CNS Macroscopes are used by hundreds of thousands around the globe

Our mission is to advance datasets, tools, and services for the study of biomedical, social and behavioral science, physics, and other networks. A specific focus is research on the structure and evolution of science and technology (S&T) and the communication of results via static and interactive maps of science. Learn more at cishell.org.

CNS Cyberinfrastructure for Network Science Center
cns.iu.edu

20+ CNS staff and students work on 20+ projects

- **Monitoring, Modeling, and Forecasting Tools for Fostering an Innovative S&T Workforce**. NIH U01 GM098959-01 (Katy Börner & James P. Crutchfield, UC Davis)
- **Scaling Philanthropy: Providing New Insight About Million Dollar Gifts**. Bill & Melinda Gates Foundation (Patrick Rooney, Una O. Osili)
- **Mapping the Emergence and Development of Scientific Disciplines.** James S. McDonnell Foundation
- **Pathways: Sense-Making of Big Data.** NSF ISE DRL-1223698 (Katy Börner, Adam V. Maltese, Joe E. Heimlich, Stephen Miles Uzzo, Paul Martin, and Sasha Palmquist)
- **Introducing the Science of Science (Sci2) Tool to the BBSRC Policy Evidence Team**. BBSRC, UK.
- …

The Global 'Scientific Food Web'

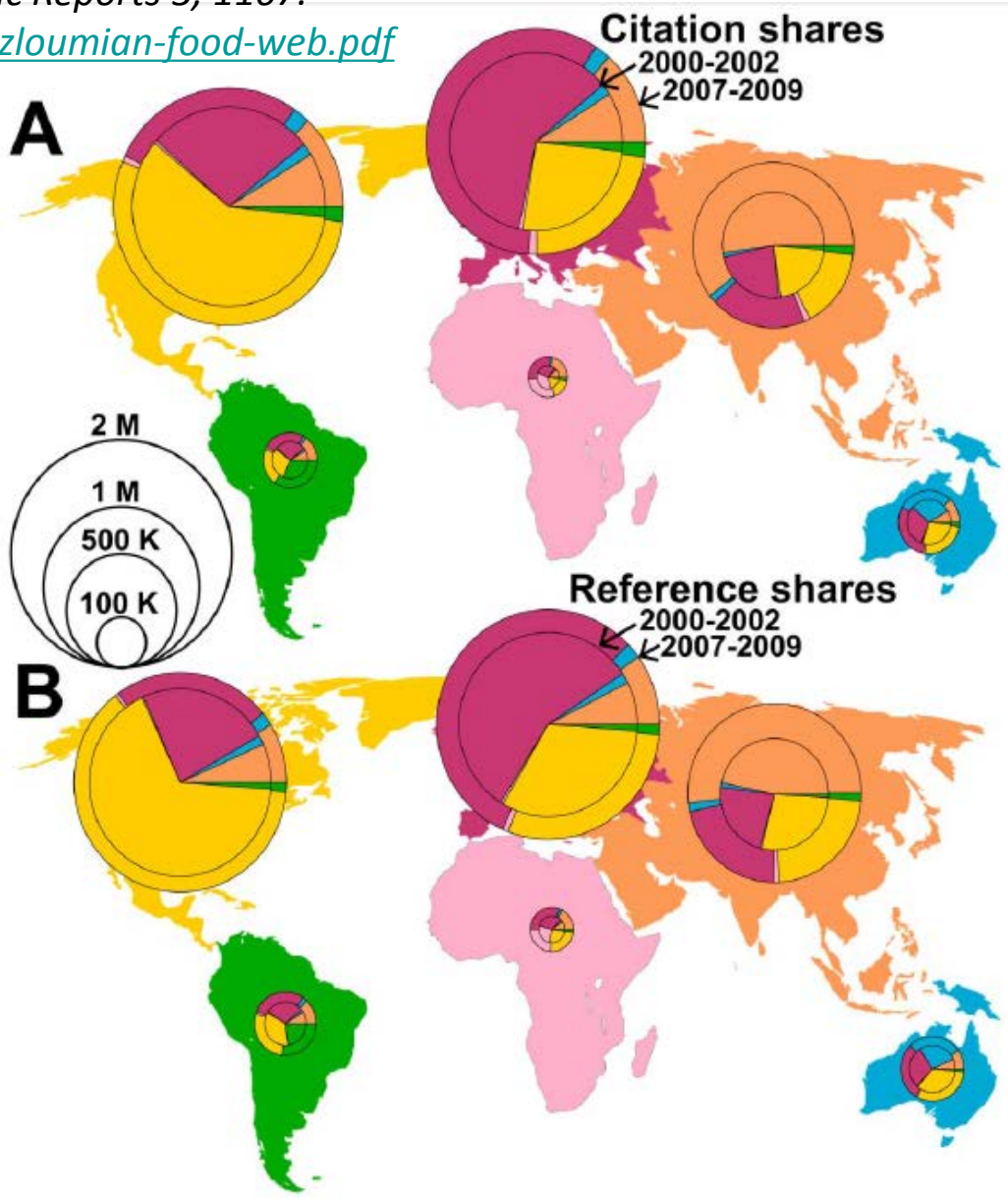
Mazloumian, Amin, Dirk Helbing, Sergi Lozano, Robert Light, and Katy Börner. 2013. "Global Multi-Level Analysis of the 'Scientific Food Web'". Scientific Reports 3, 1167.
http://cns.iu.edu/docs/publications/2013-mazloumian-food-web.pdf

Contributions:

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

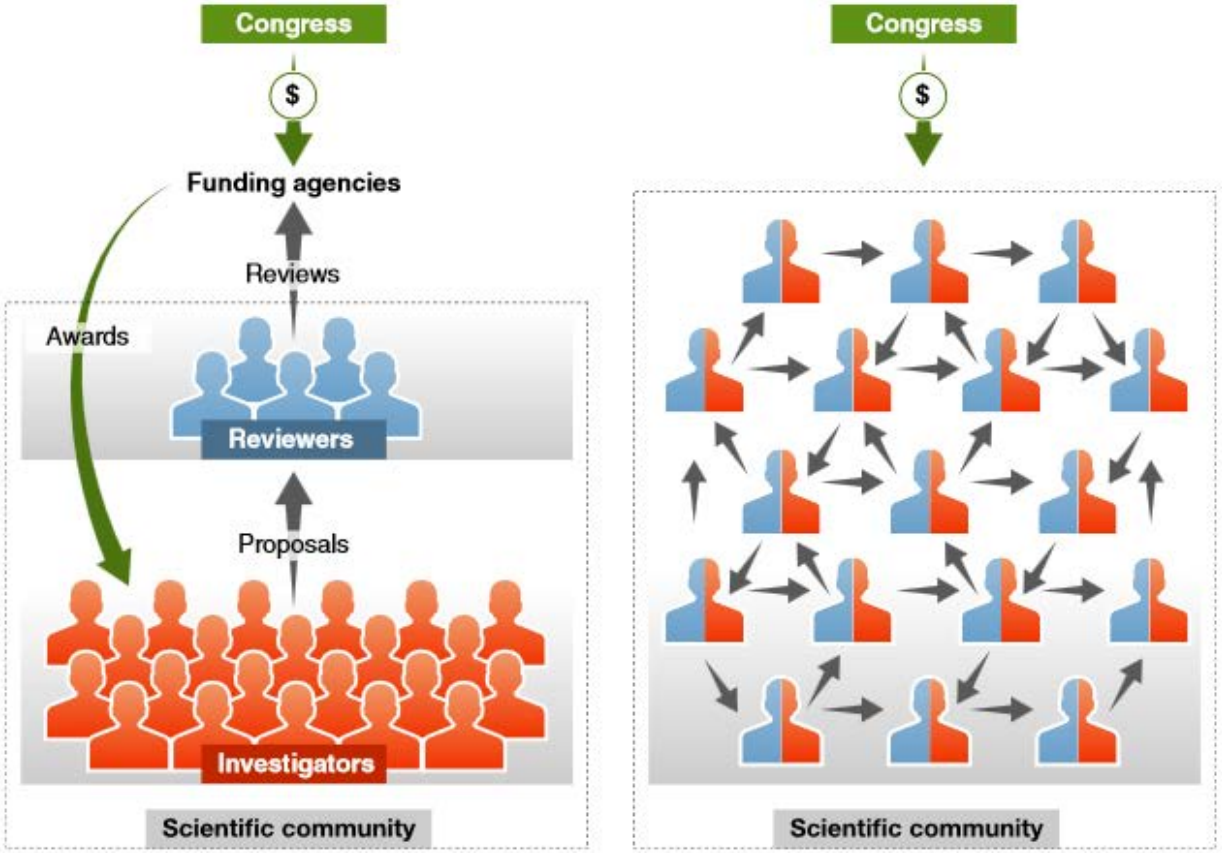
Quantifying knowledge flows between 2000 and 2009, we identify global sources and sinks of knowledge production. Our knowledge flow index reveals, where ideas are born and consumed, thereby defining a global 'scientific food web'.

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



From funding agencies to scientific agency: Collective allocation of science funding as an alternative to peer review

Bollen, Crandall, Junk, Ding & 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.

Atlas of Knowledge: Anyone Can Map

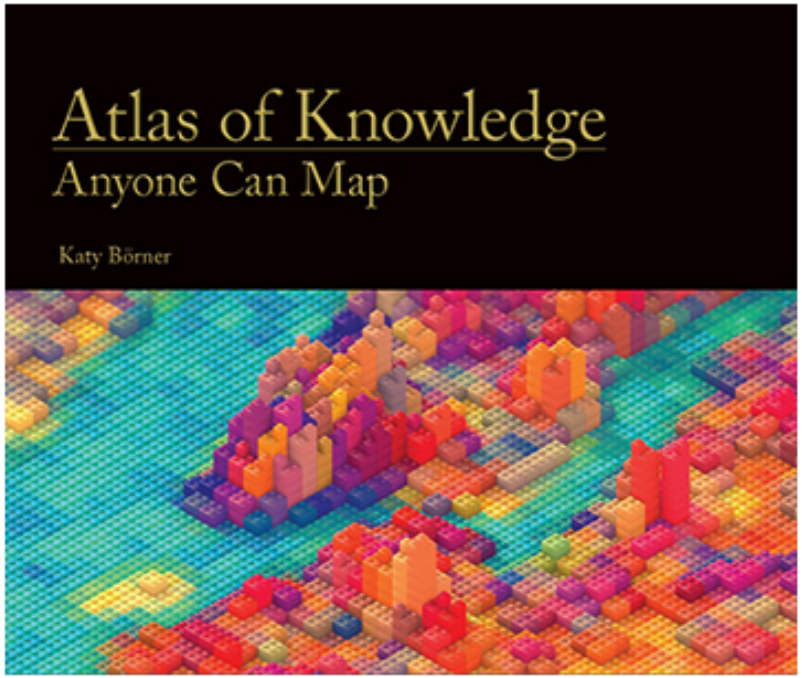
« back to the store

by Katy Börner
To be published by MIT Press in early 2015

13 x 11, 250 pp.
580 illus.
978-0-262-02881-3

Introduction | Author | Awards | History | Vendors | Images | References | Q&A | Press

Introduction



In an age of information overload, the ability to make sense of vast amounts of data and to render insightful visualizations is as important as the ability to read and write. The *Atlas of Knowledge* explains and exemplifies the power of visualizations not only to help locate us in physical space but also to help us understand the extent and structure of our collective knowledge, to identify bursts of activity, pathways of ideas, and borders that beg to be crossed.

Drawing on 15 years of research and tool development, the *Atlas* introduces a theoretical visualization framework meant to empower anyone to systematically render data into insights. It aims to teach "timeless" knowledge that holds true over a lifetime while referring to an extensive set of references for "timely" advice on what tool and workflow is currently the best for answering a specific question.

http://scimaps.org/atlas_of_knowledge.html

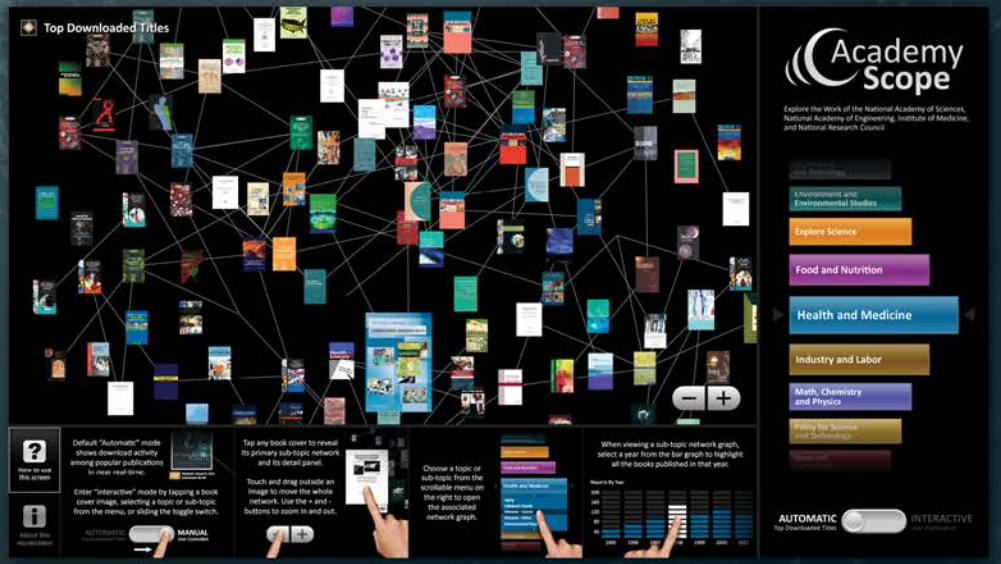
AcademyScope

AcademyScope is a state-of-the-art, interactive touch-screen visualization developed by CNS in collaboration with the National Academy of Sciences.

Using a 55-inch, multi-touch screen, viewers can explore 20 years of reports published by the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council.

Beginning in October 2014, the *AcademyScope* web application is available to the public through the National Academies Press website. Users can acccess the application through the "Browse by Topic" menu on the NAP homepage (www.nap.edu), or via the "Browse Topics" button in the header of every interior page. The application can also be accessed directly at www.nap.edu/academy-scope.

Visit cns.iu.edu/interactive_displays to learn more about the design and programming.



CNS Cyberinfrastructure for Network Science Center
cns.iu.edu

IVMOOC 2015

The Information Visualization MOOC provides an overview about the state of the art in information visualization, teaching the process of producing effective visualizations that take the needs of users into account.

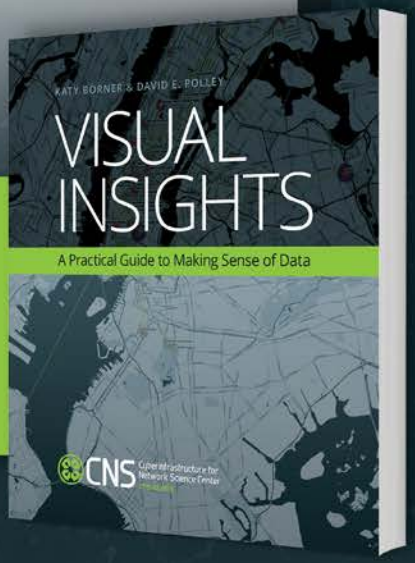
The inaugural IVMOOC, which launched in January 2013, attracted participants from more than 100 countries. It is one of the first MOOCs offered by IU and the first to offer an opportunity for students to work in teams with real clients. All registrants gain free access to the Scholarly Database and the Sci2 Tool.

The course can be taken for three Indiana University credits as part of the Online Data Science Program offered by the School of Informatics and Computing.

The course will return in January 2015. Learn more at ivmooc.cns.iu.edu.

CNS Cyberinfrastructure for Network Science Center
cns.iu.edu

This IVMOOC companion textbook offers a gentle introduction to the design of insightful visualizations. It seamlessly blends theory and practice, giving readers both the theoretical foundation and the practical skills necessary to render data into insights.



Places & Spaces Exhibit

This exhibit aims to demonstrate the power of maps to navigate and make sense of physical places and abstract topic spaces. The tenth and final iteration of maps debuted at the University of Miami on September 4, 2014, where all 100 maps will remain in display through December 11, 2014.

Phase 2 of this unique exhibit is designed to bring Macroscope tools to public places to help exhibit visitors not only learn how to **read** science maps but how to **make** them.

See all the maps and more at the new scimaps.org.

PLACES & SPACES
MAPPING SCIENCE

CNS Cyberinfrastructure for Network Science Center
cns.iu.edu

Humanexus

This groundbreaking semi-documentary animation is the result of a collaboration between Katy Börner, artist Ying-Fang Shen, and sound designer Norbert Herber. The film visualizes human communication from the Stone Age to today and beyond. It aims to make tangible the enormous changes in the quantity and quality of our collective knowledge and the impact of different media on knowledge exchange.

Since its release in 2013, *Humanexus* has won 20 awards around the world, including Third Prize at the Aviff Cannes Art Film Festival, Best in Show at the Virginia Museum of Contemporary Art's New Wave 2014, and Best Animation at the 2014 Dublin International Short Film and Music Festival.

Learn more about the film and watch the trailer at cns.iu.edu/humanexus.

CNS Cyberinfrastructure for Network Science Center
cns.iu.edu

MEDLINE-Based Career Length Analysis

- Dr. Katy Borner, Principal Investigator
- Robert Light, Senior Systems Analyst, Database Administrator

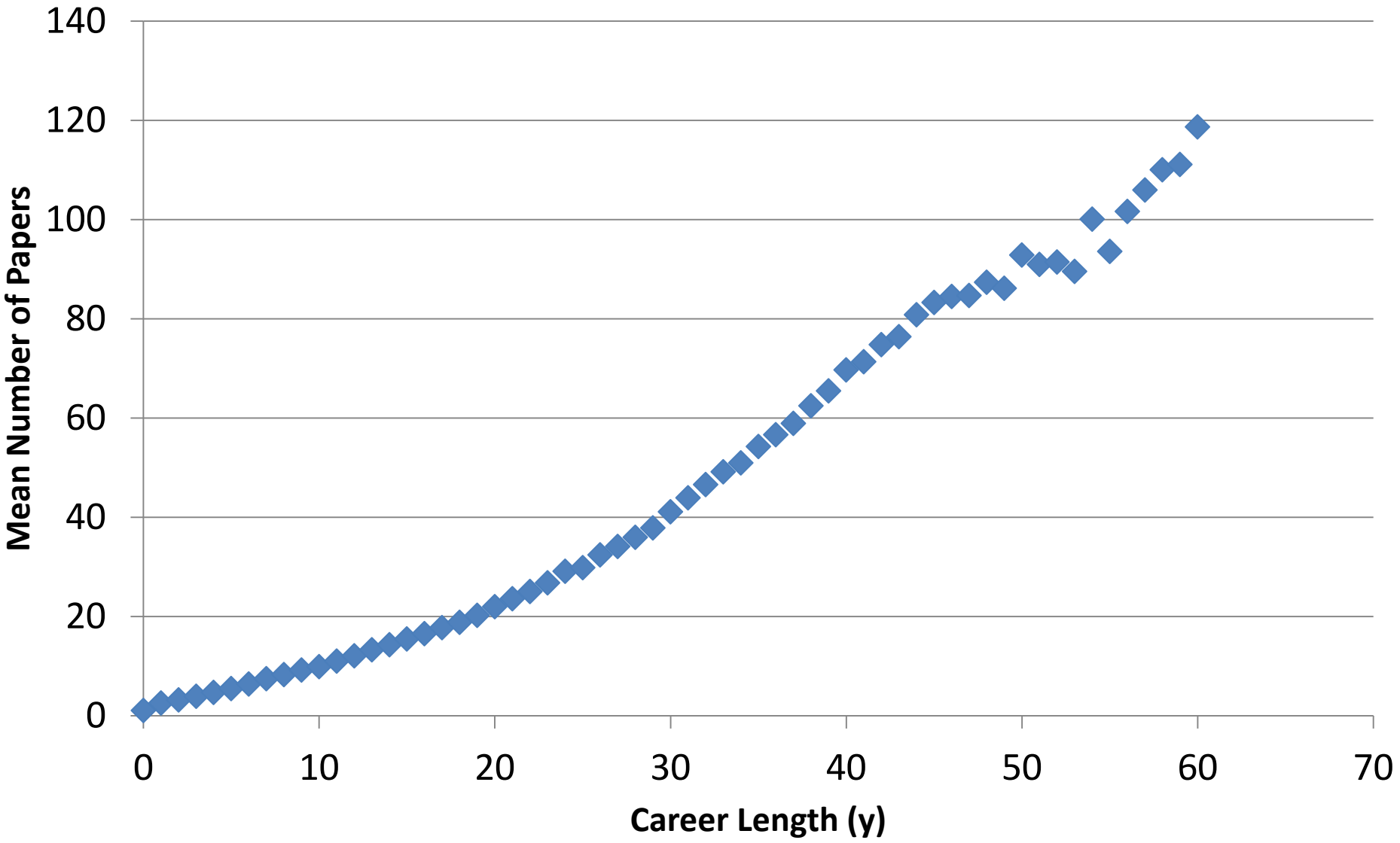
Career Length Questions

- At what point in a career is High Impact and Transformative Science (HITS) produced?
- Does the elimination of the mandatory retirement age influence the way that science and in particular HITS is produced?

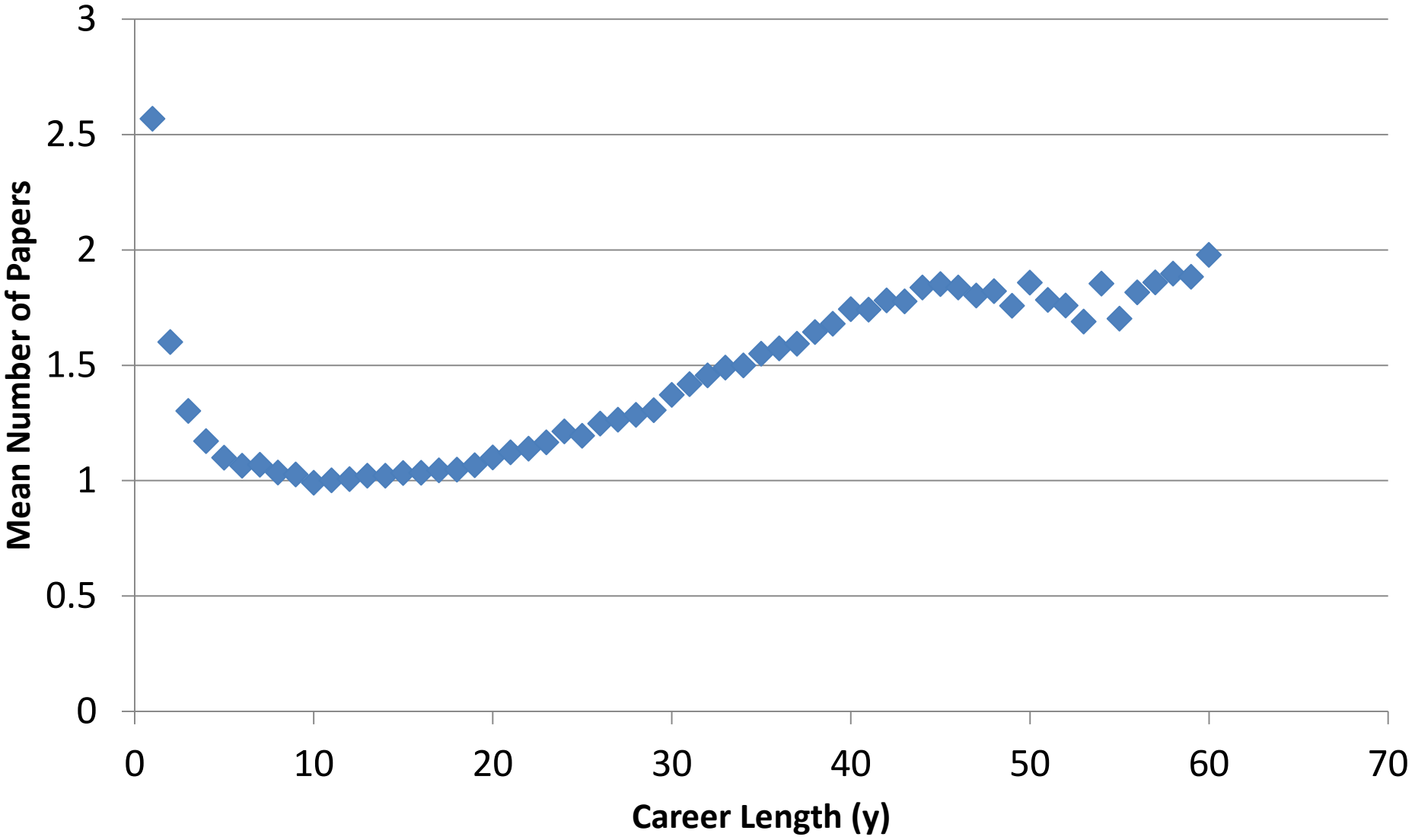
Career Duration Analysis

- Can we disambiguate authors and identify careers from MEDLINE data?
- What can we learn about not only the length of careers but how those careers progress from the MEDLINE data?
- Based on Torvik and Smalheiser's Author-ity dataset.

Mean Number of Papers vs Career Length



Papers/Year vs Career Length



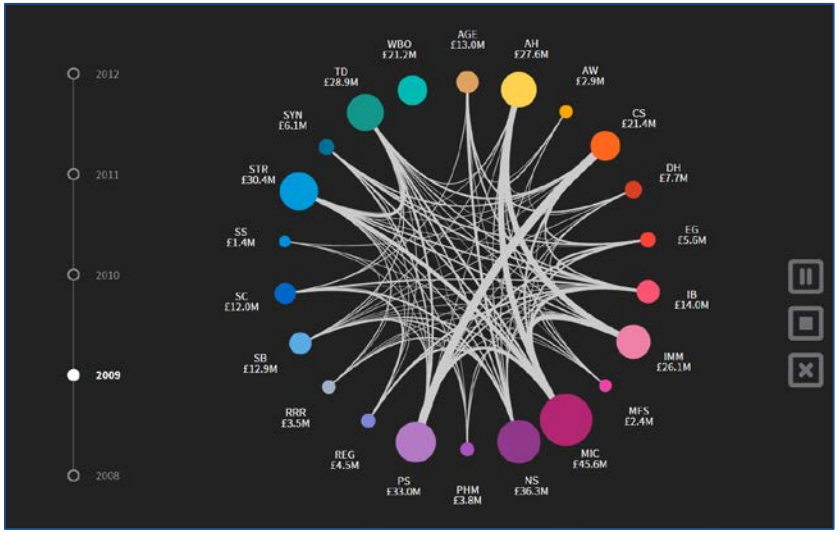
Open Questions

- When are the high impact papers being written in the field of aging? (Early, middle or late career)
- Is this consistent with medical science as a whole?

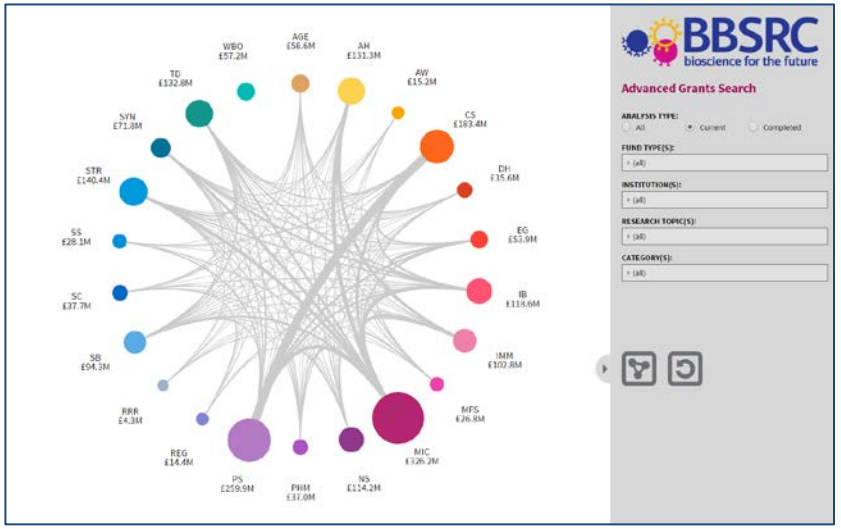
BBSRC

Biotechnology and Biological Sciences Research Council

Grant Analysis
Front-end filtering, data drill-down, animation over time
Filter by: Analysis Type, Funding Types, Institutions, Research Topics, Categories



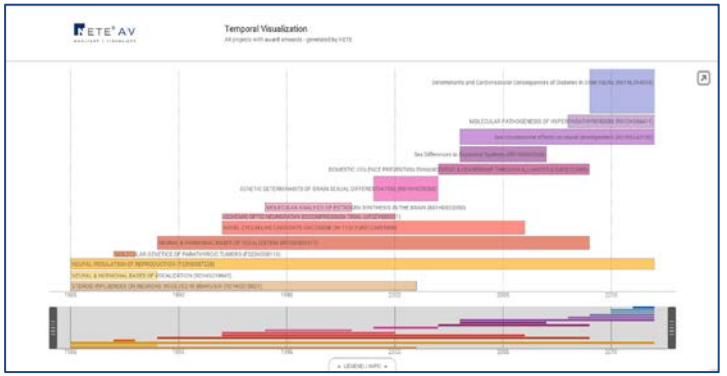
Animation



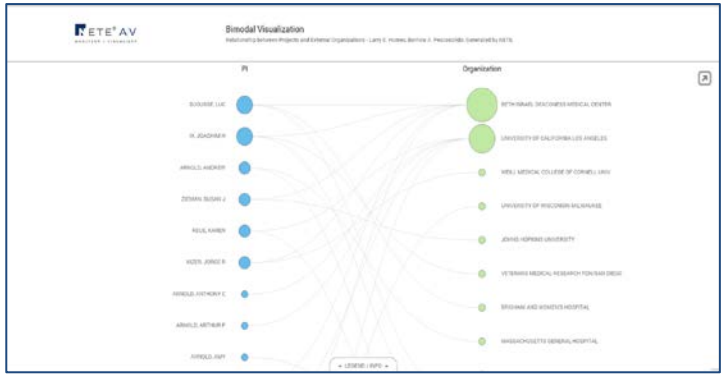
Analysis

NETE A/V

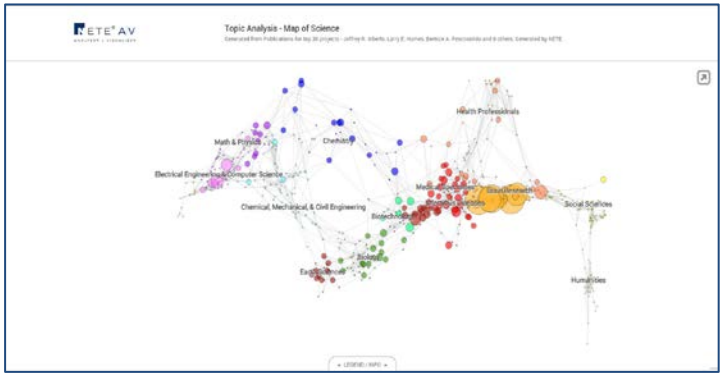
Proportional Symbol Map (Where)



Temporal Map (When)



Bimodal Map(Who)



Map of Science (What)

Front-end Framework

MV*

Framework to manage views, encapsulate data, testing, templates, etc.

JSON Spec

Pairing definition to match user fields to required fields for visualization.

Visualization and Layout

HTML5 and SVG items to render visualization.

ANGULARJS by Google

Data-Driven Documents

ember

HTML 5

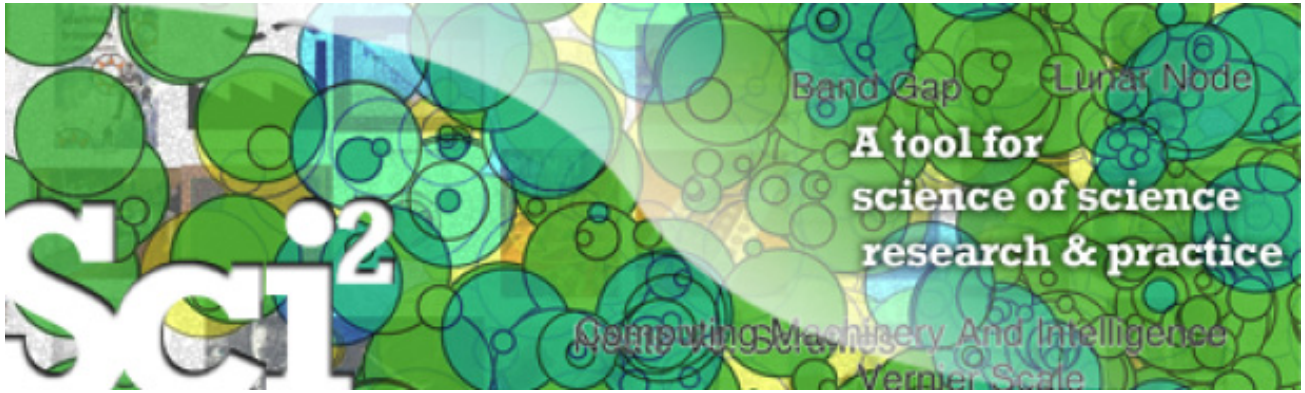
CSS 3

AGILITY.JS

jQuery write less, do more.

A Brief Look into Sci2 Tool's Users and Research

Michael Ginda
Graduate Research Assistant
Cyberinfrastructure for Network Science Center
School of Informatics and Computing
Indiana University Bloomington
http://cns.iu.edu



Overview of Tool and Development

The Science of Science (Sci^2) Tool is a modular toolset specifically designed for the study of science. It supports the temporal, geospatial, topical, and network analysis and visualization of scholarly datasets at the micro (individual), meso (local), and macro (global) levels.

In development since 2009, with the latest release, Sci2 v.1.1 Beta, coming December 2013.

Sci2 has logged **20,451** downloads, by over **11,170** user, over the last six years of development of development.

Downloads by release:

v 1.1 beta	5,705
v1.0 alpha	8,998
v0.5.2 alpha	775
v0.5.1 alpha	3,477
v0.5 alpha	379
v0.3 alpha	954
v0.2 alpha	82
v0.1 alpha	81

Brief Sci2 User Statistics

Users by Job Category:

Job Category	User Count
Education (Faculty and Staff)	5,464
Education (Student)	1,509
Government	585
Industry	906
Not for Profit	369
Other	552
(blank)	1,785

Users by Job Country

(100 or more accounts activated):

Country	User Count
United States	5463
India	473
United Kingdom	404
Brazil	372
Canada	286
Germany	258
Netherlands	213
France	205
China, People's Republic of	194
Australia	161
Colombia	159
Mexico	156
Italy	135
Spain	109
Japan	109
Russia	106
(blank)	531

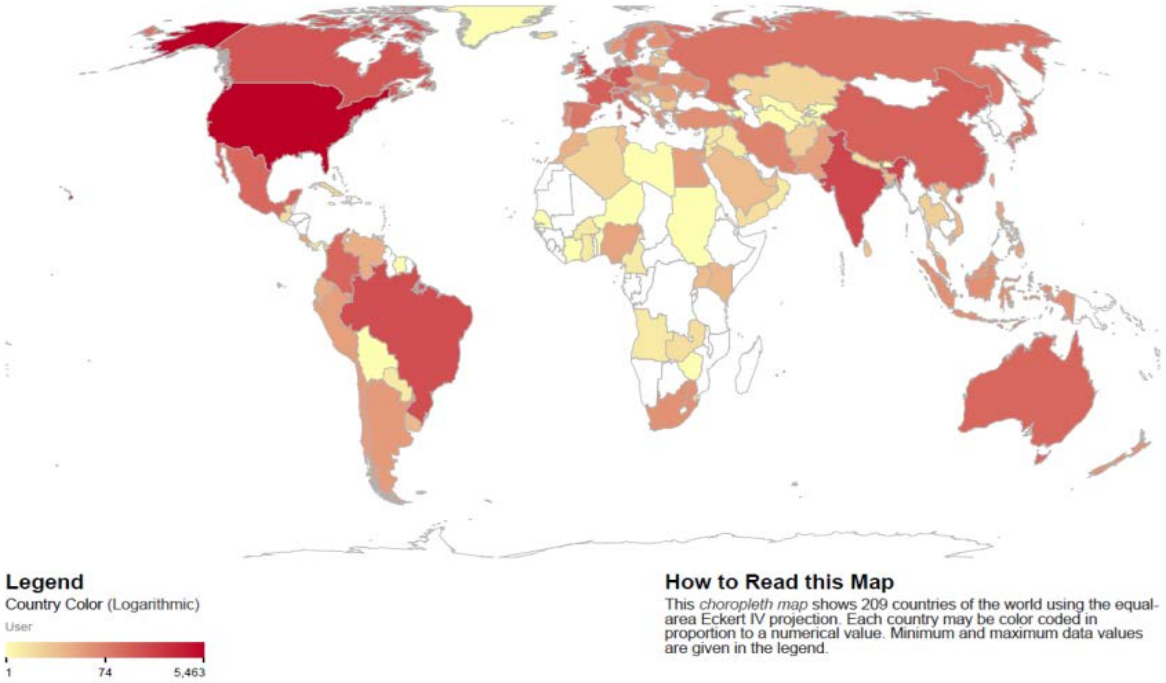
2013 Accounts by Organizations

(5 or more accounts activated)

Organization	User Count	Organization	User Count
Indiana University	85	Private	6
University of Michigan	18	Google	6
UNAM	18	Columbia University	6
NIH	12	University of New Mexico	5
IUPUI	11	Virginia Tech	5
Northwestern University	9	Wayne State University	5
University of Illinois	8	Thomson Reuters	5

Geospatial Visualization (Choropleth Map)

Generated from CSV file: D:\Users\mginda\AppData\Local\Temp\temp\Preprocessed-Sci2CountryCount-1281998522430481028.csv
Nov 04, 2014 | 01:53:37 PM EST



A Look at Research Produced Using Sci2

Data collected using a citation search Reuters of Web of Science (WoS) by querying authors “Sci2 Team” resulted in 17 publications that used the Sci2 tool, between 2009 and 2014.

WoS Research Areas

Research Areas	# of Records	% of Records
INFORMATION SCIENCE LIBRARY SCIENCE	13	76.471
COMPUTER SCIENCE	12	70.588
PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	1	5.882
PHYSICAL GEOGRAPHY	1	5.882
METEOROLOGY ATMOSPHERIC SCIENCES	1	5.882
MEDICAL INFORMATICS	1	5.882
HEALTH CARE SCIENCES SERVICES	1	5.882
GEOGRAPHY	1	5.882
ENVIRONMENTAL SCIENCES ECOLOGY	1	5.882
ENGINEERING	1	5.882
ENDOCRINOLOGY METABOLISM	1	5.882
EDUCATION EDUCATIONAL RESEARCH	1	5.882

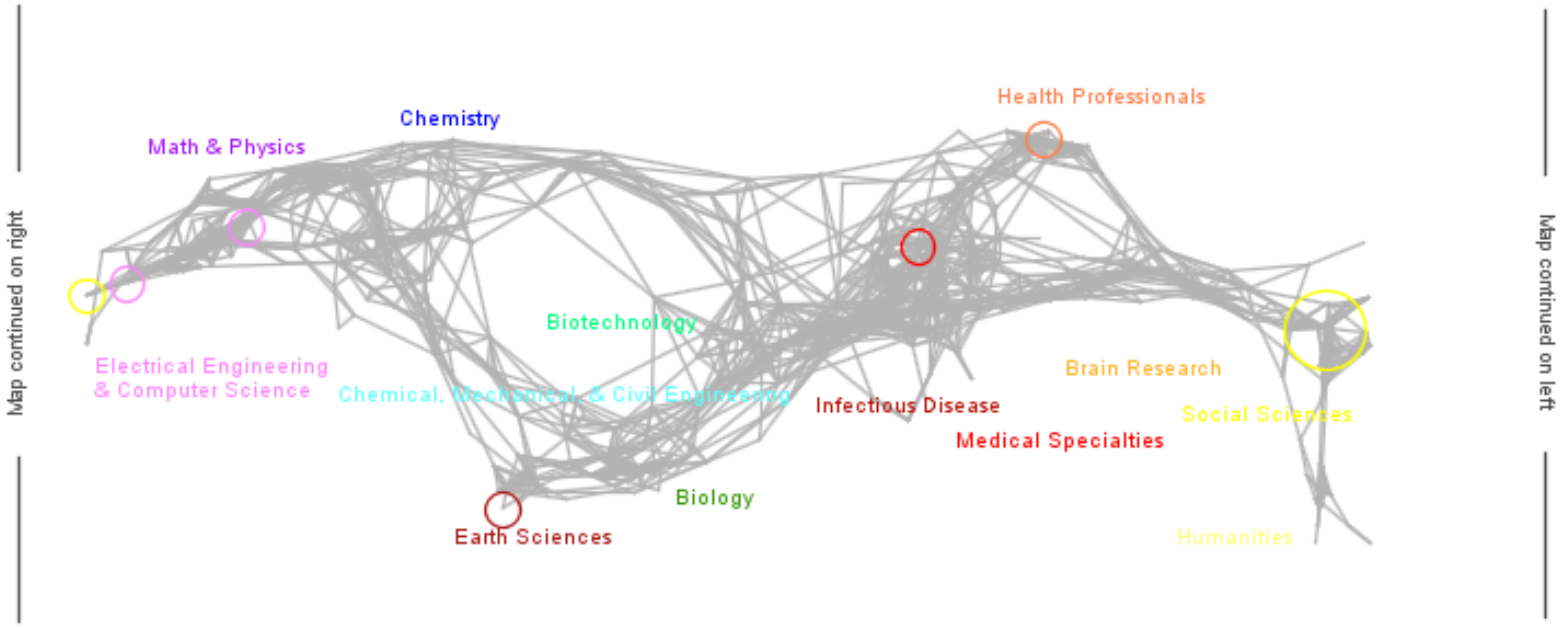
Source Titles

Source Titles	# of Records	% of Records
SCIENTOMETRICS	7	41.176
WILEY INTERDISCIPLINARY REVIEWS CLIMATE CHANGE	1	5.882
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON SCIENTOMETRICS AND INFORMETRICS	1	5.882
PROCEEDINGS OF ISSI 2011 THE 13TH CONFERENCE OF THE INTERNATIONAL SOCIETY FOR SCIENTOMETRICS AND INFORMETRICS VOLS 1 AND 2	1	5.882
OSTEOPOROSIS INTERNATIONAL	1	5.882
OCCUPATIONAL SAFETY AND HYGIENE II	1	5.882
JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY	1	5.882
JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	1	5.882
INTERNATIONAL JOURNAL OF INFORMATION MANAGEMENT	1	5.882
INTERNATIONAL JOURNAL OF GEOGRAPHICAL INFORMATION SCIENCE	1	5.882
INTERNATIONAL JOURNAL OF ELECTRICAL ENGINEERING EDUCATION	1	5.882
ASLIB JOURNAL OF INFORMATION MANAGEMENT	1	5.882

UCSD map of Science showing Domains where Sci2 has been used

Topical Visualization

Generated from 17 Unique ISI Records
7 out of 11 records were mapped to 7 subdisciplines and 5 disciplines.
November 04, 2014 | 11:36 AM EST

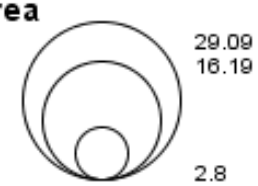


2008 The Regents of the University of California and SciTech Strategies.
Map updated by SciTech Strategies, OST, and CNS in 2011.

Legend

Circle area: Fractional record count
Unclassified = 4
Minimum = 1
Maximum = 7
Color: Discipline
See end of PDF for color legend.

Area



How To Read This Map

The *UCSD map of science* depicts a network of 554 subdiscipline nodes that are aggregated to 13 main disciplines of science. Each discipline has a distinct color and is labeled. Overlaid are circles, each representing all records per unique subdiscipline. Circle area is proportional to the number of fractionally assigned records. Minimum and maximum data values are given in the legend.

A Look at Research Produced Using Sci2

Co-Author Network of Research citing Sci2 Tool.

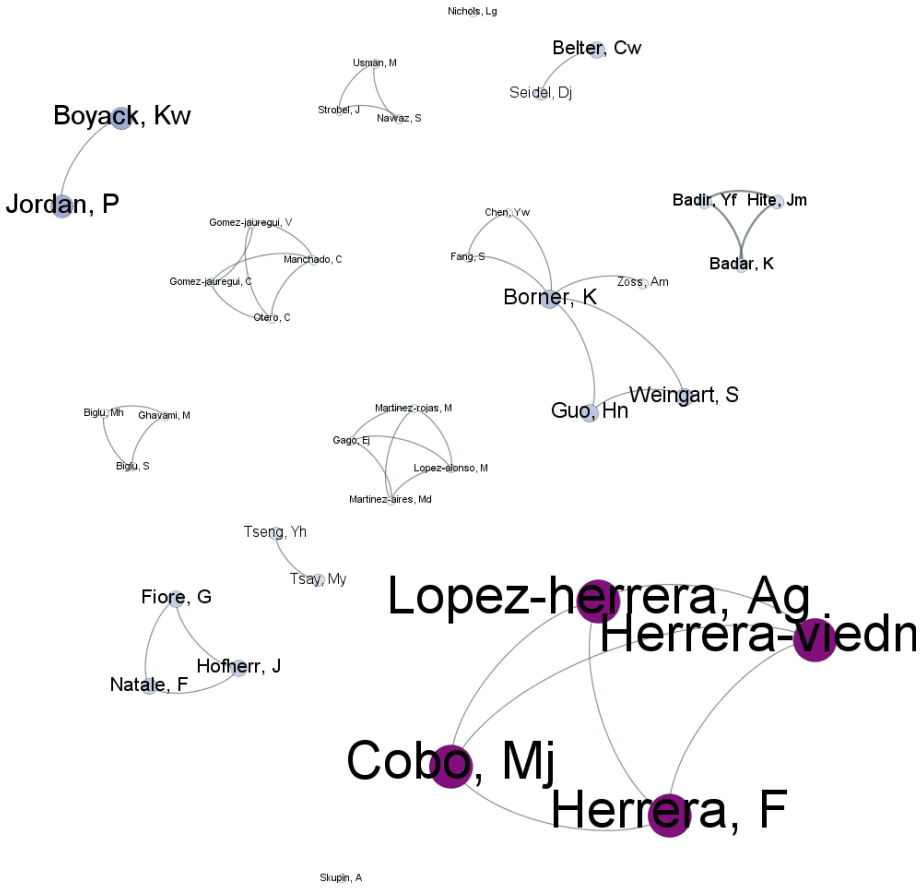
40 authors wrote 17 papers.

Papers were cited for a 60 times, with each paper being cited an average of 3.88 times.

Each papers had between 1 and 4 authors.

The article with the highest citation, 28, count is for the article:

Cobo, M. J.; Lopez-Herrera, A. G.; Herrera-Viedma, E. (2011). Science Mapping Software Tools: Review, Analysis, and Cooperative Study Among Tools. *JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY,* 62:7 (1382-1402).



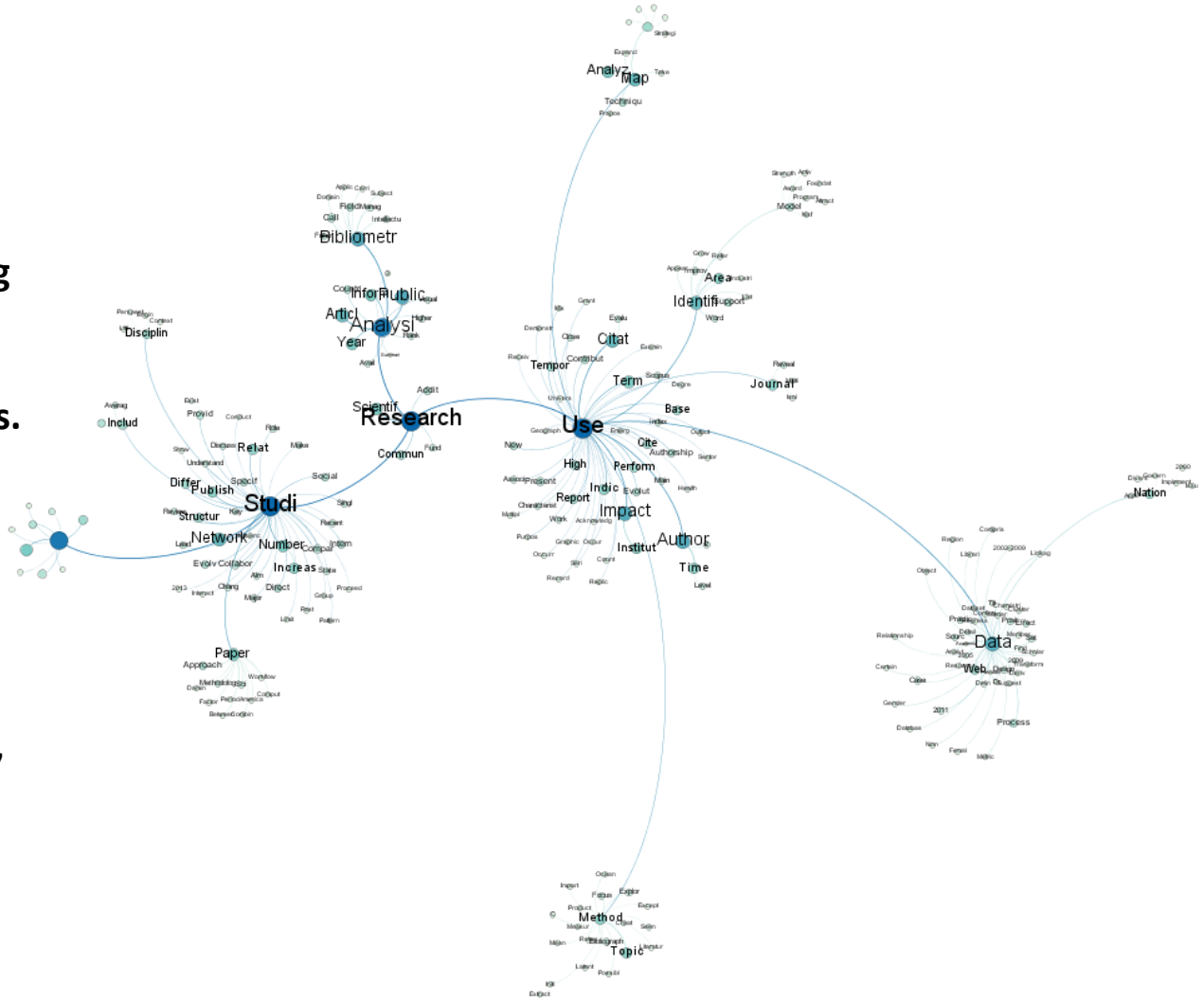
Topic Network of Research citing the Sci2 Tool

This network shows the topic map created by looking at the major concepts extracted from the 17 citations' Titles and Abstracts.

The network was reduced using the MST Pathfinder Network Scaling to highlight major relationships between concepts.

The network was further reduced to show only edge relationships with a weight greater than two.

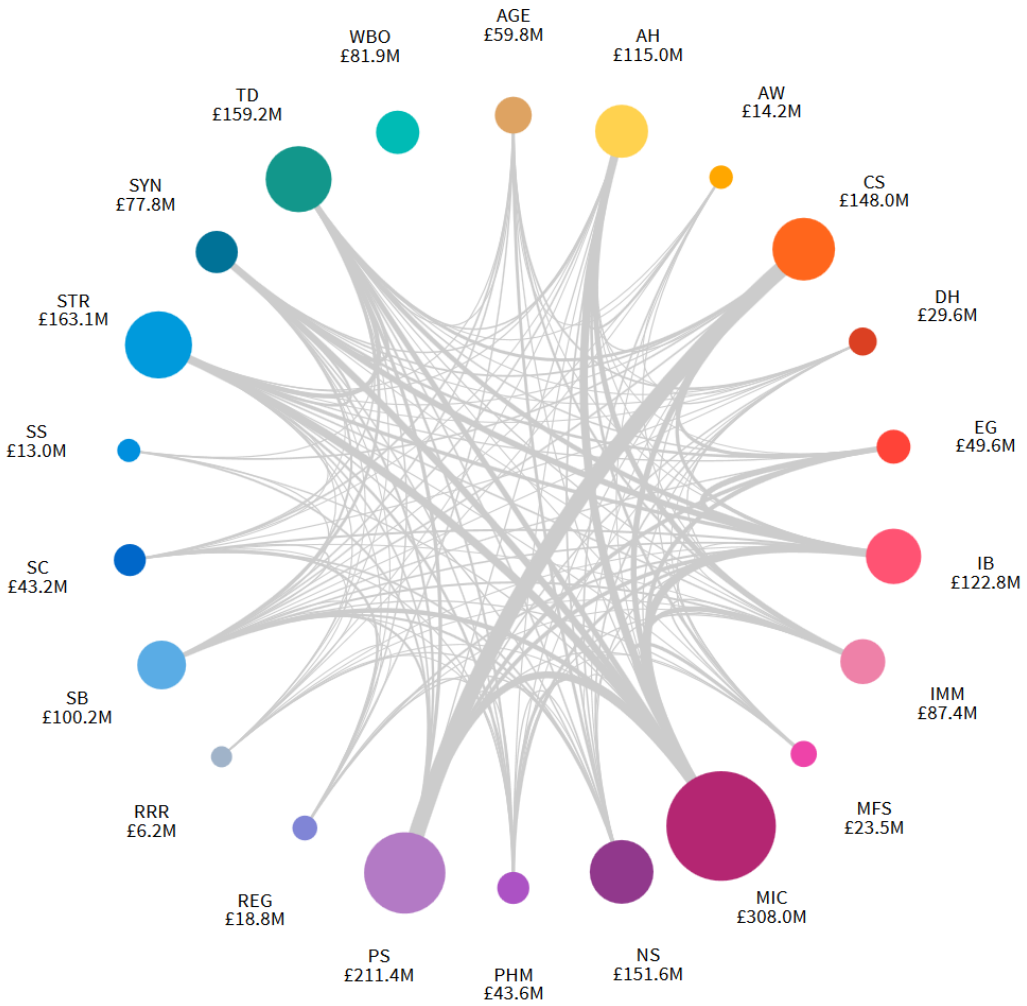
Nodes are sized and colored by the number of citations that they appear (between 2 and 17 citations.



Data-based Projects at CNS

- Robert Light, Senior Systems Analyst, Database Administrator

BBSRC



Parameters

Analysis Type(s):
All

Fund Type(s):
(all)

Institution(s):
(all)

Research Topic(s):
(all)

Category(ies):
(all)

Time Frame:
Session Year(s): (all)

Amount Type:
Total Value

BBSRC

AMOUNT

ProQuest

- Collaboration to explore dissertation data

Modeling the Scientific Workforce

- NIH Project exploring the movement of doctoral recipients through their careers

Aging in the Scholarly Workforce

- Collaboration with Ohio State University and NBER (Boston)
- Exploring the effects of aging and the abolition of mandatory retirement on the scientific community and the creation of High Impact and Transformative Science (HITS)

Other collaborations and projects

- SciELO (Brazil)
- TDAmeritrade
- SEAD
- VIVO – with Thomson Reuters/CONVERIS

CNS: Toward Sustainable Software Development

Daniel Halsey

Senior Software Engineer

CNS

The Problem

Non-repeatable practices

Orphaned code

Academic turnover

Under-documented “standards”

Short-term view

Outdated documentation

Latest-and-greatest mentality

Sustainable Development

Long-term view of systems

Better for code

Better for users

Better for developers

Repeatable practices

Testable code

Standardized platforms

Replaceable components

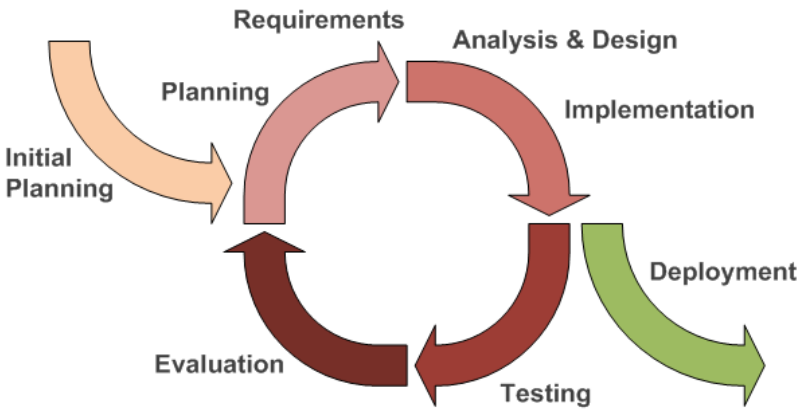
Sustainable Development

Practices

Agile techniques

Meaningful communication

Mindset



Tools

Revision control

Work tracking

Continuous integration

Frameworks that work

Key elements

- Git workflow
  - Gitflow
  - Github Workflow
- Fully test-backed development
  - Will be adding unit and integration tests as part of refactoring and updating efforts, as well as new development
  - Potential for Test-Driven Development/Behavior-Driven Development
  - Will facilitate Continuous Integration
- Continuous Integration
  - Fast, automated testing and deployment of the latest changes
  - Faster regression discovery, faster bug fixes

MOOC Visual Analytics

Empowering teachers, students, researchers, and platform developers of Massive Open Online Courses

Robert Light, Scott Emmons, Katy Börner

Demographic Data

- age, gender, education level, location

Activity Data

- content accessed, usage path, timestamps

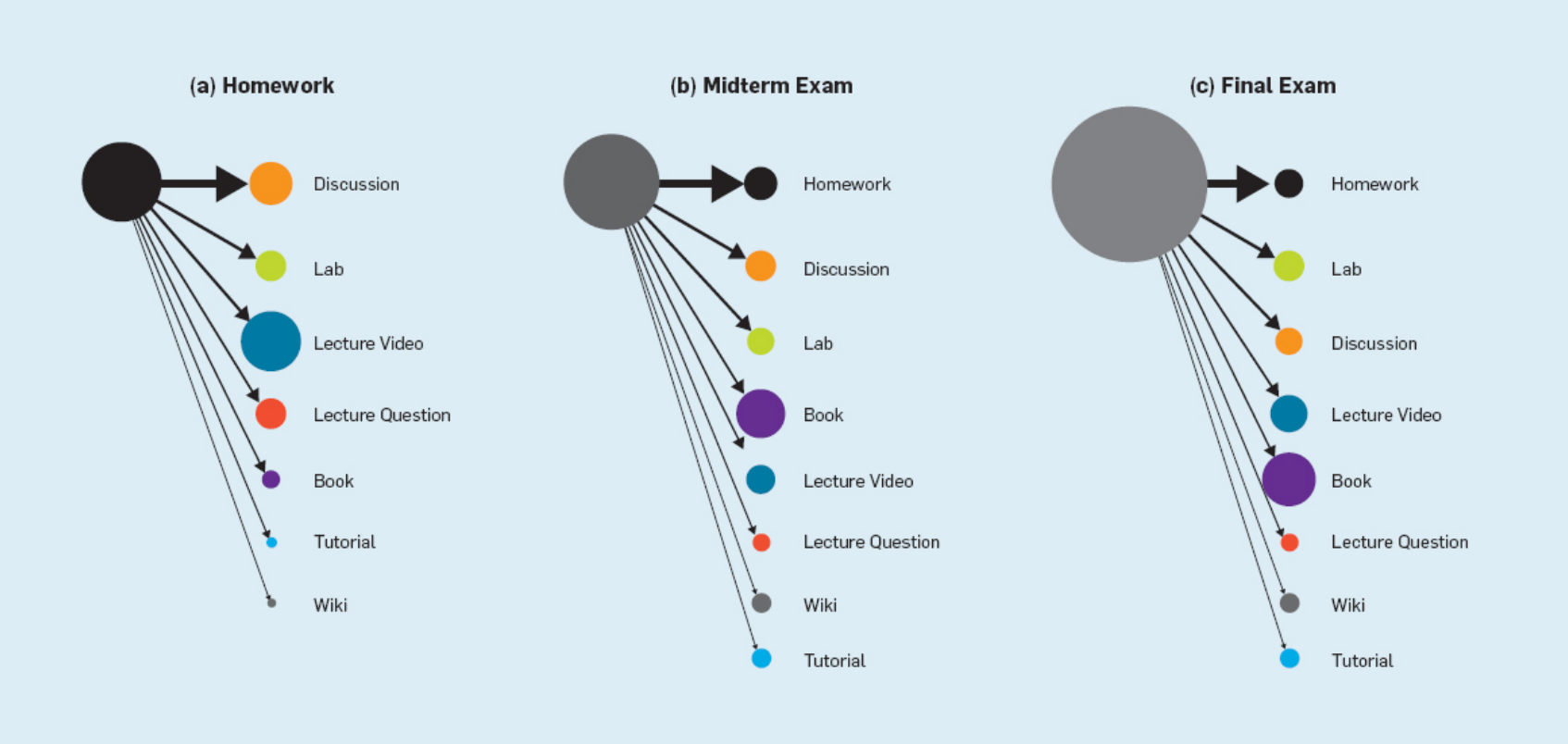
Performance Data

- assessment scores, by question breakdown

Survey Data

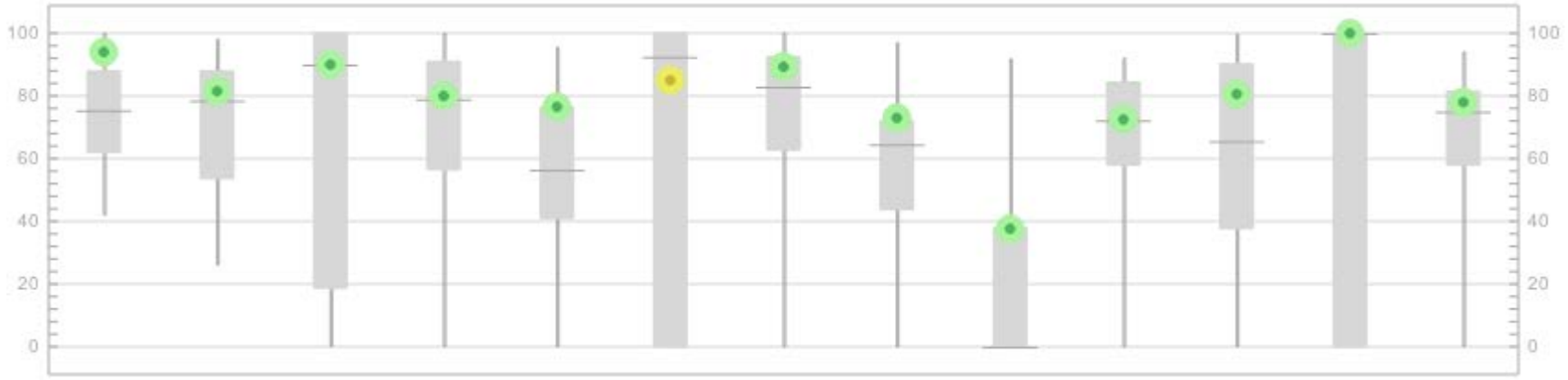
- student intent, previous experience, feedback

Related Work



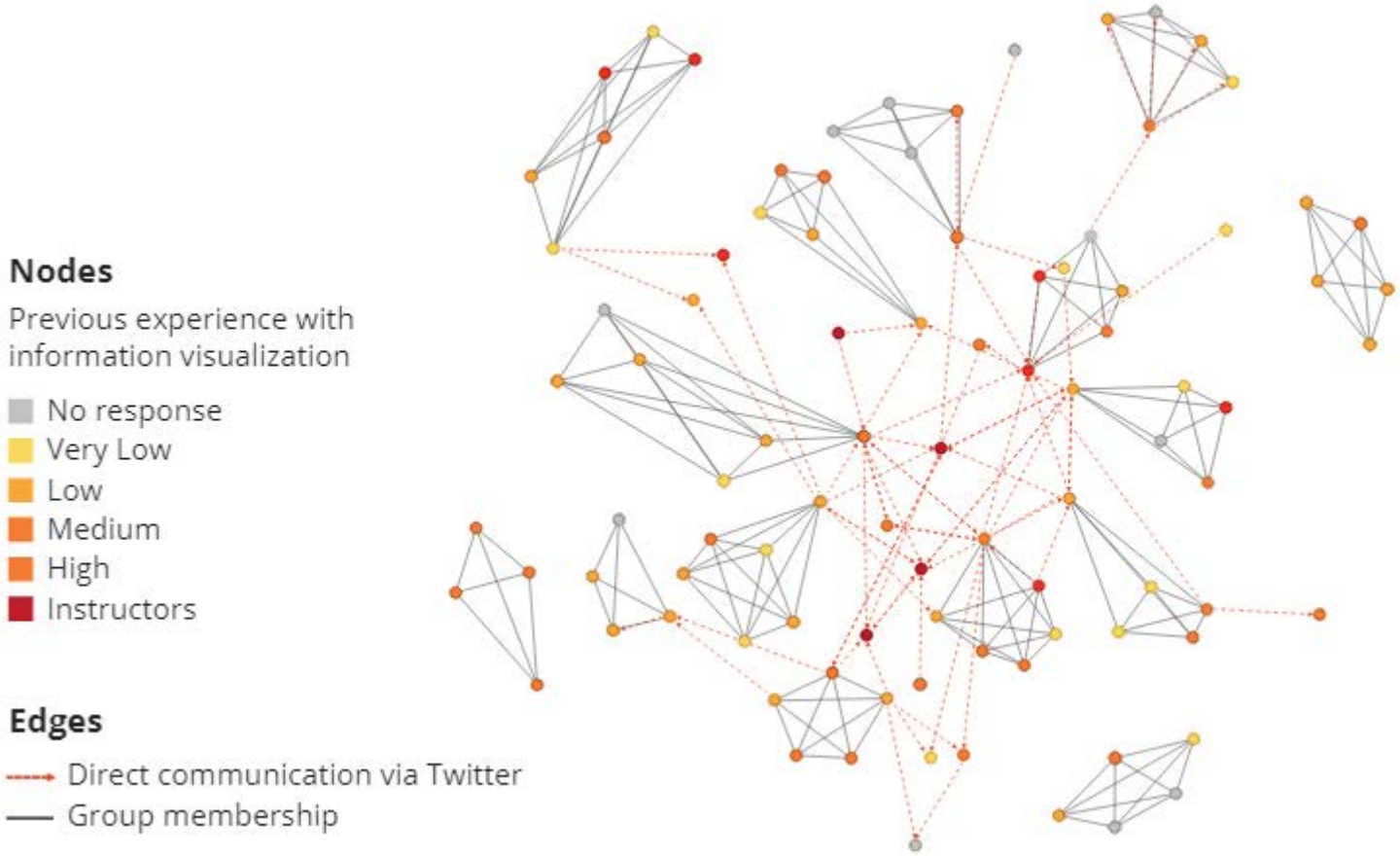
Daniel T. Seaton, Yoav Bergner, Isaac Chuang, Piotr Mitros, and David E. Pritchard. 2014. Who does what in a massive open online course?. *Commun. ACM* 57, 4 (April 2014), 58-65. DOI=10.1145/2500876 http://doi.acm.org/10.1145/2500876

Related Work



From Canvas Guides. Licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License (https://creativecommons.org/licenses/by-nc-sa/4.0/)

Our Work (Published Textbook)



Börner, Katy, and David E. Polley. 2014. *Visual Insights: A Practical Guide to Making Sense of Data.* Cambridge, MA: The MIT Press.

Our Work (Working Paper)