Humanexus: Envisioning Communication and Collaboration

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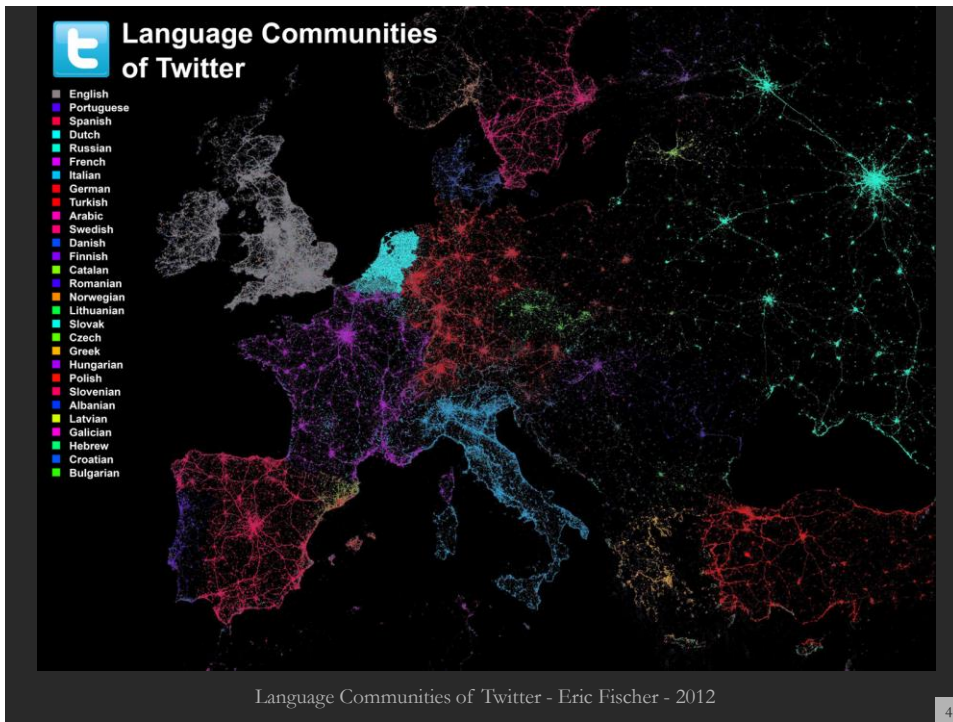June 12, 2014

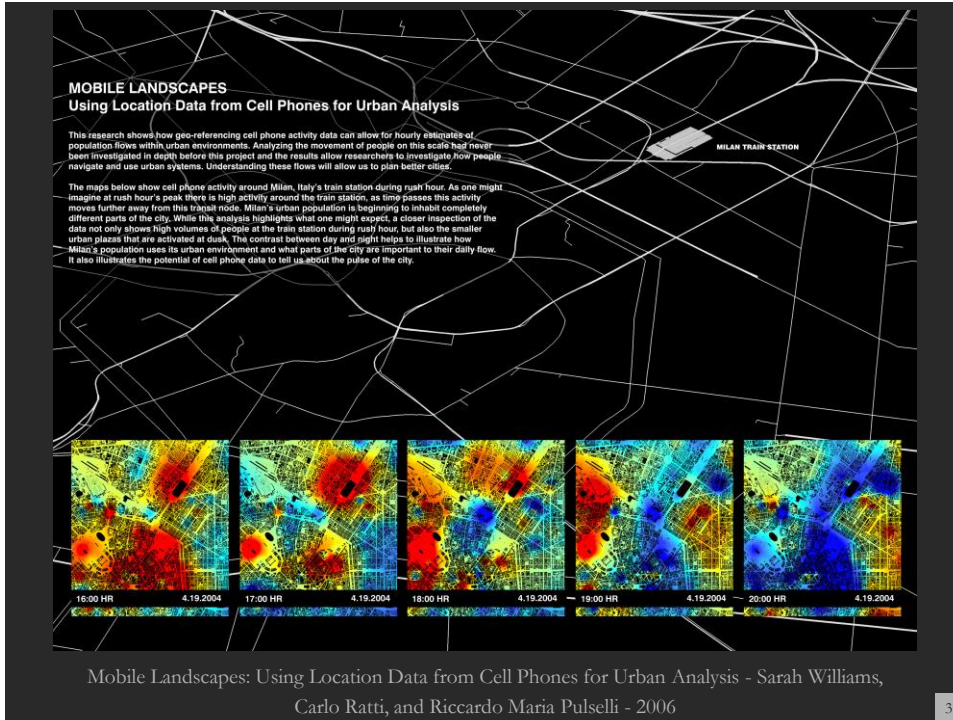
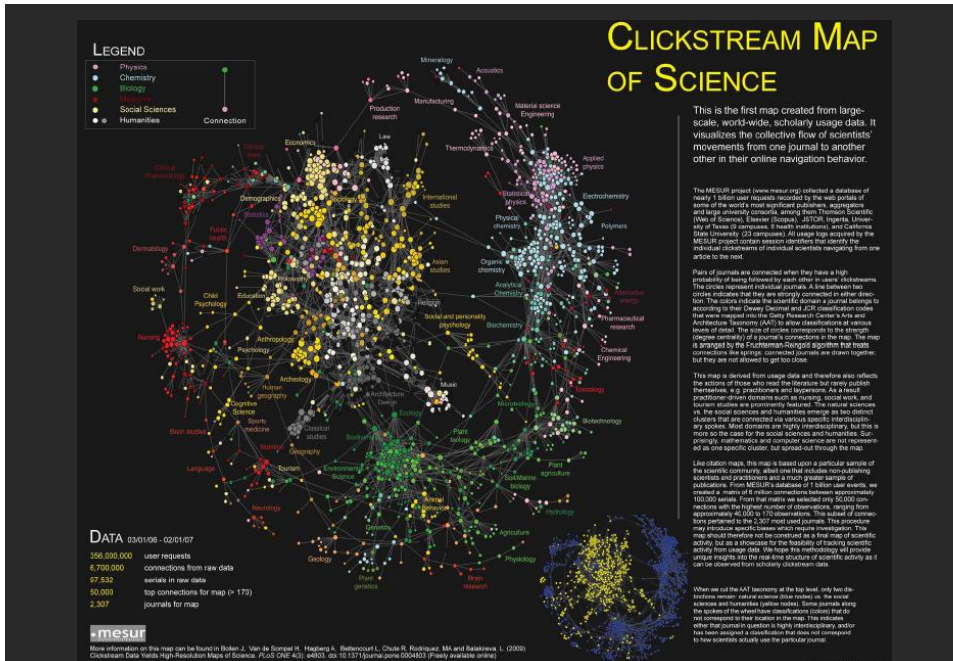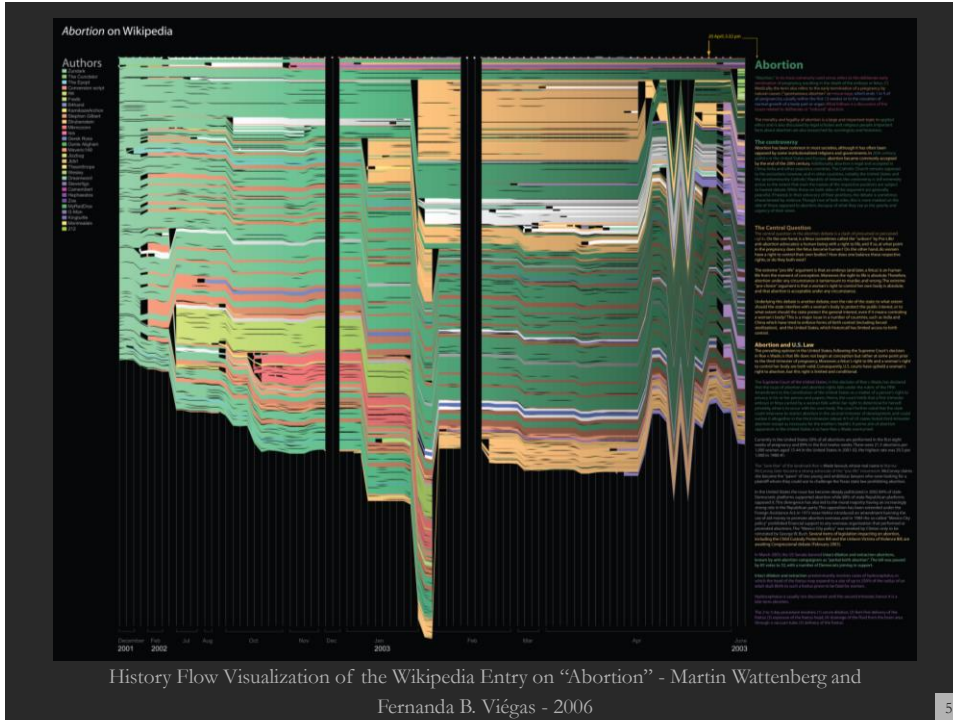Humanexus   *Watch the official trailer »*

Producer/Script Writer: Katy Börner, Designer/Artist: Ying-Fang Shen, Sound Artist: Norbert Herber, 2013.
http://cns.iu.edu/humanexus

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Mobile Landscapes: Using Location Data from Cell Phones for Urban Analysis - Sarah Williams, Carlo Ratti, and Riccardo Maria Pulselli - 2006

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Language Communities of Twitter - Eric Fischer - 2012

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History Flow Visualization of the Wikipedia Entry on "Abortion" - Martin Wattenberg and
Fernanda B. Viégas - 2006

Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriquez,
Lyudmila Balakireva. 2008. A Clickstream Map of Science.

Map of Scientific Collaborations from 2005-2009

Computed Using Data from Elsevier's Scopus

Olivier H. Beauchesne, 2011. Map of Scientific Collaborations from 2005-2009.

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Places & Spaces: Mapping Science Exhibit
http://scimaps.org

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Publications and Citations:

Spatio-Temporal Knowledge Production and
Consumption: In the U.S. and World-Wide

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## Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

Börner, Katy, Penumarthy, Shashikant, Meiss, Mark and Ke, Weimao. (2006) Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.

Research questions:
1. Does space still matter in the Internet age?
2. Does one still have to study and work at major research institutions in order to have access to high quality data and expertise and to produce high quality research?
3. Does the Internet lead to more global citation patterns, i.e., more citation links between papers produced at geographically distant research instructions?

Contributions:
- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them.
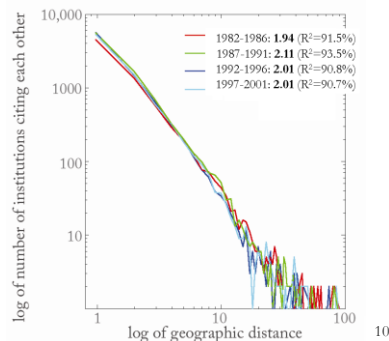
The Global 'Scientific Food Web'

Mazloumian, Amin, Dirk Helbing, Sergi Lozano, Robert Light, and Katy Börner. 2013. "Global Multi-Level Analysis of the 'Scientific Food Web'". Scientific Reports 3, 1167.
http://cns.iu.edu/docs/publications/2013-mazloumian-food-web.pdf

Contributions:

Comprehensive global analysis of scholarly knowledge production and diffusion on the level of continents, countries, and cities.

Quantifying knowledge flows between 2000 and 2009, we identify global sources and sinks of knowledge production. Our knowledge flow index reveals, where ideas are born and consumed, thereby defining a global 'scientific food web'.

While Asia is quickly catching up in terms of publications and citation rates, we find that its dependence on knowledge consumption has further increased.
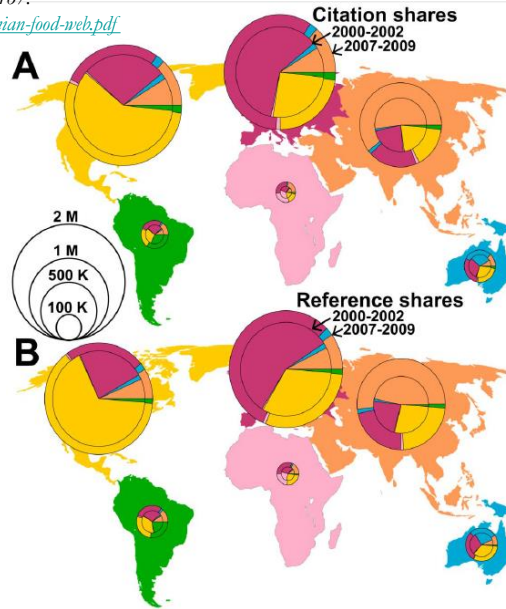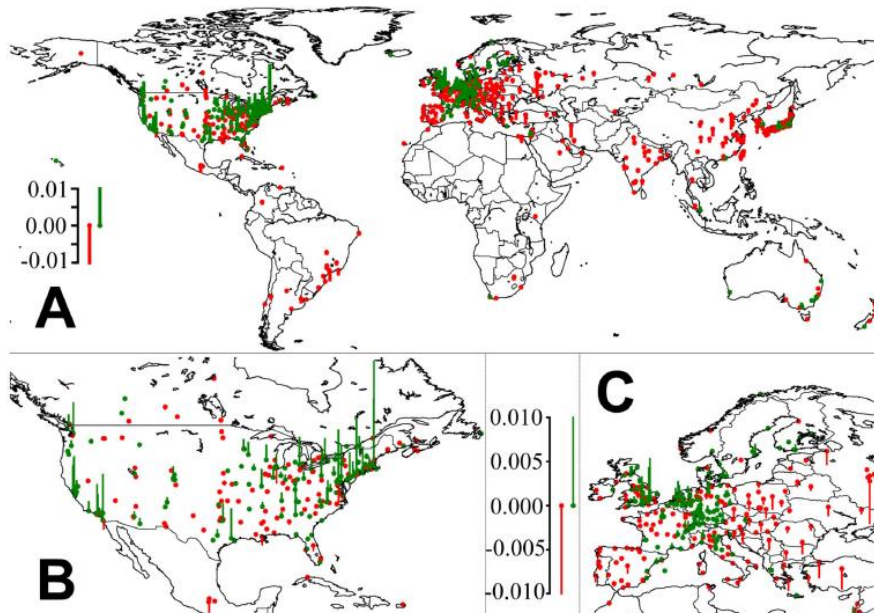

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Figure 2 | World map of the greatest knowledge sources and sinks, based on our scientific fitness index. Green bars indicate that the number of citations received is over-proportional, red that the number of citations received is lower than expected (according to a homogeneous distribution of citations over all cities that have published more than 500 papers). It can be seen that most scientific activity occurs in the temperate zone. Moreover, areas of high fitness tend to be areas that are performing economically well (but the opposite does not hold).
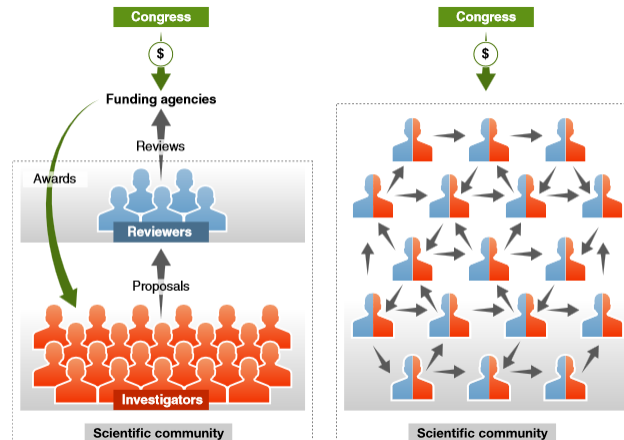
Government Funding:

Collective allocation of science funding as an alternative to peer review

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From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review
Bollen, Johan, David Crandall, Damion Junk, Ying Ding, and Katy Börner. 2014. EMBO Reports 15 (1): 1-121.

Existing (left) and proposed (right) funding systems. Reviewers in blue; investigators in red.

In the proposed system, all scientists are both investigators and reviewers: every scientist receives a fixed amount of funding from the government and discretionary distributions from other scientists, but each is required in turn to redistribute some fraction of the total they received to other investigators.

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Bollen, Johan, David Crandall, Damion Junk, Ying Ding, and Katy Börner. 2014. EMBO Reports 15 (1): 1-121.

Assume

Total funding budget in year y is t_y

Number of qualified scientists is *n*

Each year,

the funding agency deposits a fixed amount into each account, equal to the total funding budget divided by the total number of scientists: t_y/n.

Each scientist must distribute a fixed fraction of received funding to other scientists (no self-funding, COIs respected).

Result

Scientists collectively assess each others' merit based on different criteria; they "fund-rank" scientists; highly ranked scientists have to distribute more money.
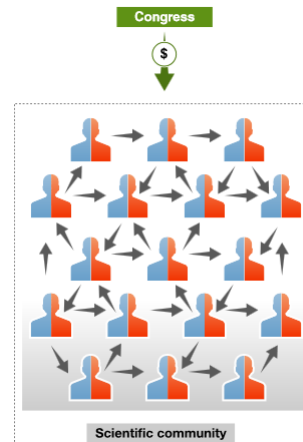
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**Example:**

Total funding budget in year is 2012 NSF budget

Given the number of NSF funded scientists, each receives a $100,000 basic grant.

Fraction is set to 50%

In 2013, scientist *S* receives a basic grant of $100,000 plus $200,000 from her peers, i.e., a total of $300,000.

In 2013, *S* can spend 50% of that total sum, $150,000, on her own research program, but must donate 50% to other scientists for their 2014 budget.

Rather than submitting and reviewing project proposals, *S* donates directly to other scientists by logging into a centralized website and entering the names of the scientists to donate to and how much each should receive.
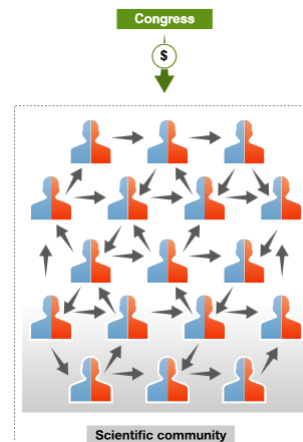
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From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review

Bollen, Johan, David Crandall, Damion Junk, Ying Ding, and Katy Börner. 2014. EMBO Reports 15 (1): 1-121.

Model Run and Validation:

Model is presented in http://arxiv.org/abs/1304.1067

It uses **citations as a proxy** for how each scientist might distribute funds in the proposed system.

Using 37M articles from TR 1992 to 2010 Web of Science (WoS) database, we extracted **770M citations**. From the same WoS data, we also determined 4,195,734 unique author names and we took the **867,872 names** who had authored at least one paper per year in any five years of the period 2000–2010.

For each pair of authors we determined the number of times one had cited the other in each year of our citation data (1992–2010).

NIH and NSF funding records from IU's Scholarly Database provided 347,364 grant amounts for 109,919 unique scientists for that time period.

Simulation run begins in year 2000, in which every scientist was given a fixed budget of B = \$100k. In subsequent years, scientists distribute their funding in proportion to their citations over the prior 5 years.

The model yields funding patterns similar to existing NIH and NSF distributions.
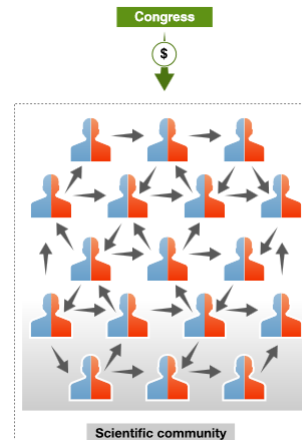
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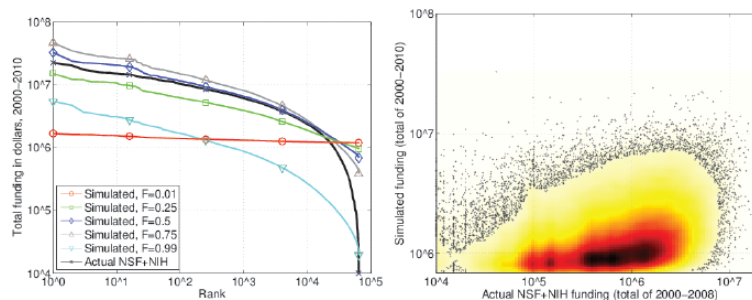
Fig. 2: Results of the distributed funding system simulation for 2000-2010. *(a):* The general shape of the funding distribution is similar to that of actual historical NSF and NIH funding distribution. The shape of the distribution can be controlled by adjusting F, the fraction of funds that scientists must give away each year. *(b):* On a per-scientist basis, simulated funding from our system (with F=0.5) is correlated with actual NSF and NIH funding (Pearson $R = 0.2683$ and Spearman $\rho = 0.2999$).

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Model Efficiency:

Using data from the Taulbee Survey of Salaries Computer Science (*http://cra.org/resources/taulbee*) and the National Science Foundation (NSF) the following calculation is illuminating:

If four professors work four weeks full-time on a proposal submission, labor costs are about $30k. With typical funding rates below 20%, about five submission-review cycles might be needed resulting in a total expected labor cost of **$150k**.
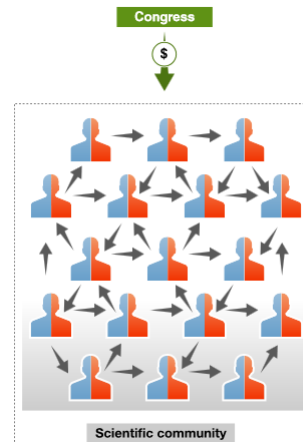
The average NSF grant is **$128k** per year.

U.S. universities charge about 50% overhead (ca. $42k), leaving about **$86k**.

In other words, the four professors lose **$150k-$86k=$64k** of paid research time by obtaining a grant to perform the research.

That is, U.S. universities should forbid professors to apply for grants—if they can afford to forgo the indirect dollars.

To add: Time spent by researchers to review proposals. In 2012 alone, NSF convened more than 17,000 scientists to review 53,556 proposals.

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Register for free at http://ivmooc.cns.iu.edu. Class will restart in January 2015.

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References

Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, Volume 37, Chapter 5, pp. 179-255. http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf

Shiffrin, Richard M. and Börner, Katy (Eds.) (2004). **Mapping Knowledge Domains**. *Proceedings of the National Academy of Sciences of the United States of America*, 101(Suppl_1). http://www.pnas.org/content/vol101/suppl_1/

Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science.** In Blaise Cronin (Ed.), *ARIST*, Information Today, Inc., Volume 41, Chapter 12, pp. 537-607.
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Katy Börner, Michael Conlon, Jon Corson-Rikert, Cornell, Ying Ding (2012) **VIVO: A Semantic Approach to Scholarly Networking and Discovery**. Morgan & Claypool.

Katy Börner and David E Polley (2014) **Visual Insights: A Practical Guide to Making Sense of Data**. MIT Press.

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All papers, maps, tools, talks, press are linked from http://cns.iu.edu
These slides will soon be at http://cns.iu.edu/docs/presentations

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Mapping Science Exhibit Facebook: http://www.facebook.com/mappingscience

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