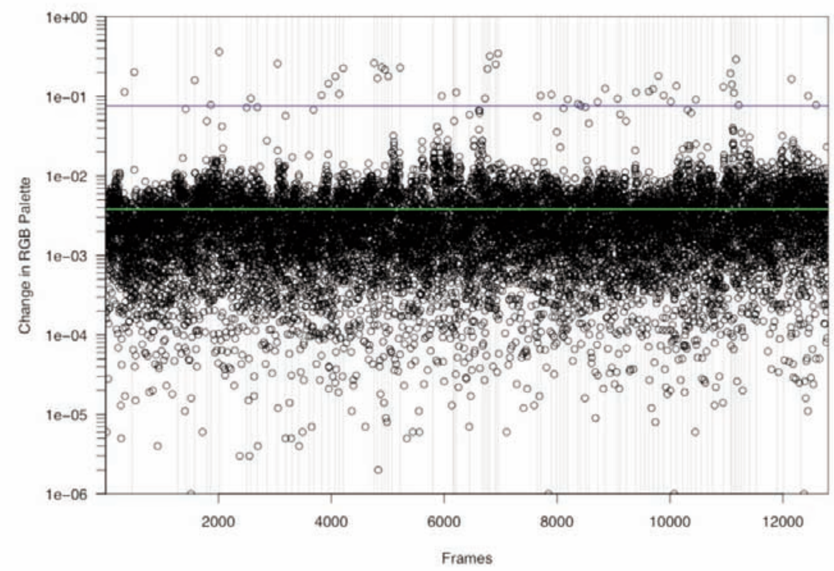
Structural analysis. We converted the Bodega Bay to an AVI file and then extracted the individual frames to 12,803 JPG image files. We generated RGB histograms for each of the 12,803 frames using the Python Imaging Library. A Lorenz transformation was then performed on each histogram. We calculated a Gini coefficient for each frame to generate a scalar value representing the color distribution of each frame. The Gini coefficient compares a perfectly even distribution of RGB against the actual distribution in each frame. We used the differences in Gini coefficients between successive frames as a measure of change across frames.

Codifying Bellour's analysis. Bellour's analysis does not include precise times or frame numbers to either select key frames or delineate frame sets; however, he includes photographs of the key frames. The frame numbers for Bellour's key frames and frame set boundaries were selected using visual comparison between the photographs from Bellour's article and the extracted frames. Frame sets were composed of all the frames between successively identified key frames and tagged using Bellour's numbering convention. Bellour grouped frame sets into higher-level groups. The frame sets were arranged into higher level groups using Bellour's description.

Results

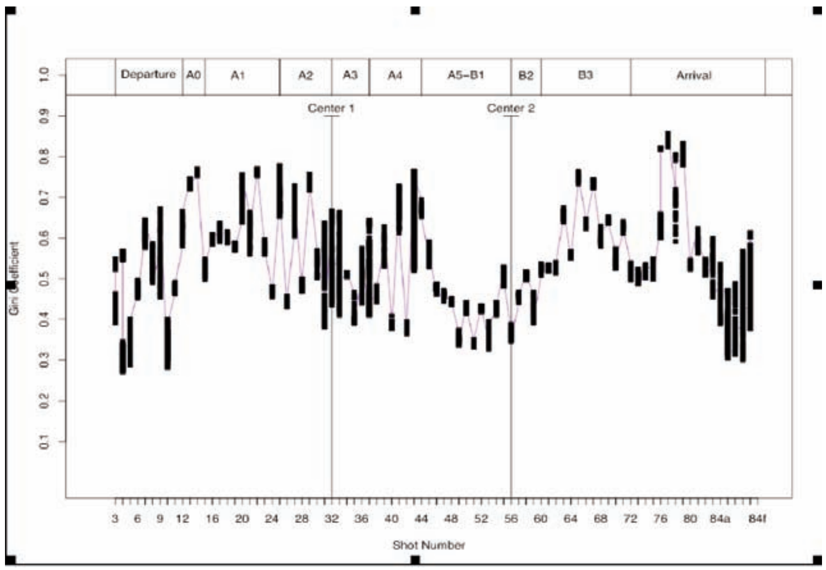
Due to the differences in precision between Bellour's analysis and the structural analysis, we believed that visual analysis would be the most appropriate option for the task at hand. Bellour's analysis began with shot number 3 of the segment and continued to shot 84. Bellour includes two groups of shots that have little bearing on his analysis of the sequence: Melanie's acquisition and boarding of the boat (3-12) and Melanie's arrival at the dock following her trip and the gull strike (84a-84f). These sets do not play into Bellour's analysis and appear to function only to demarcate the segment within the larger document – the entire film of *The Birds*.

FIGURE 1. Differences in the Gini values between successive frames in the Bodega Bay sequence



Detection of key frames and frame sets. Figure 1 shows the absolute value of the difference between the Gini value of a particular frame of the Bodega Bay sequence of *The Birds* and the previous frame. The mean difference between frames for all frames in the sequence is 0.003826, which is represented on the graph by the green (lower) horizontal line. The mean difference between frames identified as key frames by Bellour was 0.075678. The difference values fall into a bimodal distribution. The difference values of key frames and the proceeding frame were an order of magnitude higher than the difference values between frames that were not identified as key frames. Figure 2 shows the Gini coefficients for each frame broken down into individual frame sets as identified by Bellour. Within shots, the Gini coefficients remain stable for most shots and trend in

FIGURE 2. Gini coefficients of each frame broken down by shot number.



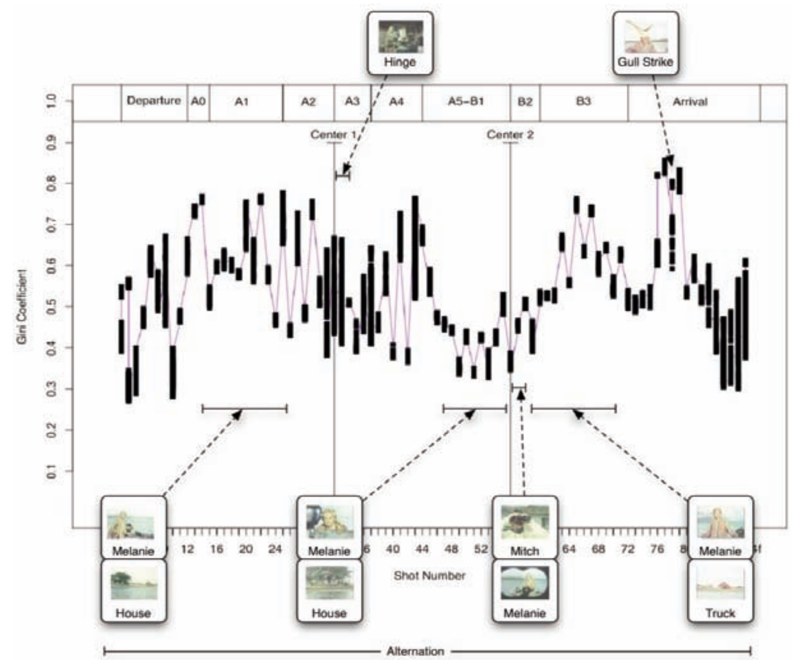
a linear manner. Notable exceptions to this pattern include the group of frame sets that make up Bellour's "hinge" sequence (25-43); the gull strike (77); and Melanie's arrival at the dock following the gull strike (84a-84f).

Analysis of frame sets. Figure 2 shows the Gini coefficients of each frame of the segment broken down by shot number, presenting the flow of the color distributions across the time of the film sequence. We might construct a tact map by over-layering indicators for some of the key elements mapped by the data in Figure 2, as in Figure 3 (below). Once Melanie is actually underway on her trip to the Brenner house, we have almost uninterrupted alternation. We are presented with Melanie in the boat, then the Brenner house as she sees it – Bellour's shots 15 through 22. Then we are presented with Melanie paddling the boat and seeing the dock – 23-24; then walking on the dock and seeing the barn – 25-31. That is, shots 15 through 31 present Melanie, what she sees, Melanie, what she sees, and so on. The latter portion is more distinct in the graph, though the entire sequence of shots clearly shows alternation.

We should note that the RGB graph does not necessarily indicate that there is alternation in the sense of Melanie/dock/Melanie/dock/Melanie. However, one would still be able to say that there is alternation of the RGB pallets, regardless of whether a human viewer would say that the same objects were in front of the lens. Such an RGB alternation might have its own discursive power.

Bellour's hinge sequence runs from frame number 5219 to frame number 6447 – Bellour's shot numbers 32-36 (A3). Bellour also refers to this sequence as the first of the two centers. It would make some sense, then, that it would be in the vicinity of the center and the final frame number 6447 is very near the center of 12,803 frames. More significant is the distribution of the Gini values – they are clustered more closely to the .5 line and they display much less variation than we see in most of the rest of the graph. Given the different form of the distributions on either side of the first center it is not untenable to assert the graphic appearance of a hinge (Figure 3).

FIGURE 3. "Tact map" showing Bellour's hinge sequence and other key features.



What is not so immediately evident graphically is the second center – that point in the sequence when Mitch sees Melanie – a second center in that it breaks up the rhyme of the trip out and the trip back for a second time. That is, Melanie has exited the house and heads back to the dock and the boat. It seems that after having been in the house – the first center – Melanie will simply head back; however, Mitch's discovery of Melanie and the eventual uniting of "hero and heroine for the first time in the ironic and ravishing complicity of an exchange" (p. 53) interrupt the return.

Though Bellour suggests that the second center "stands out less starkly," it does nonetheless stand out. Shot 43, whose large number of Gini values suggests both its length and the varying data set, is where Melanie moves along the dock and into the boat. Shots 44 and 45 begin the pattern of displacement along the Gini value that was typical in the earlier alternation. This alternation pattern develops strongly between 48 and 54 – alternating Gini values remain almost fixed in place along the Gini axis and they occupy a narrow band of the axis. At 55, the shot crosses the 0.5 boundary and the subsequent Gini values suggest alternation again, though of a more widely distributed sort. It is during this fragment that Melanie has watched Mitch, then, at 54 Mitch runs to the house and at 55 Melanie stands up and tries to start the motor. The second center displays a form of alternation, but this takes place in a manner that presents almost a mirror image of the alternation in the trip out – the alternation here hanging below the .5 line. As the second center closes, the alternation repeats the pattern of the trip out – all the Gini values arcing above .5.

Closing Thoughts

The order of magnitude difference between the mean differences for key frames and non-key frames presents a numerical representation of the key frame tact. We have a precise, numerical way of speaking of the key frames identified by Bellour, as well as an automated way of detecting those frames.

The clustering of Gini coefficients in the "on water" sequences with distinctly different and separated patterns presents a numerical representation of the alternation tact. Melanie's Brenner house sequence presents a distinctly different numerical and graphical representation, giving us the hinge tact. The numerical and graphical "bunching up" in the representation of Mitch's discovery of Melanie and their double seeing alternation, presents us with the second center and a means for speaking precisely of the two-centers tact.

Bellour does not speak to any significant degree about the gull strike on Melanie, though the strike is often mentioned in other discussions of the Bodega Bay sequence. The entire strike is approximately one second of running time and may have been too microscopic for Bellour to address in his analysis. However, the numerical analysis and graphical presentation present a striking data set. Almost every frame presents a Gini value significantly different from its predecessor. This is a very high entropy portion of the sequence – several rapid changes in the data stream in less than a second of running time is a very different pattern from that of any other portion of the film. We might suggest that digital frame-by-frame precision might have enabled Bellour to speak of this brief fragment.

In some sense, the hardest thing about what we are doing is seeing what is actually computable only from the physically present data. That is, film criticism and analysis have so long depended on human engagement with the physical document that the distinction between the data stream of the document and the contribution of the viewer's prior knowledge of what is represented remain difficult to tease apart. So we can easily cluster shots with roughly similar RGB patterns. However, going from an MS of Melanie in the boat to an LS of Brenner's house, while it shows us an RGB change does not show us anything that would definitively indicate MS to LS. Also, one could imagine a change from MS to LS (say a cityscape of one or two building fronts to a LS of several buildings) in which the RGB would remain fairly constant. Within any one film or one director's body of work we might be able to make some calculations that would describe/predict CS MS LS changes, but there is just nothing inherent only in the data that makes that a widespread property. This problem does not diminish either Bellour's analysis or the digital analysis – it simply speaks to the complexity of understanding filmic documents and even simply describing them accurately. Indeed, this demonstrates one of our initial assertions: that the engineering of the message structure and the semantic meaning are separate, complementary notions.

That said, the close correlation between the frame-to-frame analysis and Bellour's writing suggests that our use of an expert analyst's response to *The Birds* indeed demonstrates the validity of this approach to numerical and graphical representation of filmic structure. Perhaps one of the most significant consequences of the close correlation is the availability of a vocabulary for description and analysis. A fundamental problem with previous systems of analysis has been the reliance on words to describe visual, time-varying documents. Being able to represent visual attributes and time-varying states of the attributes at the pixel, frame, frame set ("shot"), sequence and document level with the same processes and terms should enable deeper and more fruitful analysis.

At the same time, the techniques provide means for discovering structural elements. It would be too facile to suggest that we now have a robust mechanism for automated description of filmic structure; however, we do at least have a robust automated means for mapping the structure. We could run any film through a frame by frame comparison of RGB and be able to state that certain portions remain stable for some time, then change; and at some points, rapid changes take place – the points of change, the points of discontinuity in the data stream, represent points where something different is happening.

Perhaps even more intriguing and a likely avenue of rewarding research would be the use of RGB fingerprints in classification. Do all of Hitchcock's films, or at least those from a particular period, share the same fingerprint patterns? If De Palma is the heir to Hitchcock, do his films actually bear a numerical similarity to Hitchcock's films? Do music videos and early Russian documentaries (for example, Vertov's *Man with the Movie Camera* [24]), films with very different structures from the classic Hollywood films studied by Bellour, yield useful numerical descriptions?

Of course, most moving image documents are made up of more than simply RGB data. Multiple sound tracks for voice, narration, sound effects and music significantly increase the amount of data available for analysis; however, there is no reason that these time-varying data could not be described using a similar numerical and graphical technique.

As we have demonstrated here, the data available for analysis is not limited to the signals available in the physically present document. Bellour's analysis of *The Birds*, in essence, becomes another signal or memetic attribute of the document. Other critics who have commented on *The Birds* or viewer reactions to the piece could be analyzed in the same manner that we have applied to Bellour's work. Every person who interacts with a document and commits some permanent behavioral product of that interaction contributes to the document's signal set for subsequent uses.

Considered from our perspective, this contribution becomes a fundamental aspect of the setting for considering the relationship between the document/message structure and the semantic meaning. The additional signal, for example a review, can have a significant impact on whether a document is accessed and on how it is evaluated for fitness to a given information need. The document is not necessarily static with the same impact on any given user; rather, it is an evolutionary process. The concept of document as evolutionary process receives more discussion in Anderson [25] and Wilson [26].

Bellour sought means to explore and represent moving image documents with the precision already applied to verbal documents at the micro and macro levels. He sought means to go beyond what Augst [8] termed the "gratuitousness and arbitrariness of impressionistic criticism." The digital environment offers the opportunity to do so; to enable speaking directly of the native elements such as the RGB components and their changes across time; and, to paraphrase Godard, to confront vague ideas with precise images. ■

RESOURCES on next page

Resources Mentioned in the Article

[1] Pryluck, C. *Sources of meaning in motion pictures and television*. (1976). Manchester, NH: Arno Press.

[2] Augst, B. & O'Connor, B. C. (1999). No longer a shot in the dark: Engineering a robust environment for film study. *Computers and the Humanities, 33*, 345-63.

[3] Bonitzer, P. (1977). Here: The notion of the shot and the subject of cinema. *Cahiers du cinéma*, 273.

[4] Eisenstein, S. (1969). *Film form: Essays in film theory*. New York: Harvest Books.

[5] Vertov, D. (1984). *Kino-eye: The writings of Dziga Vertov*. Berkeley, CA: University of California Press.

[6] LaSalle, M. (2005, October 28). This guy just can't hang up his mask. *SFGate*. Retrieved April 14, 2009, from www.sfgate.com/cgibin/article.cgi?file=/c/a/2005/10/28/DDG17FEH3K1.DTL.

[7] Addiego, W. (2005, October 14). Domino quit modeling for the glamour of guns. *SFGate*. Retrieved April 14, 2009, from www.sfgate.com/cgibin/article.cgi?file=/c/a/2005/10/14/DDG7VF7DPK1.DTL.

[8] Augst, B. (1980). *Instructor's course notes on Bellour's "Les Oiseaux: Analyse d'une sequence."*

[9] Bellour, R. (1969, October). Les Oiseaux: Analyse d'une séquence. *Cahiers du cinéma*, 216.

[10] Hitchcock, A. (Director). (2000). *The Birds* [Motion picture]. (The Alfred Hitchcock collection). Universal City, CA: Universal Studios Home Video.

[11] Metz, C., (1974). *Film language: A semiotics of the cinema*. (M. Taylor, Trans.). Chicago, IL: University of Chicago Press.

[12] Dailianas, A., Allen, R. B., & England, P. (1995, October). Comparison of automatic video segmentation algorithms. Paper presented at *SPIE Photonics East'95: Integration Issues in Large Commercial Media Delivery Systems*. Retrieved April 14, 2009, from www.cis.drexel.edu/faculty/ballen/RBA/pubs.html and other locations.

[13] Kearns, J. & O'Connor, B. C. (2004). Dancing with entropy: Form attributes, children, and representation. *Journal of Documentation, 60*(2), 144-63.

[14] Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication*. Urbana, IL: University of Illinois Press.

[15] Skinner, B. F. (1957). *Verbal behavior*. New York, NY: Appleton-Century-Crofts.

[16] Catania, A. C. (1998). *Learning* (4th ed.). Upper Saddle River, N.J.: Prentice Hall.

[17] Wittgenstein, L. (1953). *Philosophical investigations*. New York, NY: Macmillan.

[18] Day, W. F., & Leigland, S. (1992). *Radical behaviorism: Willard Day on psychology and philosophy*. Reno, Nev.: Context Press.

[19] Skinner, B. F. (1953). *Science and human behavior*. New York, NY: Macmillan.

[20] Bellour R., Penly, C. (ed.) (2002). *The analysis of film*. Bloomington, IN: University of Indiana Press.

[21] Salt, B. (2003). *Film style and technology history and analysis*. (2nd expanded ed.) London: Starword.

[22] O'Connor, B. (1991). Selecting key frames of moving image documents: A digital environment for analysis and navigation. *Microcomputers for Information Management, 8*(2).

[23] Kearns, J. (2005, October 7-9). Clownpants in the classroom? Entropy, humor, and distraction in multimedia instructional materials. Paper presented at *DOCAM 05, Document Academy, 2005*.

[24] Vertov, D. (2002). *Man with the movie camera* [*Chelovek kino-apparatom* (1929)] [motion picture]. Chatsworth, CA: Image Entertainment.

[25] Anderson, R. (2006). Functional ontology modeling: A pragmatic approach to addressing problems concerning the individual and the informing environment. Unpublished doctoral dissertation. University of North Texas.

[26] Wilson, P. (1968). Two kinds of power: An essay in bibliographic control. Berkeley, CA: University of California Press.

An Arbitrage Opportunity for Image Search and Retrieval

by Ray Uzwyshyn

A new paradigm for image search metadata collection is emerging exemplified by the Human Computation School's application of gaming principles to information science search challenges. In parallel, a suite of Web 2.0 interface applications for visual search have recently appeared opening new interactive possibilities and visual metaphors for navigation. This article briefly introduces this paradigm shift and then looks critically toward wider innovation with an eye on fresh territory. Arbitraging differing methodologies opens new visual search possibilities, as affordances and differences between models present opportunities to leverage inefficiencies in one model with efficiencies of the other. This article capitalizes on such inequities, prescriptively suggesting a synergistic path for combining new image-retrieval metadata methodologies with new front-end visual search directions for future application innovation.

Human Computation and Image Metadata

Perhaps a good place to begin this discussion is with *Google's Image Search* [1], which claims to be the web's most comprehensive. The computational challenge with regard to visual search and images has been to improve relevancy, precision and the quality of textual matching when searching any large group of images. How does one provide high quality metadata for images that will optimize these parameters?

Searching on words such as *dog*, h*orse* or *stock market* usually brings up a good representation of images, some relevant, others less so. However, challenges become more apparent as the level of keyword abstraction or ambiguity increases. Take, for example, the abstractions *bravery*, *intelligence* or *courage* or cognates like "intelligent dog" or "courageous lion."

FIGURE 1. Google Image Search (http://images.google.com)

Larger scale computational image search methodologies have traditionally worked through algorithms that search and pair metadata (alt tags, keywords, file metatags, surrounding description) or, more commonly, text strings with various image file types. Because a computer has no common sense and cannot tell whether the surrounding description is appropriate, relevancy decreases as the precision needed increases.

A fresh approach to this metadata challenge is outlined in recent work by Luis von Ahn. Von Ahn proposes [2, 3] to capitalize on the efficiencies of human processing cycles through games to help solve traditionally intractable problems. By appropriating an online gaming methodology, two randomly paired participants are simultaneously and separately shown the same image and asked to propose matches. The recorded game play and results provide a new data-gathering mechanism to more accurately label or

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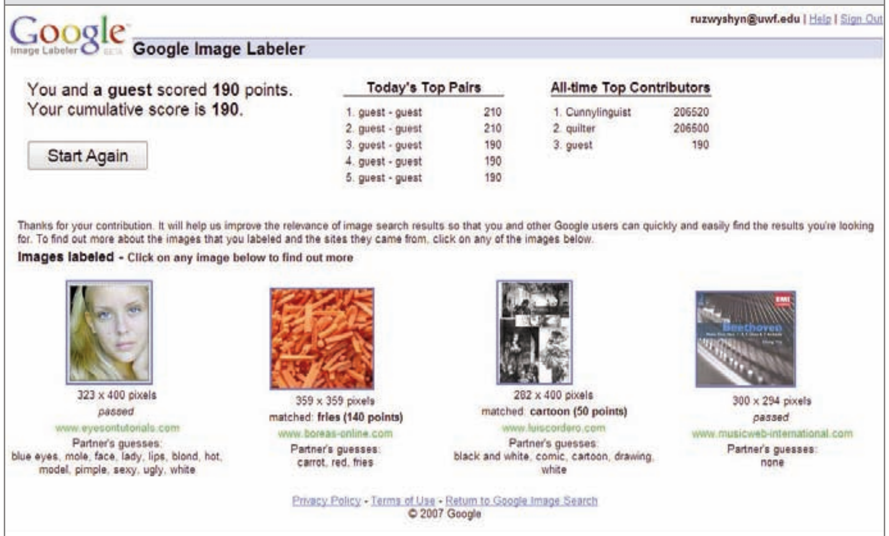
FIGURE 2. *Google Image Labeler Beta* (http://images.google.com/imagelabeler/) [4]



provide reliable image metadata (Figure 2). Combining the gathered metadata with statistical methodologies opens a door to creating better databases of visual search image data.

The covert harnessing of human processing cycles and common sense reasoning through overt gaming methodology is an interesting model that could be further exploited to meet more difficult challenges such as providing polyphonic metadata for images, adequate metadata for video and film or accurate labeling for sections of images. The wider idea is to leverage intrinsic human strengths with computer affordances and bring these into efficient and natural synergy. The deeper innovation is into the "medium specificity" [5] or the unique possibilities opened by computational media in synergy with natural human strengths and inclinations. The insight here involves "object relations" [6] between human and computer – or the dynamic and evolving process of augmenting cognition in the wider ecology between human and computer. By reexamining this relationship, new solutions to present-day computational challenges are enabled. There is room for further work here with von Ahn's practical innovations most cogently displayed in his online *Games with a Purpose Project* [7]. Von Ahn's trajectory actualizes earlier more speculative endeavors within a Web 2.0 framework. Of note is the work of two earlier heterodox artificial intelligence researchers, Push Singh [8, 9] (see the Open Mind Common Sense Site [10, 11]) and Christopher Mckinstry [12]. Their attempts to harness common sense reasoning are worth revisiting for further reflection and possibility. Other pioneering efforts include those by Douglas Lenat [13] and Marvin Minsky [14].

New Visual Search Interface Metaphors

Traditionally, visual image search on the web has been presented through an interface and photographic contact sheet metaphor. For example, in a Google image result set, 20 thumbnail images are presented on a single page in a 4x5 (20 image/page) grid with links to larger images (Figure 3).

FIGURE 3. *Google Image Search*: Keyword "Kennedy"

The visual metaphor used for presentation is the photographic contact sheet. By clicking through a numbered list, one clicks through contact sheet pages. Clearly, for the result set of 20,300,000 pages produced by keyword "Kennedy" (Figure 4), this presentation is hugely inefficient for humans, yet it is the dominant interface metaphor in practice for image-search navigation.

FIGURE 4. Pages 1-16 of 20,300,000 Pages for Keyword "Kennedy"

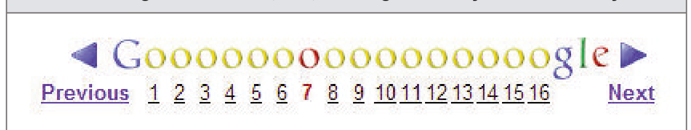


FIGURE 5. *Cooliris*: Image Wall Browser and Media Discovery Tool (www.cooliris.com/)

Recently, various online applications have emerged to challenge this method and metaphor with new, more interactive and agile visual navigation possibilities enabled through AJAX (Asynchronous JavaScript and XML) and FLASH (.swf) based technologies that present other metaphors for display and navigation. For example, *Cooliris* [15] takes image search's visual display into an interactive horizontal 3D wall methodology that can be scrolled or fast-forwarded with commands like those available on a film reel or media controller, such as "play," "fast forward" or "rewind."

The cinematic and interactive image wall methodology lends itself to searching and retrieving an image from a large number of images more humanly. Interestingly, the antecedents for the emerging Cooliris School of applications have been in place for a number of years. Similar to von Ahn, the wider broadband web infrastructure and improved application environment of Web 2.0 have only recently made these ideas practicable. There is room for a recasting of historical interface possibilities that in the 90s and early millennia were only available in R&D environments for wider dissemination. See, for instance, work by Card, Mackinlay, Schneiderman, Rao and others [16, 17, 18, 19].

Methodological Synthesis and Arbitrage: Common Sense Metadata and New Interface Metaphors

Looking back at the two examples outlined (human computation and improved interface metaphors), clearly both offer better models for visual image search. The first presents new metadata possibilities by harvesting common sense data for images through games. The second model improves front-end interface metaphors. What is needed is an arbitrage and synthesis of paradigms. Because of their overwhelming attention to the front end, applications exemplified by *Cooliris* and this new metaphor/interface school lack strong attention to metadata application or, as yet, integration of innovative metadata methodologies to improve search/retrieval. These applications simply overlay other search engines' metadata or map antecedent methods. Similarly, while the *Google Image Labeler* and the Human Computation School provide new avenues for better metadata collection, they rely heavily on traditional presentation and do not as yet utilize or attempt integration with new interface possibilities. Capitalizing on inefficiencies in both models through a leveraging of the innovation in each results in a new synthesis. Further opportunity may also be opened through a similar methodological arbitrage of prevailing disparate paradigms.

In the ever-evolving human/computation relationship, the larger keyword is *human*. In harvesting these new vintages of metadata possibilities, it is increasingly important to beware of placing new wine in old wineskins. New container metaphors are available. A new synthesis, taking affordances into account, will provide a better lens through which to look back at both schools of applications. This new foundation may also allow a reexamination of the present dominant text search metaphor – the long scrolling result list. A more robust point of departure is also needed for search applications investigating the more uncharted territory of digital film or video. Beginning to integrate these newer paradigms will provide a better window for visual image search. Opportunities outlined present fertile territory for the future of media-based information retrieval. ■

RESOURCES on next page

Resources

Visual Image Search, Metadata and Common Sense Reasoning

[1] *Google Image Search*: http://images.google.com.

[2] von Ahn, Luis. (July 26, 2006). *Google Tech Talks: Human computation*. Retrieved March 11, 2009, from http://video.google.com/videoplay?docid=-8246463980976635143.

[3] von Ahn, Luis. (December 7, 2005). *Human Computation*. (Doctoral dissertation. Carnegie Mellon University.) Retrieved April 27, 2009, from http://reports-archive.adm.cs.cmu.edu/anon/2005/CMU-CS-05-193.pdf

[4] *Google Image Labeler Beta*: http://images.google.com/imagelabeler/.

[5] This term – *medium specificity* – is appropriated from art history/media theory and used in a digital framework here. It may not be as well known in information science contexts. For further explanation, see http://en.wikipedia.org/wiki/Medium_specificity and http://csmt.uchicago.edu/glossary2004/specificity.htm

[6] The term – *object relations* – as used here is from psychoanalytic theory. As with the term *medium specificity*, it may not be as well known in information science contexts. For further context see http://en.wikipedia.org/wiki/Object_relations and www.objectrelations.org/introduction.htm.

[7] *Games with Purpose*: www.gwap.com.

[8] Singh, P. (2006). *MIT publications list*. Retrieved March 11, 2009, from web.media.mit.edu/~push/#Publications.

[9] Singh, P. (June 2005). *Em-One: An architecture for reflective commonsense thinking*. (Doctoral dissertation. Massachusetts Institute of Technology). Retrieved April 21, 2009, from http://web.media.mit.edu/~push/#Publications.

[10] *Open Mind MIT Common Sense Database*: http://openmind.media.mit.edu/

[11] *Open Mind Initiative*: http://openmind.org

[12] Chris Mckinstry. (April 15, 2009). *Wikipedia*. Retrieved April 21, 2009, from http://en.wikipedia.org/wiki/Chris_McKinstry. [Includes Mindpixel links.]

[13] *Cyccorp*: www.cyc.com. [Douglas Lenat's pioneering common sense website.]

[14] *Marvin Minsky*: web.media.mit.edu/~minsky/

Image Interface Search Possibilities

[15] *Cooliris: Website and application download*: www.cooliris.com/

[16] *Ramama Rao's information flow*: www.ramanarao.com/. [Website with links to Rao's publications]

[17] Robertson, G, Mackinlay, J.D., & Card, S.K. (1991, June). The perspective wall: Detail and context smoothly integrated. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, New Orleans* (pp. 173-176). New York: ACM. Retrieved March 11, 2009, from www.infovis-wiki.net/index.php/Perspective_Wall. [Shows an example of perspective walls]

[18] Marc Schmidt, C. Expressing information [PowerPoint presentation]. Retrieved April 23, 2009, from www.christianmarcschmidt.com/NYU2007/components/071023_presentation.pdf. [Includes information on the Timewall [Slide 40] and other pioneering visualization methodologies]

[19] Shneiderman, B., Mackinlay, J., & Card, S. *Readings in information visualization: Using vision to think*. New York: Morgan Kaufman, 1999.

Feature

Professional Responsibility, Power, Recruitment and Retention of Members in the Society

by Phillip M. Edwards

Editor's note: Phillip Edwards is one of two recipients of the 2008 James M. Cretsos Leadership Award, which honors new ASIS&T members (members for less than seven years) who have demonstrated outstanding leadership qualities. The *Bulletin* has asked him to describe his ASIS&T experiences and the motivations for his service to the Society.

It is a great honor to be selected as a recipient, along with Elise Lewis, of the 2008 James M. Cretsos Leadership Award. (Elise has a written a wonderful essay about her experiences for the February/March 2009 issue of the *Bulletin* [1].) I never had a chance to meet Jim in person but have learned about him through his writing and the stories that other ASIS&T members tell about their interactions with him. In this column, I wanted to explore not only the impact he had our on field but also to reflect upon avenues through which the Society could better carry forward some of his ideals. When Jim was the chairman of the Professional Enhancement Committee in the mid-1970s, he took a particularly impassioned stance on professional responsibilities of ASIS&T members:

> Certainly, an organization such as ours, whose members can control the flow of information, has enormous power…Since many members of our profession are not accustomed to thinking of themselves as powerful, there is a strong tendency to ignore or even flee from responsibility for the impact of their work. Undoubtedly, some of our members are totally unaware of the eventual consequences of what they do. ([2], p. 211)

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Although the intervening years yielded a set of professional guidelines for members of the Society [3], the notions of power and responsibility in our field are still ones that bear upon us, particularly as ASIS&T deals with some very pressing challenges in terms of recruitment and retention of members.

I suppose that interjecting a bit of personal narrative might illustrate how these themes – power, responsibility, recruitment and retention – could impact the sustainability of the Society. I joined ASIS&T as a student member in 2002. At the time, I was a master's student at the University of Michigan, and I had just completed my B.S. in chemistry the previous year. When I noted the opportunity to apply for a travel award to subsidize my attendance at the ASIS&T Annual Meeting, sponsored by Chemical Abstracts Service (CAS) and awarded by SIG/STI, I applied. I met a handful of other SIG/STI members at that Annual Meeting, people who continue to be excellent friends and colleagues. I certainly had no idea what I was getting myself into – nor did I really have a sense of how important ASIS&T might be for me, both personally and professionally – by the end of that first Annual Meeting.

In 2003, I took a year off from the Annual Meeting. I had just moved across the country to Seattle and had little money to devote to meeting attendance. The following year, Eugene Garfield donated the funds to support several travel awards for students. I was just starting my second year in the doctoral program at the University of Washington, and I was selected as one of the awardees. From 2004 to 2006, I subsidized my travel to the Annual Meeting with portions of the stipend from the Paul Evan Peters Fellowship, and each year I took on more ASIS&T responsibilities, the first of which was secretary/treasurer of SIG/STI in 2005.

The key challenge – based on in my personal history with the Society and, I believe, shared by many new and student members – is the ability to support Annual Meeting attendance until members have a chance to develop as leaders within the organization. Absent the support from CAS, from Eugene Garfield, from the friends and family of Paul Evan Peters, I would not have been able to discover and pursue leadership opportunities along with the veteran leaders who regularly attend the Annual Meetings. As a Society, we are reasonably successful in getting students and new members to their first meeting, but we may be less effective at specifically supporting those members during their second and third outings. This support is, I believe, one of the responsibilities we have as Society members, and, despite the current economic climate, an area in which we have the power to respond. We can, through the creativity of SIGs and chapters, continue to expand our efforts to support travel to Annual Meetings or opportunities for involvement, dialogue and networking among members that do not involve travel (for example, virtual meetings and sessions). By specifically targeting newer-but-returning ASIS&T members through these programs, these experiences may mean the difference between developing a vibrant community of early-career leaders and stagnating as a Society.

Comments and feedback related to this column are welcomed and may be sent via email to phillip.m.edwards<at>unc.edu. ■

Resources Mentioned in the Article

Lewis, E. (2009, February/March). An intellectual playground. *Bulletin of the American Society for Information Science and Technology, 35*(3), 29-30. Retrieved April 5, 2009, from www.asis.org/Bulletin/Feb-09/FebMar09_Lewis.html.

American Society for Information Science. (1992, May 30). ASIS professional guidelines. American Society for Information Science & Technology. Retrieved April 5, 2009, from www.asis.org/AboutASIS/professional-guidelines.html.

Cretsos, J. M. (1976). Scientific freedom and responsibility. *Journal of the American Society for Information Science, 27*(4), 211-2

Resource Description and Access (RDA) and New Research Potentials

by Shawne D. Miksa

Resource Description and Access (RDA) [1], set to be released in the third quarter of 2009, is a new set of descriptive cataloging rules developed to replace the longstanding Anglo-American Cataloguing Rules 2 (AACR2) [2], first released in 1978. The principal goal of the new rules is to facilitate resource discovery through library catalogs in a more consistent and powerful way than is currently possible with AACR2. To understand this new rule set, it is necessary to understand the critical concepts found within *Functional Requirements for Bibliographic Records* (FRBR) [3] and *Functional Requirements for Authority Data* (FRAD) [4], two publications developed through International Federation of Library Association (IFLA) that are used to form the backbone of the RDA.

The change in cataloging rules is much needed, but not welcomed by all. Blogs and listservs such as *Planet Cataloging* [5] or *RDA-L* [6] within the global cataloging community are ablaze with talk on RDA and functional requirements, raising more questions and offering critical and constructive analysis (for example, see comments by the Cataloguing Committee of the Swedish Library Association Swedish Library [7]). They are also very often portals for venting frustrations brought on by an imminent change in comfortable cataloging procedures. The main questions being asked are "How do we use it?" and "How do we implement it in our library?" and "Are the vendors creating new systems that use it?" Perhaps the most challenging aspect will be learning the complexity of the FRBR entity-relationship models in which information resources are classified as Works, Expressions, Manifestations and Items (often referred to as WEMI).

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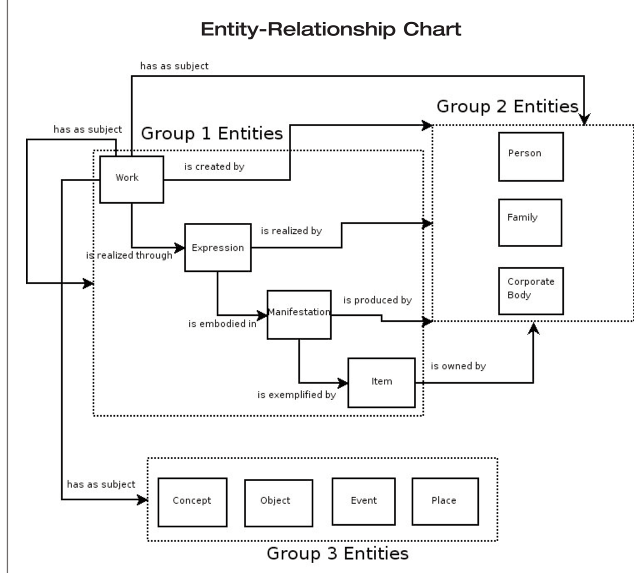
FIGURE 1. Entity-Relationship chart (from www.frbr.org/files/entity-relationships.png, at the FRBR blog at www.frbr.org/) [9]



The FRBR and FRAD conceptual models resulted from the international cataloguing community's effort to address a constantly changing information environment, the emergence of new forms of information resources and increasing density of networked information systems. In 2007 Howarth and Weihs [8] wrote

> The cataloguing community is clearly at a crossroad, navigating the transition from forty years of creating bibliographic records using the Anglo-American Cataloguing Rules within a print-dominant environment to a proposed new content standard that reaches beyond the library domain to a world of digital objects and multipurpose metadata. (p. 15)

The Joint Steering Community for the Development of RDA (JSC) has called for constituency reviews of several drafts of the new rules [1], with the intent of reviewing all submissions and incorporating comments and edits when and where possible.

AACR2 arranges chapters by the type of information resource and then by type of main or added access points (see Table 1). In AACR2's Part I, chapters 2-12 each focus on a separate format and address only the description of the resources. The code is weak on access points, even though Part II is devoted to choice and formation of personal, corporate body and title access points and discusses main and added access points (always a sore point for many catalogers, especially in the digital environment). Catalogers have to look all over Part II for access point provisions (for example, title access points are mentioned in chapter 21 only – and then just as a default provision and with little direction). Most importantly, AACR2 is not based on the idea of a *work*. Rather, it is very much based on the unit record system (that is, the *item*).

RDA puts considerably more emphasis on authority control as well as having a vastly different structure from its predecessor. As outlined in the "RDA Scope and Structure" [1] the new rules are "… divided into ten sections: sections 1-4 cover elements corresponding to the entity *attributes* defined in FRBR and FRAD; sections 5-10 cover elements corresponding to the *relationships* defined in FRBR and FRAD." (p. 7). Furthermore the choice of what type of record to create, once based on the format, is shifted to what "type of description" the record should represent – comprehensive, analytical or multi-level (that is, both comprehensive and analytical). In cataloging terminology an entry is "analytical" if it includes a description or analysis of the sub-parts of the resource being cataloged. In other words, with the RDA, the variety of resource formats represented in a library catalog is not in question. The question now centers more heavily on the scope of the representation. This shift in focus allows the catalog to accommodate the interpretation and/or depiction of relationships between resources more readily within a dynamic library environment. Current catalogs mostly operate on the premise that one record represents one resource. It is now possible with RDA to create records that may represent more than one

TABLE 1. RDA [1] and AACR2 [2] compared. (Left) RDA (37 chapters, 13 appendices) and (right) AACR2 (20 chapters, 5 appendices)

RESOURCE DESCRIPTION AND ACCESS (RDA)	
RECORDING ATTRIBUTES	
Introduction	
Section 1.	Chapters 1-4 Recording attributes of manifestation and item
Section 2.	Chapters 5-7 Recording attributes of work and expression
Section 3.	Chapters 8-11 Recording attributes of person, family, and corporate body
Section 4.	Chapters 12-16 Recording attributes of concept, object, event and place
RECORDING RELATIONSHIPS	
Section 5.	Chapter 17 Recording primary relationships between work, expression, manifestation, and item
Section 6.	Chapters 18-22 Recording relationships to persons, families, and corporate bodies
Section 7.	Chapter 23 Recording relationships to concepts, objects, events, and places associated with a work
Section 8.	Chapters 24-28 Recording relationships between works, expressions manifestations, and items
Section 9.	Chapters 29-32 Recording relationships between persons, families, and corporate bodies
Section 10.	Chapters 33-37 Recording relationships between concepts, objects, events, and places
Appendices A-M Glossary	

ANGLO-AMERICAN CATALOGING RULES, 2ND ED., REV.
PART I. DESCRIPTION
Introduction
Chapter 1 General rules
Chapters 2-12 Special Rules
Chapter 13 Analytical descriptions
PART II. HEADINGS, UNIFORM TITLES AND REFERENCES
Chapter 20 Introduction
Chapter 21 Choice of access points [main and added]
Chapter 22 Headings for persons
Chapter 23 Geographic names
Chapter 24 Headings for corporate bodies
Chapter 25 Uniform Titles
Chapter 26 Reference
Appendices A-E Index

resource, should the cataloger choose to do so, or to group and display single-item records in order to show more clearly how they are related.

However, as Oliver points out [10]:

> RDA is a content standard, not a display standard and not a metadata schema. RDA is a set of guidelines that indicates how to describe a resource, focusing on the pieces of information (or attributes) that a user is most likely to need to know. It also encourages the description of relationships between related resources and between resources and persons or bodies that contributed to creation of that resource. (p. 251)

Despite the fact that it is not an actual display standard, the possibilities of new display options in catalog systems is intriguing.

New Research Potentials

The prospect of the re-learning of library cataloging by seasoned catalogers and the re-engineering of bibliographic control systems is daunting, but we should also consider some of the areas of potential new research that may present themselves as a result of RDA, FRBR and FRAD.

The Library of Congress (LC), the National Library of Medicine (NLM) and the National Agricultural Library (NAL) are working together "to make a joint decision on whether or not to implement RDA, based on the results of a test of both RDA and the web product. The goal of the test is to assure the operational, technical and economic feasibility of RDA" [11]. These tests should generate a considerable amount of data for analysis and study. At the very least, the testing may simply reveal that the rules don't work and thus show us how *not* to develop cataloging guidelines, which is always a valuable lesson.

Here are some other areas, in no particular order, that hold possibilities. Where possible, corresponding research already in progress is noted:

- FRBR's four users tasks (find, identify, select, obtain). Are they successful? How are they supported in the library catalog? MARC content designation utilization (MCDU) project has investigated MARC support of these tasks [12].
- RDA implementation issues, feasibility studies, training issues, usability studies involving catalogers, reference librarians and the end-user as they work on creating and using RDA-based records, across all types of libraries. See programs given by the RDA Implementation Task Force (ALA) at 2008 and 2009 annual and mid-winter meetings or the National Library of Australia [13] on issues of implementation.
- Redesign of library systems in order to take advantage of the entity relationship modeling. See VTLS [14] and LC [15] for examples of FRBR display software.
- More in-depth studies of bibliographic relationships, bibliographic families and how these relationships impact user searching and bibliographic control or if they are successfully represented using RDA and similar questions.
- Entity-relationship models and visualizing new cataloging workflows; how the ER model of work, expression, manifestation, item (WEMI) is used to portray relationships between resources, its impact resource discovery, user satisfaction and other factors. See the cataloging scenarios at the Dublin Core Metadata Initiative website [16].
- Impact on encoding standards such as MARC and Dublin Core [17], [12]
- Historical studies of cataloging rules, changes in these rules and AACR1, AACR2 implementations (for example Knowlton's recent article in *Library Resources & Technical Service* on criticism of cataloging code reform 1957-66 [18]).
- Diffusion of RDA within the cataloging community, rate of adoption and understanding by libraries and catalogers
- Re-conceptualization of bibliographic control: This will perhaps be the most impacted area of LIS. See recent reports such as *On the Record* by the Working Group for the Future of Bibliographic Control at the Library of Congress [19], as well as the public testimonies submitted to the group by members of the cataloging community. Recommendations from the report – the guiding principles, Chapter 3, Chapter 4 and Chapter 5, in particular, should be considered.
- Re-defining the library catalog – what are the boundaries of the catalog, objectives of the catalog. These issues are worthy of a serious

dissertation or two. (For example, see the *RDA-L* listserv [6] thread "libraries, society and RDA" from Nov 2008.)

- Addition of non-traditional data to bibliographic records such as citation data, reviews and tag clouds
- Studies such as Shoichi Taniguchi's work on orientedness in cataloging rules, recording the history of changes in data values, design of cataloging rules and similar topics ([20], [21], [22], [23], [24], [25])
- Interoperability between library systems, copy cataloging, outsourcing of records as impacted by choice of type of description (comprehensive, analytical or multilevel)
- Bibliographic control education in LIS programs – new curriculum, standards, textbooks, manuals and other teaching materials, especially the problem of when, and if, to stop teaching AACR2 and when to start teaching RDA. ■

Resources Mentioned in the Article

[1] Joint Steering Committee for the Development of Resource Description and Access. (2009). *Resource description and access*. Retrieved May 1, 2009, from www.rdaonline.org/constituencyreview/.

[2] Joint Steering Committee for the Revision of AACR2. (2002). *Anglo-American cataloguing rules*, (2nd ed., rev. with 2004 updates). Chicago: American Library Association.

[3] International Federation of Library Associations, IFLA Study Group on the Functional Requirements for Bibliographic Records. (1998). *Functional requirements for bibliographic records: Final report*. Retrieved May 1, 2009, from http://archive.ifla.org/VII/s13/frbr/frbr_2008.pdf.

[4] International Federation of Library Associations, IFLA Study Group on the Functional Requirements and Numbering of Authority Records. (2008). *Functional Requirements for Authority Data*. Retrieved October 17, 2008, from http://archive.ifla.org/VII/d4/wg-franar.htm. (May 1, 2009: Please note the actual pdf is not currently linked – a final version of FRAD is in the works.)

[5] *Planet Cataloging* (web log): http://planetcataloging.org/.

[6] *RDA-L* (listserv): www.collectionscanada.gc.ca/jsc/rdadiscuss.html.

[7] The Cataloguing Committee of the Swedish Library Association. (2009). *Comments on the final draft of RDA*. Retrieved May 1, 2009, from www.biblioteksforeningen.org/komm/katalog/pdf/sweden_comments%20on%20the%20final_draft_of_RDA_20090201.pdf.

[8] Howarth, L., & Weihs, J. (2007). Making the link: AACR to RDA: Part I: Setting the stage. *Cataloging and Classification Quarterly, 45*(2), 3-18.

[9] Denton, W. (2008). Entity-relationship chart. Retrieved May 1, 2009, from www.frbr.org/files/entity-relationships.png.

[10] Oliver, C. (2007). Changing to RDA. *Feliciter, 53*(7), 250-253. Retrieved May 1, 2009, from www.collectionscanada.gc.ca/jsc/docs/felicitervol53no7p250-253.pdf.

[11] Bibliographic Control Working Group, Library of Congress. (2009). Testing Resource Description and Access (RDA). Retrieved May 1, 2009, from www.loc.gov/bibliographic-future/rda/.

[12] Miksa, S., Moen, W., Snyder, G., Polyakov, S. & Eklund, A. (2006). Metadata assistance of the Functional Requirements for Bibliographic Records' four user tasks: A report on the MARC Content Designation Utilization (MCDU) Project. In G. Budin, C. Swertz, & K. Mitgutsch (Eds.). *Knowledge organization for a global learning society: Proceedings of the Ninth International ISKO Conference (Vienna, Austria, July 4-7, 2006)* (pp. 41-49). Würzburg: Ergon. (*Advances in Knowledge Organization, 10*).

[13] Australian Committee on Cataloguing, National Library of Australia. (2009). Resource Description and Access. Retrieved May 1, 2009, from www.nla.gov.au/lis/stndrds/grps/acoc/rda.html.

[14] *Visionary Technology in Library Solutions* (*VTLS*): www.vtls.com/.

[15] Network Development and MARC Standards Office, Library of Congress. (2009). *FRBR Display Tool*. (Version 2.0.) Retrieved May 1, 2009, from www.loc.gov/marc/marc-functional-analysis/tool.html.

[16] Dublin Core Metadata Initiative. (2009). *Scenarios*. Retrieved May 1, 2009, from http://dublincore.org/dcmirdataskgroup/Scenarios.

[17] RDA/MARC Working Group. (2009). Retrieved May 1, 2009, from www.collectionscanada.gc.ca/jsc/rdamarcwg.html.

[18] Knowlton, S. (2009). Criticism of cataloging code reform, as seen in the page of Library Resources and Technical Services (1957-66). *Library Resources and Technical Services, 53*(1), 15-24.

RESOURCES continued on next page

Resources Mentioned in the Article, continued

[19] Library of Congress Working Group for the Future of Bibliographic Control. (2008). *On the record*. Retrieved May 1, 2009, from www.loc.gov/bibliographic-future/news/lcwg-ontherecord-jan08-final.pdf.

[20] Taniguchi, S. (1996). A system for analyzing cataloging rules: A feasibility study. *Journal of the American Society for Information Science, 47*(5), 338-356.

[21] Taniguchi, S. (1999). An analysis of orientedness in cataloging rules. *Journal of the American Society for Information Science, 50*(5), 448-460.

[22] Taniguchi, S. (2004). Design of cataloging rules using conceptual modeling of cataloging process. *Journal of the American Society for Information Science and Technology, 55*(6), 498-512.

[23] Taniguchi, S. (2005). Recording evidence in bibliographic records and descriptive metadata. *Journal of the American Society for Information Science and Technology, 56*(8), 872-882.

[24] Taniguchi, S. (2006). A system for supporting evidence recording in bibliographic records. *Journal of the American Society for Information Science and Technology, 57*(9), 1249-1262.

[25] Taniguchi, S. (2007). A system for supporting evidence recording in bibliographic records. Part II: What is valuable evidence for catalogers? *Journal of the American Society for Information Science and Technology, 58*(6), 823-841.

Selected Abstracts from *JASIST*

Authors who choose to do so prepare and submit these summaries to the editor of the *Bulletin*.

From *JASIST* v. 60 (4)

Wu, I.-L.& Lin, H.-C., (2009). A strategy-based process for implementing knowledge management: An integrative view and empirical study (789-802).

Study and Results: This study proposes a strategy-based process for implementing knowledge management with four components: competitive strategy, knowledge strategy, implementation approach and company performance. It develops three hypotheses to verify the relationships between any two consecutive components. Measurement is designed from relevant literature and used to collect empirical data. The firms from knowledge-intensive industries, including manufacturing, service and financial industries, are selected as the study sample. Chief information/knowledge officers are the major respondents. We used contingency tables with Chi-square statistics to analyze their relationships. The results indicate that different competitive strategies will have significant impact on the selection of knowledge strategies and, in turn, technology implementation approaches, to effectively manage knowledge resources.

What's New? Many researchers explore knowledge management performance from knowledge infrastructure and process within organizational boundaries. This study has approached it from the perspective of competitive strategy. This approach has shown better company performance through effective knowledge management. We suggest that practitioners consider this model to plan their knowledge management projects in the future.

Limitations: The respondents are mainly from manufacturing industries, and the empirical results may possibly limit ability to generalize to other industries.

Liu, R.-L. (2009). Context recognition for hierarchical text classification (803-813).

Study and Results: Automatic text classification may be improved by recognizing each category's *context of discussion* (COD), which is governed by the main contents of the category's ancestor categories in a given hierarchy.

What's New? A novel COD recognition technique is developed, whose performance is both better and more stable. It does not require any trials to manually set parameters and, therefore, is more portable and easier to implement. The contributions are significant to the management and dissemination of information, since much textual information has been hierarchically organized, and by classifying texts into suitable categories, information may be properly archived, retrieved and recommended to those users interested in corresponding categories.

Limitations: A set of texts labelled with suitable categories in a hierarchy needs to be given so that the text classifier may be constructed automatically.

Westbrook, L. (2009). Information myths and intimate partner violence: Sources, contexts, and consequences (826-836).

Study and Results: Survivors of intimate partner violence (IPV) face more than information gaps; many face powerful barriers in the form of information myths. Triangulating data from in-depth interviews and community bulletin board postings, this study incorporates insights from survivors, police and shelter staff to begin mapping the information landscape through which survivors move. An unanticipated feature of that landscape is a set of 28 compelling information myths that prevent some survivors from making effective use of the social, legal, economic and support resources available to them. The myths fall into four categories: (1) IPV, abusers and survivors; (2) issues with children; (3) interacting with government agencies, including police and Child Protective Services (CPS); and (4) interacting with shelters and civil law.

What's New? Librarians are particularly well situated to help service providers address the implications of and identify resources to counter the effects of these information myths. By examining the information perspective in serving these individuals in crisis, librarians can assist both IPV survivors and those social service staff who support survivor safety.

Limitations: This qualitative study draws primarily from U.S. bulletin board postings and interviews throughout the state of Texas. Additional sites and online communities may well deal with additional myths. ■