

# Figure-Centric Search Engine

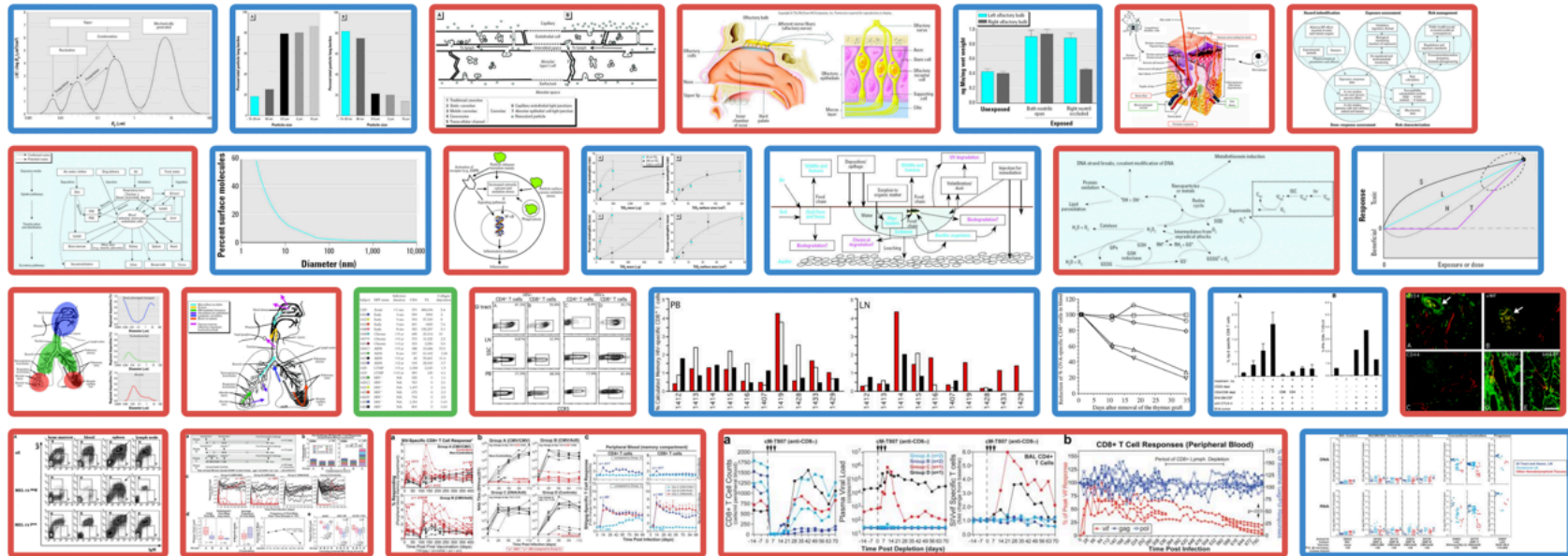


VizioMetrix About Search Crowdsourcing

Impact blood lymph

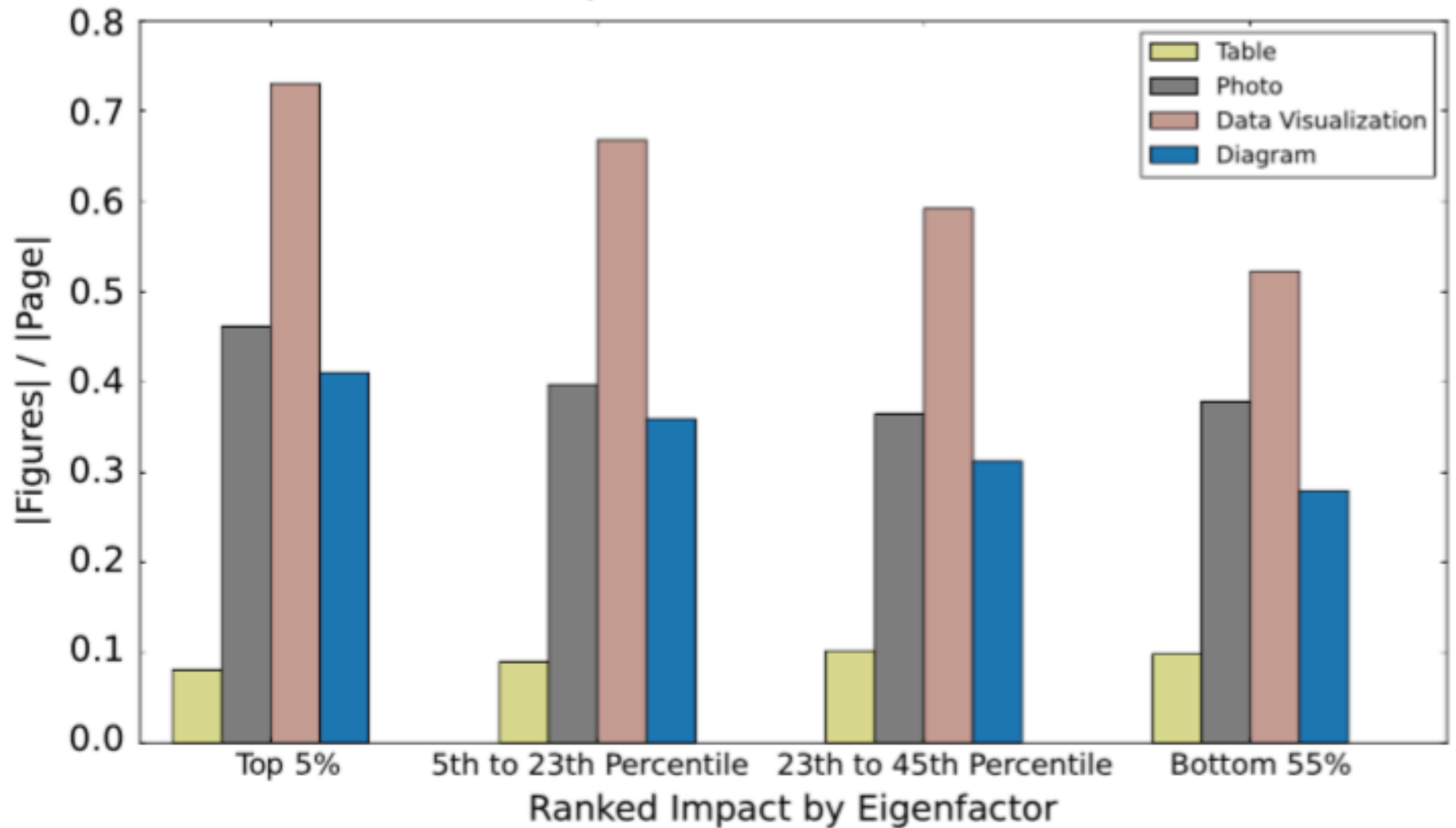
Search

☐ Composite ☐ Equation ☒ Diagram ☐ Photo ☒ Plot ☒ Table



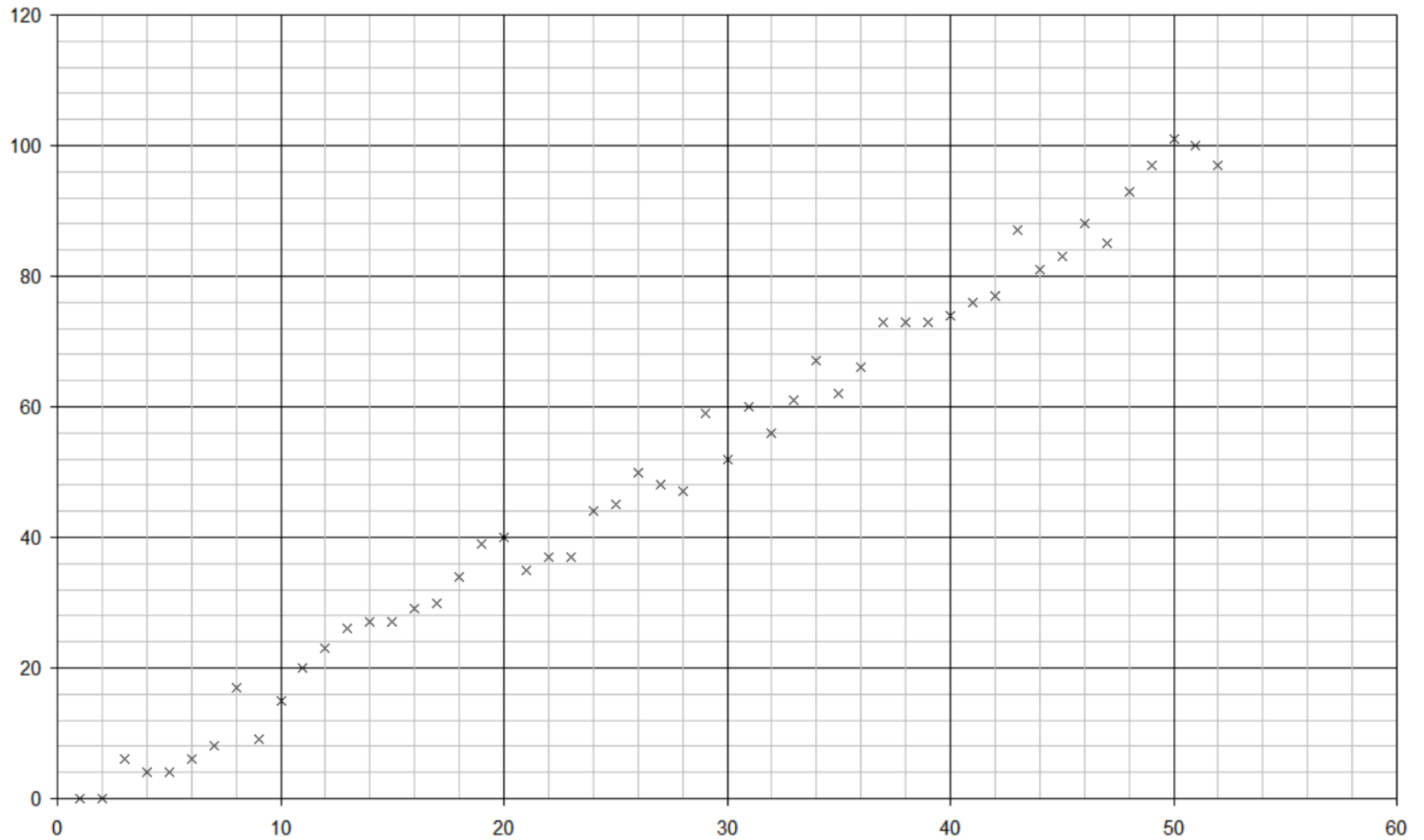
A project of the eScience Institute at the University of Washington

# Impact versus Figure Density



Lee et al. (2016) Viziometrics: Analyzing Visual Information in the Scientific Literature.  
<https://www.arxiv.org/pdf/1605.04951.pdf>

# Gridlines

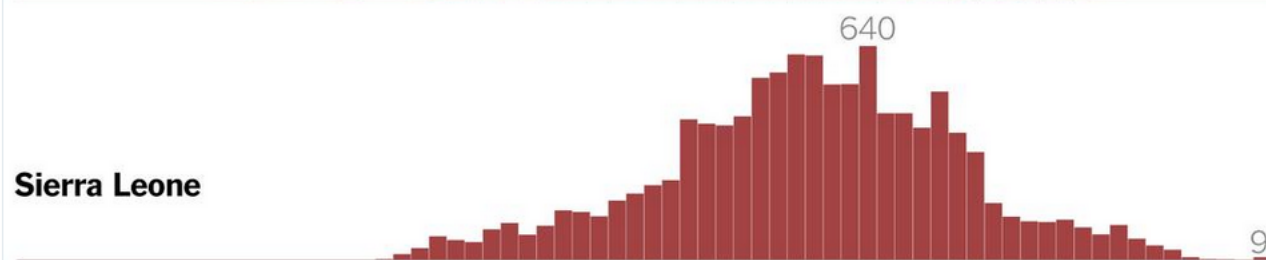


New cases each week

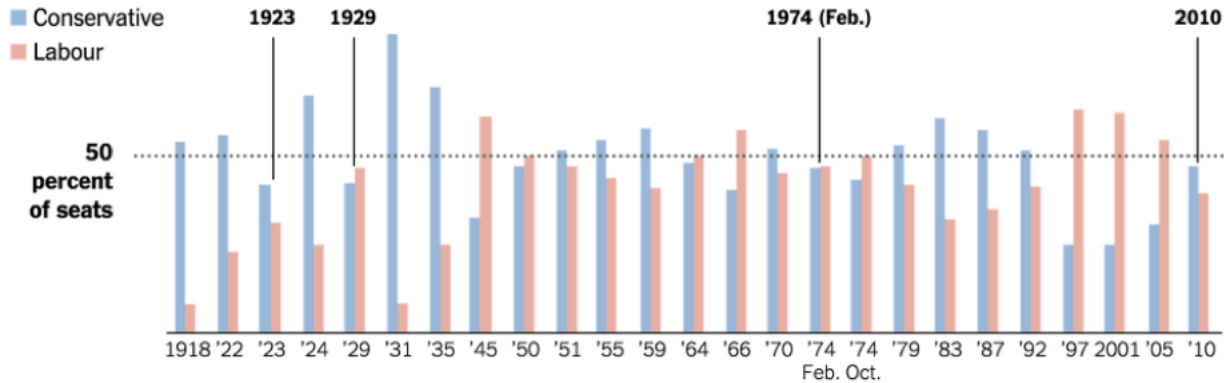
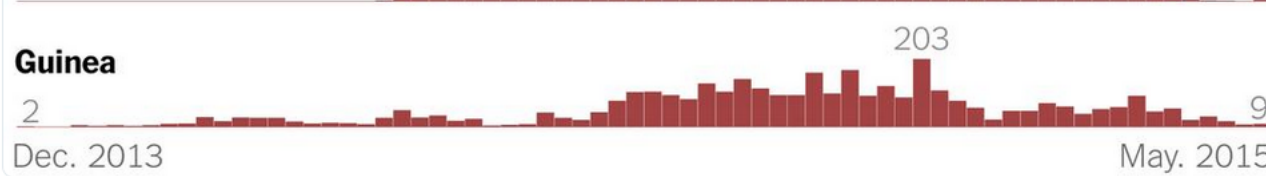
**Liberia**



**Sierra Leone**



**Guinea**

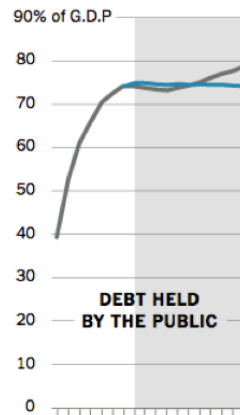
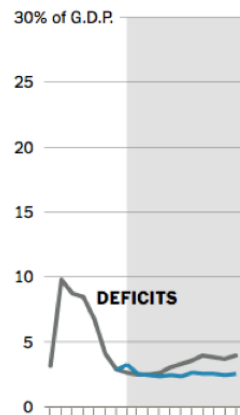
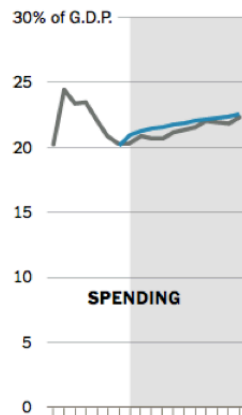
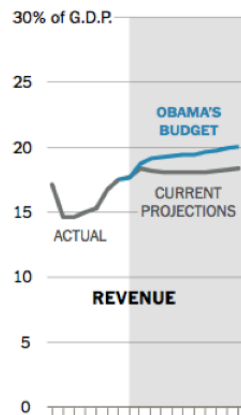
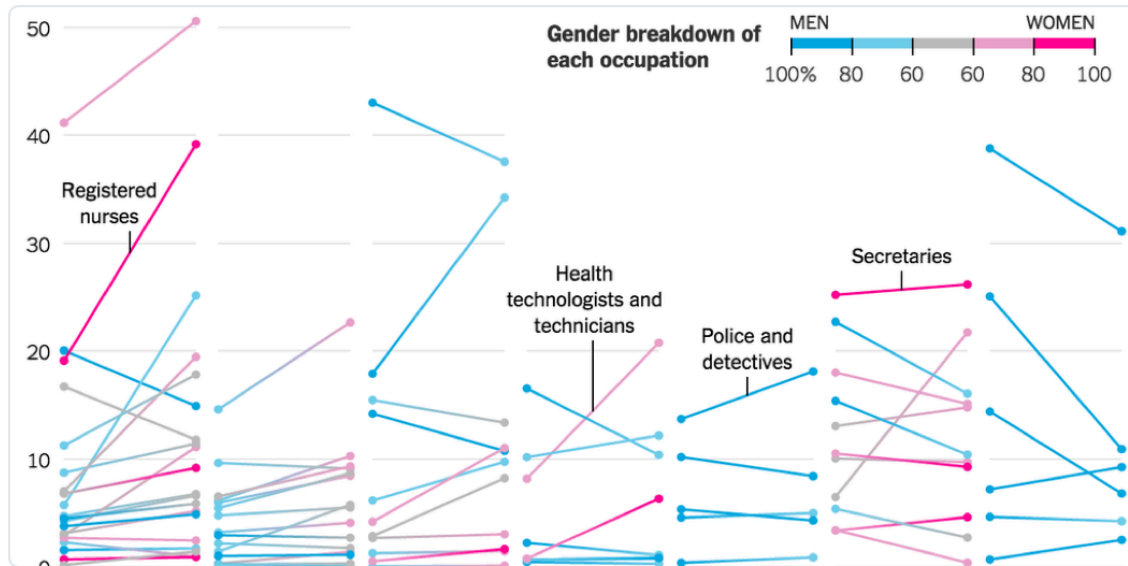
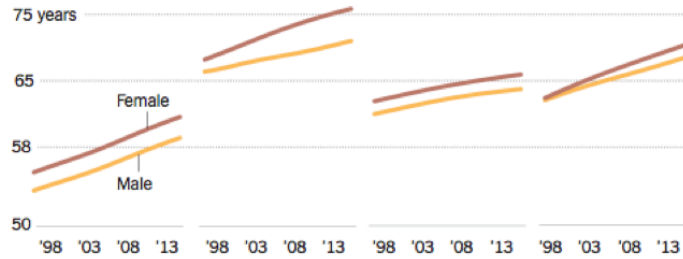


Acknowledgement: slides and discussions around gridlines with Carl Bergstrom



## Life Expectancy

Worldwide, women are generally expected to live longer than men. This is true in Afghanistan as well. But life expectancy in Afghanistan is still well behind other countries in the region.

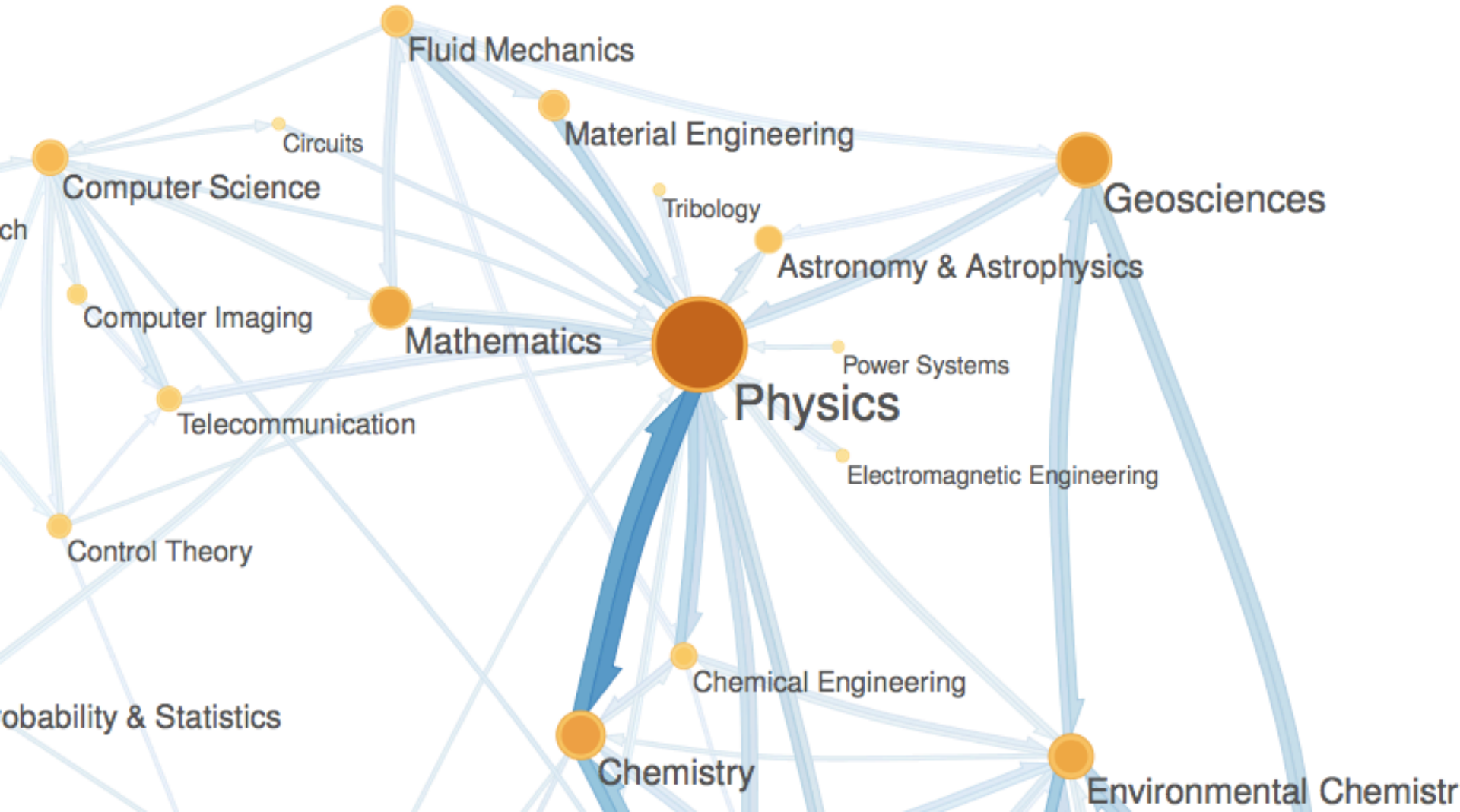


# Gridline Rules

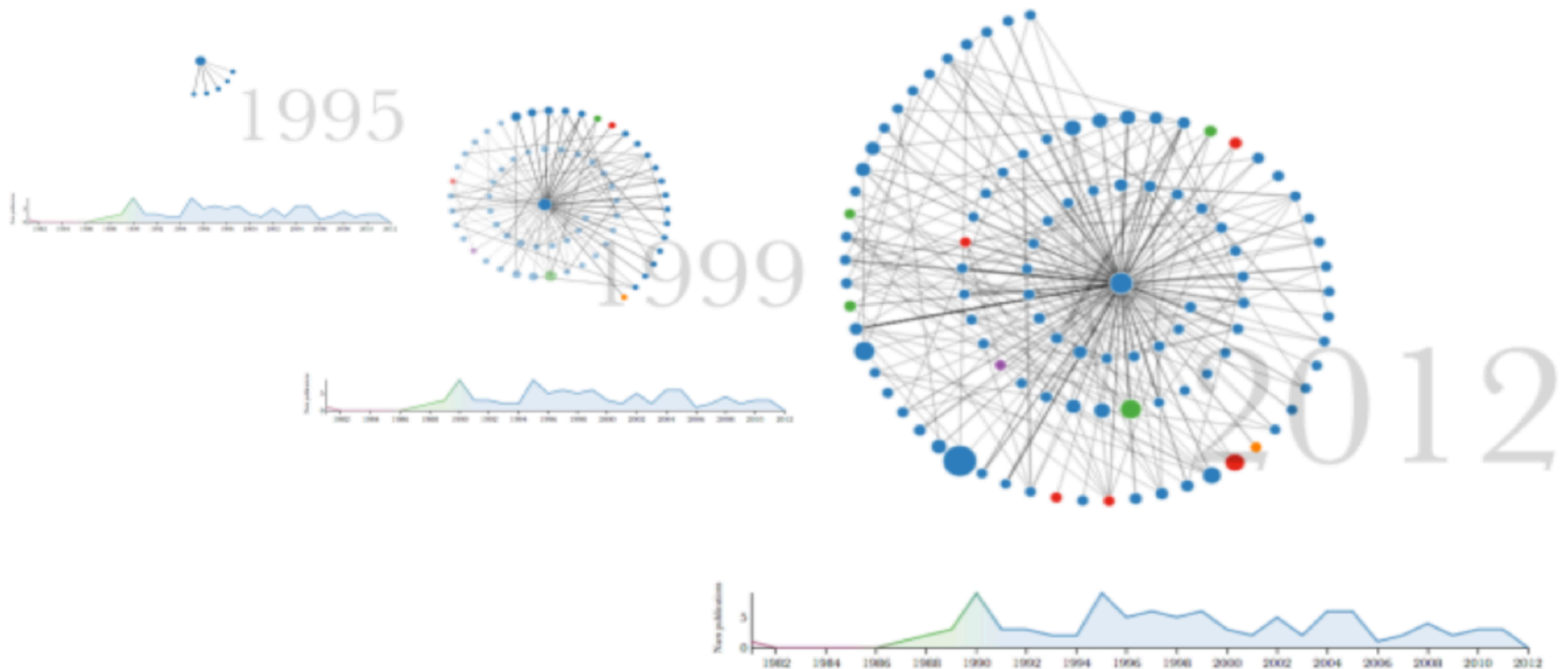
- 1) Gridlines should always be labelled.
- 2) Corollary: One should not use grid lines on any axis that lacks a scale.
- 3) If one does use grid lines, they should be ONLY be used to demarcate increments of the dependent variable.
- 4) Grid lines should be subtle elements of the background, and not draw the eye from the foreground elements.

Jevin West, Information School, University of Washington

Jevin West, Information School, University of Washington



# Explore the data ***[scholar.eigenfactor.org](http://scholar.eigenfactor.org)***



\* Please use Chrome web browser for best results

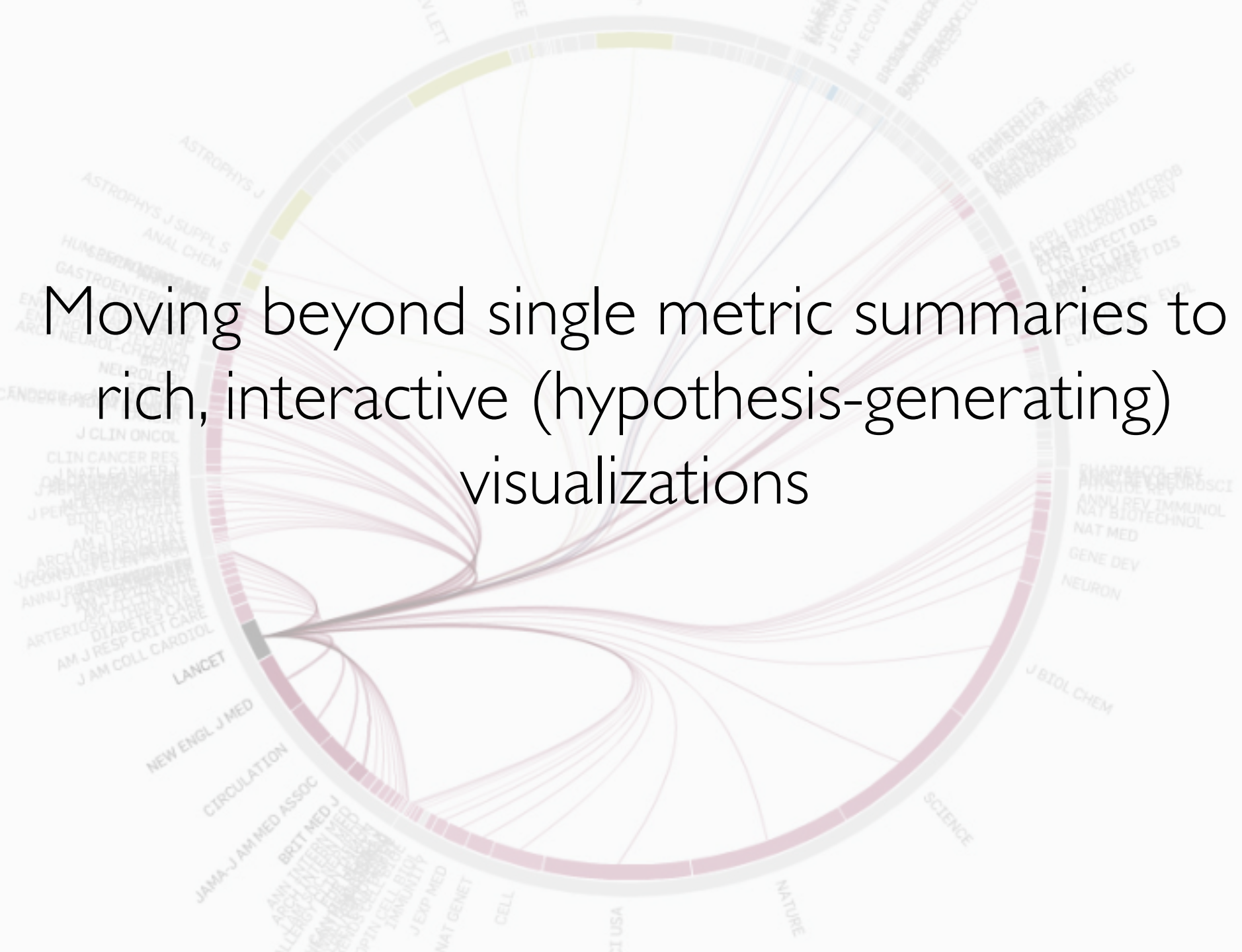
**[scholar.eigenfactor.org](https://scholar.eigenfactor.org)**

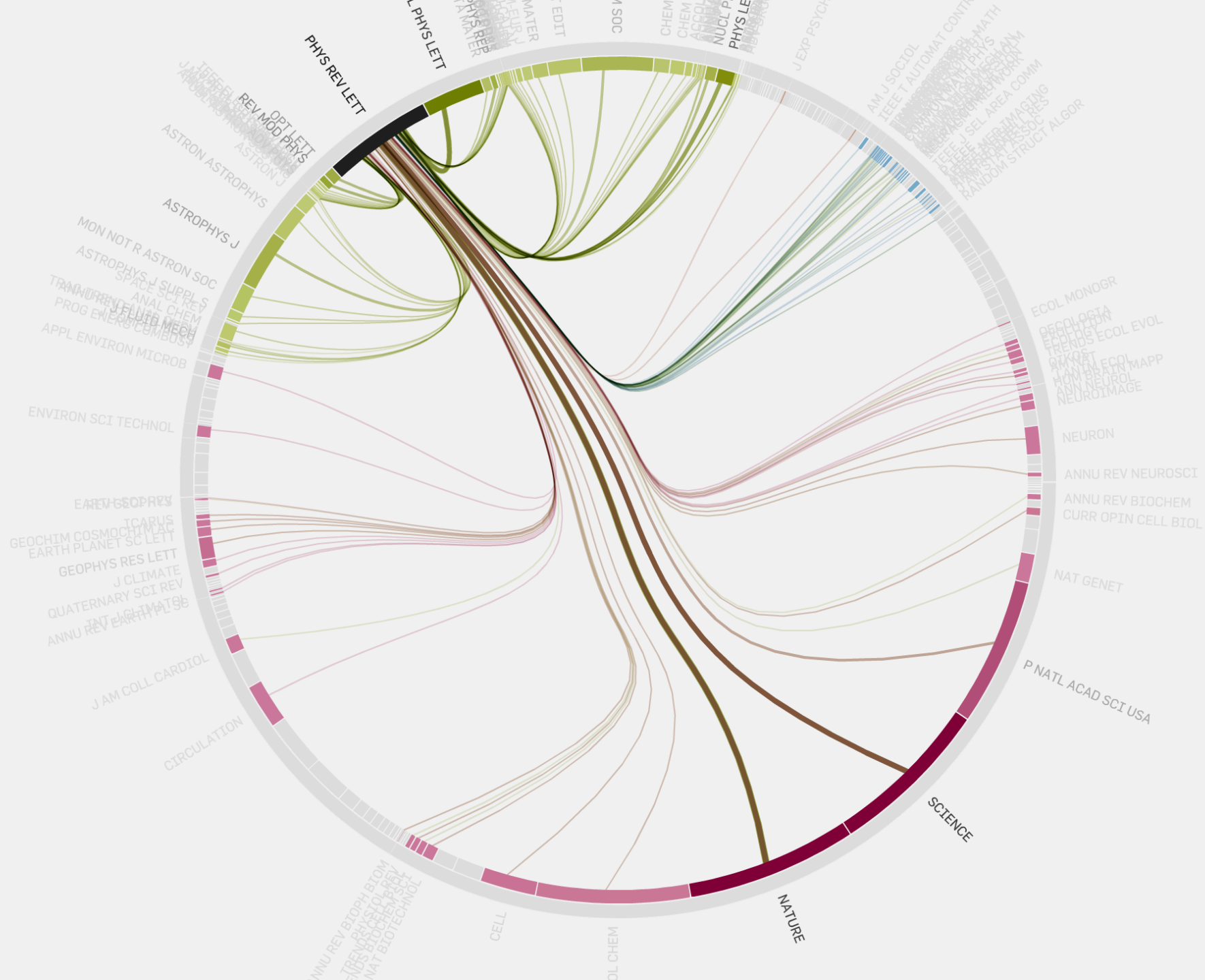
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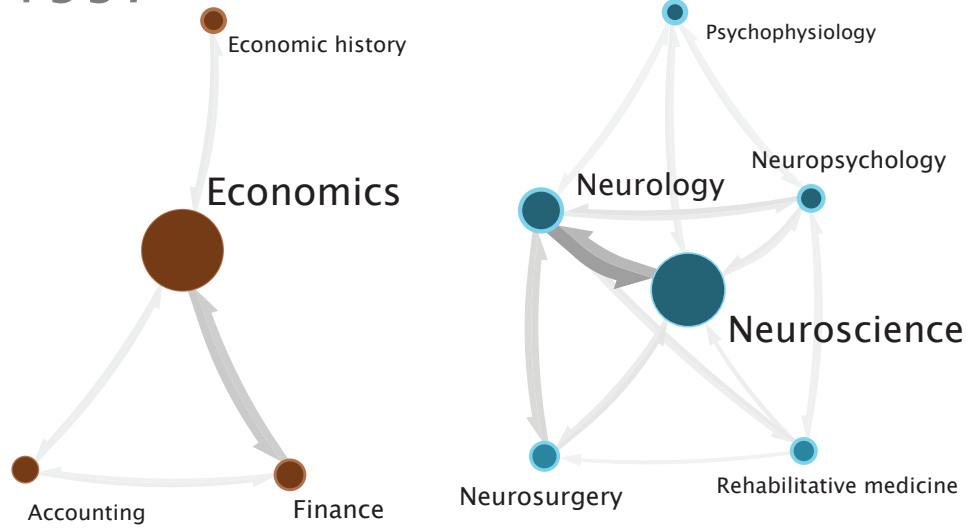
Jevin West, [jevinw@uw.edu](mailto:jevinw@uw.edu)

Moving beyond single metric summaries to  
rich, interactive (hypothesis-generating)  
visualizations

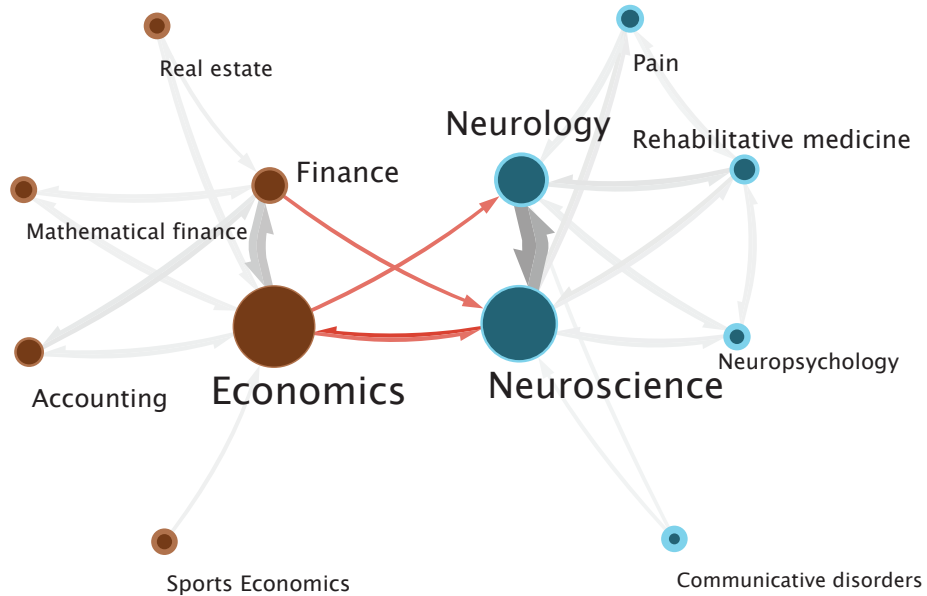




1997



2010



NEUROECONOMICS



How do we *map* the evolution of  
scientific disciplines?

What is my impact on science?

**\$7,933,670,366**





22,756 awards

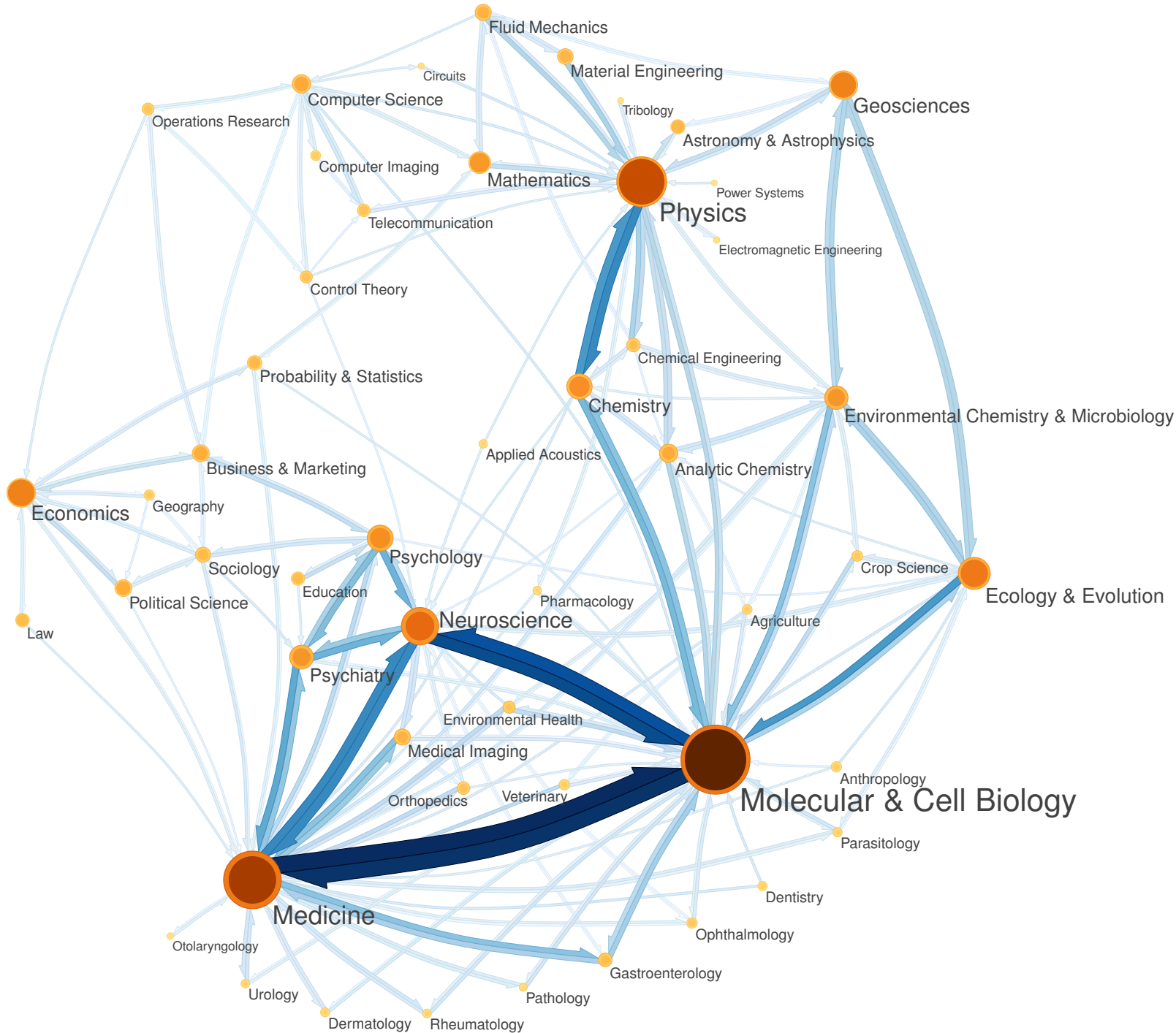
17,849 researchers

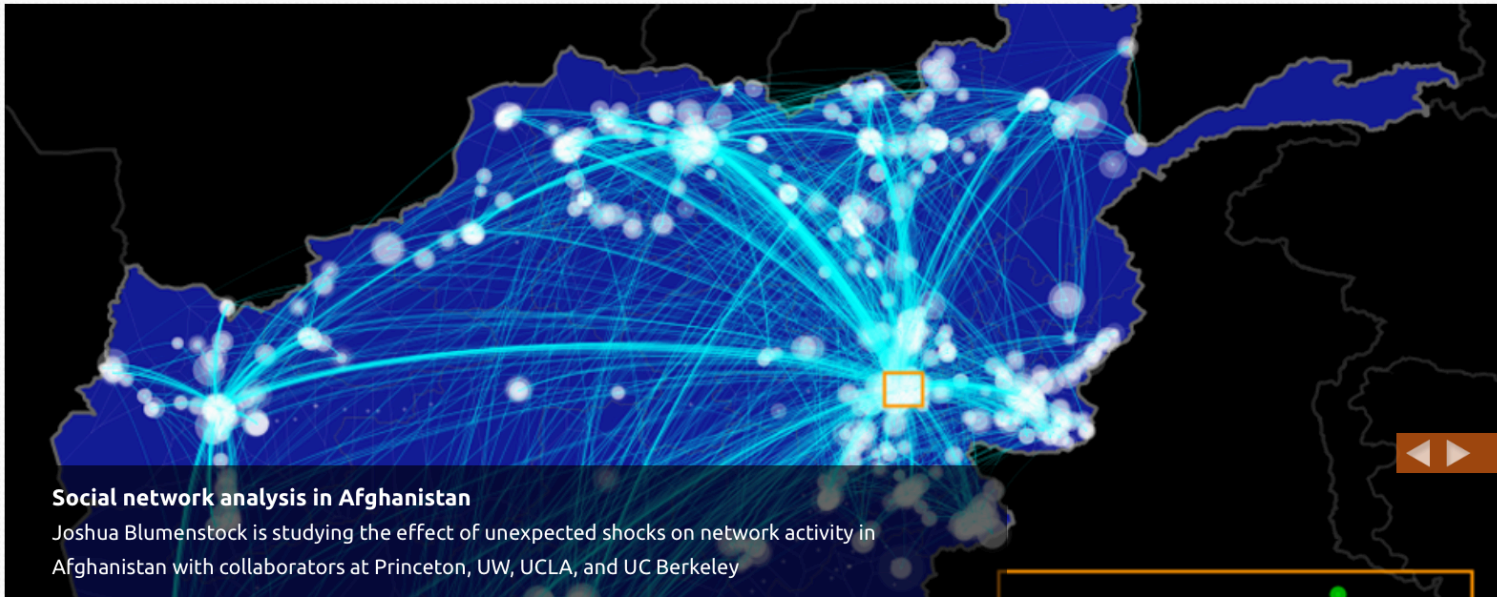
344,917 papers

8,174,533 citations

23.7 citations/paper

2006 - 2015





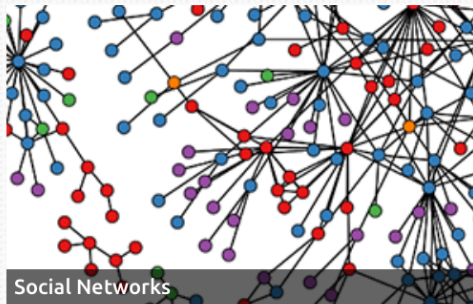
### Social network analysis in Afghanistan

Joshua Blumenstock is studying the effect of unexpected shocks on network activity in Afghanistan with collaborators at Princeton, UW, UCLA, and UC Berkeley

### Research Focus Areas



Data for Development



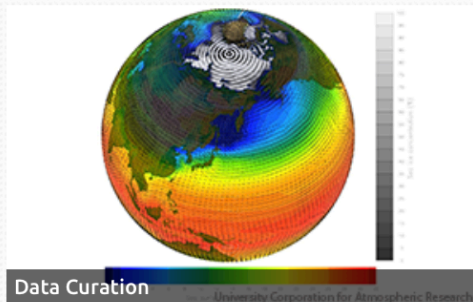
Social Networks



Data Visualization



Computational Social Science



Data Curation



Science of Science





## What We Do



### Overview

Over the course of the last decade many disciplines have evolved from recording observations in laboratory notebooks to the use of instruments capable of digitally recording many gigabytes of data in a day. This abundance of data provides unprecedented opportunities for discovery. Tapping its potential requires the application of sophisticated new computational techniques operating on large scale storage, computational and network resources. Since its creation in 2008, the eScience Institute has worked to create the intellectual and physical infrastructure needed to meet this challenge.

At the core of the eScience Institute are individuals who have proven track records in developing and applying advanced computational methods and tools to real world problems. Their task is to seek out and engage researchers across disciplines where eScience approaches are likely to have the greatest impact. To ensure that researchers have access to the necessary physical infrastructure, the Institute has undertaken coordinated planning and support for advanced local and remote computational platforms. This includes developing relationships with commercial and non-commercial service providers as well as the development of shared facilities on campus. This support extends to assistance in the preparation of select proposals where we are able to focus resources, improving their chances for success.

### Also in... What We Do

#### [Appliance Gallery](#)

Find and use the eScience Institute's virtual machines equipped with software useful for specific applications.

#### [Campus Compute & Storage](#)

Learn about what UW is doing to support scalable scientific computing on campus

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From algorithm development to database creation to cloud computing, we can help.

#### [Projects](#)

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View a list of courses offered in eScience disciplines.

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#### [Tools](#)

Whether it's database management, visualization, or developer tools, learn about tools we can help you use.

### Latest eScience News

#### [Data Science Incubation Program - Winter 2016](#)

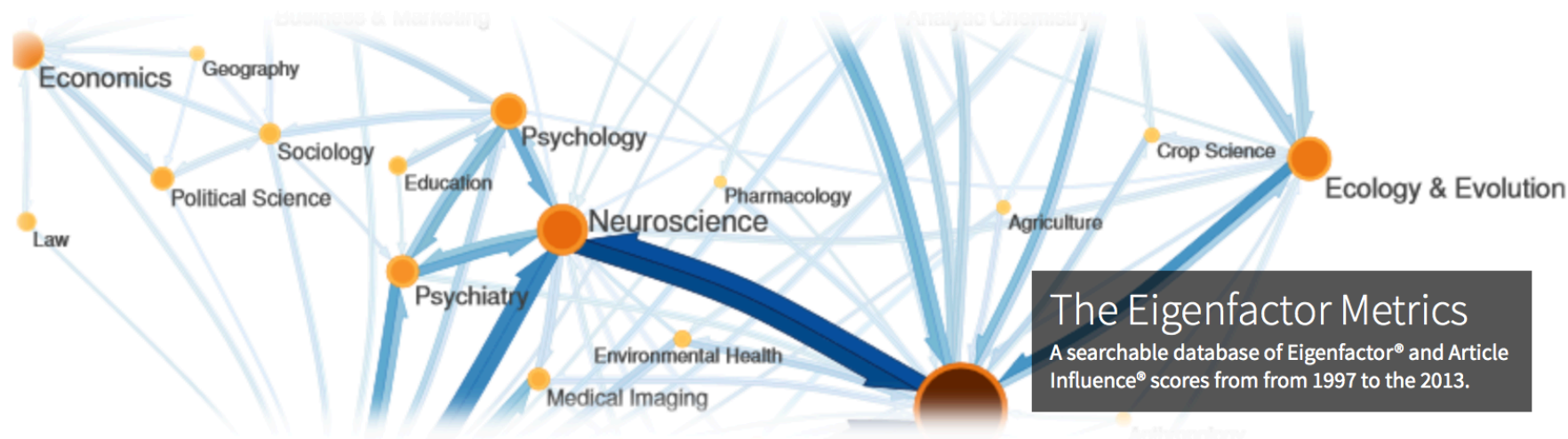
2 hours 4 min ago

#### [Ben Marwick On How Computers Broke Science](#)



EIGENFACTOR.org

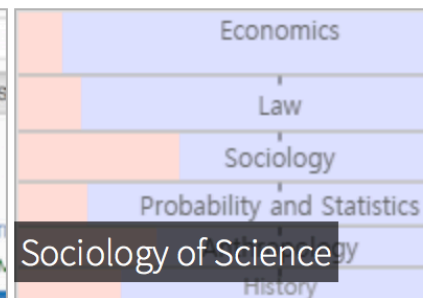
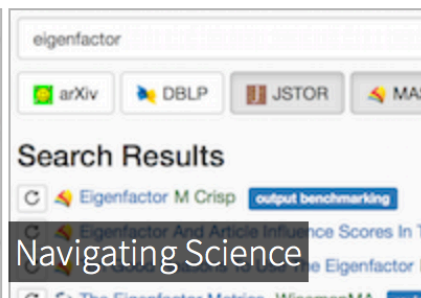
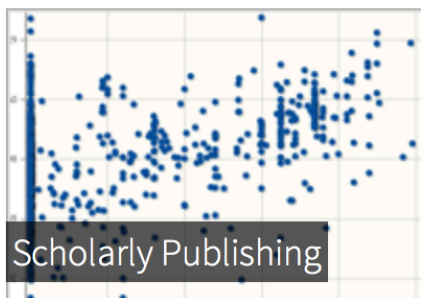
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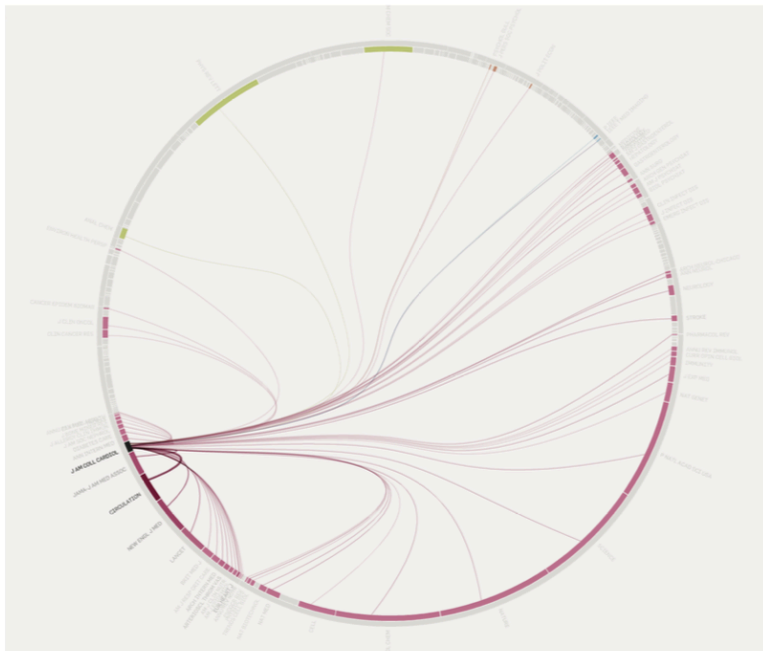


## The Eigenfactor Metrics

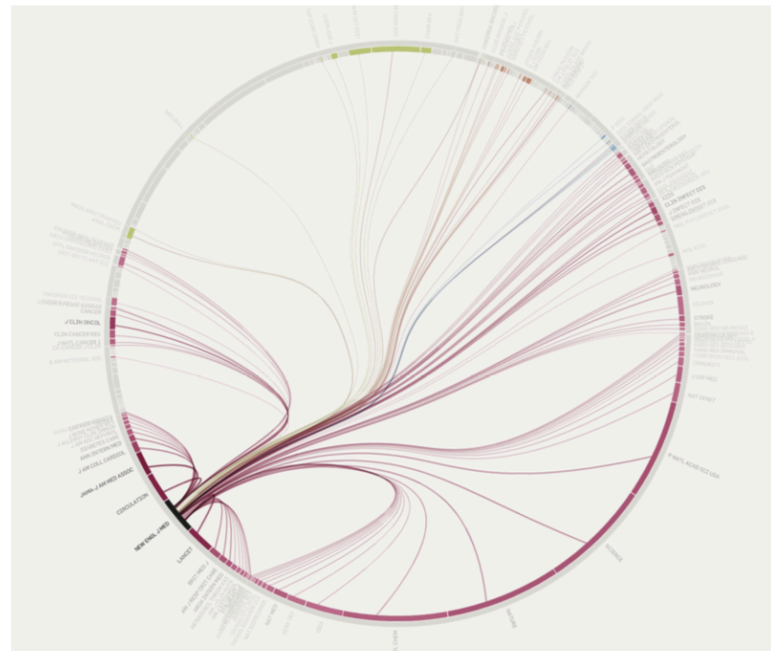
A searchable database of Eigenfactor® and Article Influence® scores from 1997 to the 2013.

## RESEARCH AREAS

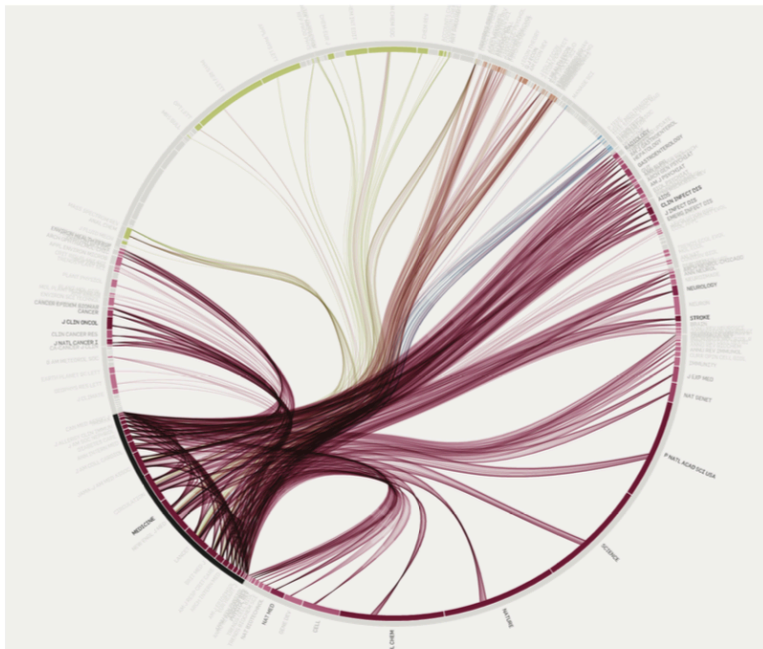




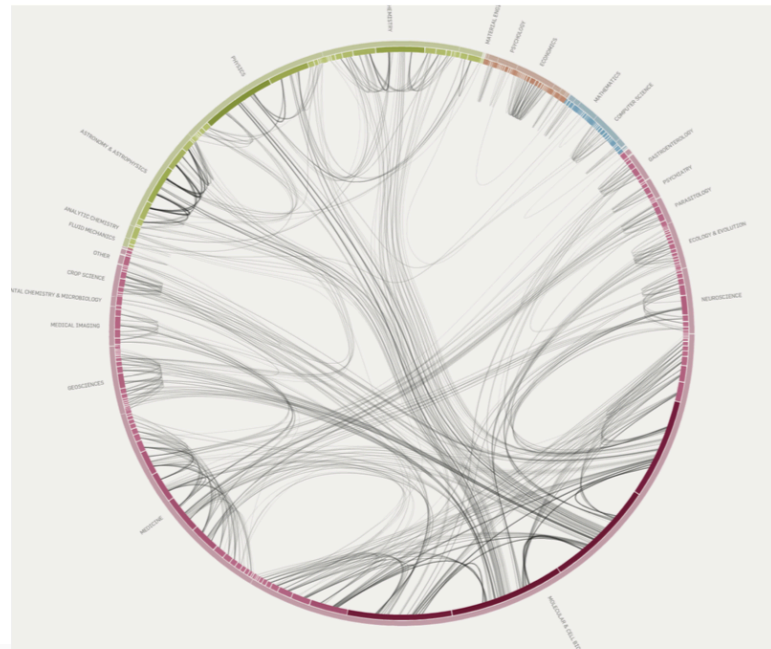
a) Journal of the ACC



b) New England Journal of Medicine



c) All of Medicine



d) All of Science



**List 2: Medicine**  
Differences in Relative Ranking (2006 Data)

Impact Factor	Article Influence	
CA-CANCER J CLIN	NEW ENGL J MED	16.82
NEW ENGL J MED	CA-CANCER J CLIN	13.94
LANCET	JAMA-J AM MED ASSOC	10.29
JAMA-J AM MED ASSOC	LANCET	8.635
J NATL CANCER I	CLIN MICROBIOL REV	5.884
ANN INTERN MED	PLOS MED	5.803
PLOS MED	ANN INTERN MED	5.772
J CLIN ONCOL	J NATL CANCER I	5.473
ANNU REV MED	LANCET INFECT DIS	4.969
CLIN MICROBIOL REV	CIRCULATION	4.273
LANCET INFECT DIS	ANNU REV MED	4.004
CIRCULATION	ANNU REV NUTR	4.002
ANNU REV NUTR	CIRC RES	3.919
CIRC RES	HEALTH TECHNOL ASSES	3.665
J AM COLL CARDIOL	J CLIN ONCOL	3.475
BRIT MED J	J AM COLL CARDIOL	3.354
AM J RESP CRIT CARE	BRIT MED J	3.287
J ALLERGY CLIN IMMUN	ARCH INTERN MED	3.271
EPIDEMIOLOG REV	DIABETES	2.895
CLIN PHARMACOL THER	AM J RESP CRIT CARE	2.825
DIABETES	MILBANK Q	2.673
ARCH INTERN MED	ARTERIOSCL THROM VAS	2.631
DIABETES CARE	ARCH DIS CHILD-FETAL	2.626
ANN SURG	AM J EPIDEMIOLOG	2.534
J AM SOC NEPHROL	EUR HEART J	2.522
EUR HEART J	ANN SURG	2.478
PHARMACOGENETICS	DIABETES CARE	2.475
ARTERIOSCL THROM VAS	ANNU REV PUBL HEALTH	2.472
CAN MED ASSOC J	EPIDEMIOLOG REV	2.307
ANNU REV PUBL HEALTH	EMERG INFECT DIS	2.224
AM J TRANSPLANT	J AM SOC NEPHROL	2.211
MILBANK Q	AM J CLIN NUTR	2.199
HUM REPROD UPDATE	AIDS	2.198
J BONE MINER RES	J ALLERGY CLIN IMMUN	2.134
CRIT CARE MED	J BONE MINER RES	2.119
AM J CLIN NUTR	CLIN INFECT DIS	2.117
CLIN INFECT DIS	CAN MED ASSOC J	2.097
THORAX	THORAX	2.077
HYPERTENSION	HUM REPROD UPDATE	2.05
ATHEROSCLEROSIS SUPP	J INFECT DIS	2.049
CARDIOVASC RES	STROKE	2.035
J CLIN ENDOCR METAB	MED CARE	2.033
CURR OPIN LIPIDOL	CURR OPIN LIPIDOL	2.002
AIDS	INT J EPIDEMIOLOG	1.980
CLIN CHEM	EPIDEMIOLOG	1.976
STROKE	AM J BIOETHICS	1.906
PHARMACOGENET GENOM	DIABETOLOGIA	1.89
J INFECT DIS	AM J PUBLIC HEALTH	1.881
ALLERGY	J CLIN ENDOCR METAB	1.872
HEALTH TECHNOL ASSES	AM J MED	1.829
DIABETOLOGIA	B WORLD HEALTH ORGAN	1.816
AM J EPIDEMIOLOG	PHARMACOGENETICS	1.805
ONCOLOGIST	HYPERTENSION	1.792
ANN ONCOL	CLIN CHEM	1.787
MEDICINE	CLIN PHARMACOL THER	1.785
J THROMB HAEMOST	MEDICINE	1.780
EMERG INFECT DIS	LUNG CANCER	1.758
EUR RESPIR J	CARDIOVASC RES	1.739
B WORLD HEALTH ORGAN	PEDIATRICS	1.733
PEDIATRICS	AM J TRANSPLANT	1.712
ANTIVIR THER	HEALTH AFFAIR	1.695
J MOL CELL CARDIOL	J MOL CELL CARDIOL	1.661
CURR OPIN INFECT DIS	AM J PREV MED	1.637
KIDNEY INT	J GEN INTERN MED	1.598
ARCH DIS CHILD-FETAL	JAIDS-J ACQ IMM DEF	1.589
J INTERN MED	CANCER EPIDEM BIOHAR	1.572
BREAST CANCER RES TR	HIV MED	1.563
ANN MED	J THROMB HAEMOST	1.544
CANCER	ANN BEHAV MED	1.51
AM J MED	CANCER	1.505
INT J EPIDEMIOLOG	HEALTH SERV RES	1.488
DRUGS	EUR RESPIR J	1.483
INTENS CARE MED	BONE	1.482
CANCER TREAT REV	AM J PHYSIOL-ENDOC M	1.478
EPIDEMIOLOG	CRIT CARE MED	1.455

**List 3: Cardiac & Cardiovascular Systems**  
and Peripheral Vascular Disease  
Differences in Relative Ranking (2006 Data)

Impact Factor	Article Influence	
CIRCULATION	CIRCULATION	4.273
CIRC RES	CIRC RES	3.919
J AM COLL CARDIOL	J AM COLL CARDIOL	3.354
EUR HEART J	ARTERIOSCL THROM VAS	2.631
ARTERIOSCL THROM VAS	EUR HEART J	2.522
HYPERTENSION	STROKE	2.035
ATHEROSCLEROSIS SUPP	CURR OPIN LIPIDOL	2.002
CARDIOVASC RES	HYPERTENSION	1.792
CURR OPIN LIPIDOL	CARDIOVASC RES	1.739
STROKE	J MOL CELL CARDIOL	1.661
J THROMB HAEMOST	TRENDS CARDIOVAS MED	1.563
J MOL CELL CARDIOL	J THROMB HAEMOST	1.544
TRENDS CARDIOVAS MED	J THORAC CARDIOV SUR	1.450
CURR OPIN NEPHROL HY	HEART	1.388
J HYPERTENS	AM HEART J	1.339
CURR VASC PHARMACOL	HEART RHYTHM	1.302
ATHEROSCLEROSIS	HEART FAIL REV	1.256
BASIC RES CARDIOL	ATHEROSCLEROSIS	1.210
HEART RHYTHM	AM J PHYSIOL-HEART C	1.174
AM J PHYSIOL-HEART C	J HYPERTENS	1.17
HEART	CARDIOL CLIN	1.117
J THORAC CARDIOV SUR	AM J CARDIOL	1.110
AM HEART J	J CARDIOVASC MAGN R	1.105
CURR PROB CARDIOLOGY	J VASC SURG	1.068
SHOCK	THROMB HAEMOSTASIS	1.043
J VASC SURG	J CARD FAIL	1.017
J CARDIOVASC ELECTR	ATHEROSCLEROSIS SUPP	0.9876
EUR J HEART FAIL	PROG CARDIOVASC DIS	0.9315
HYPERTENS RES	CURR OPIN NEPHROL HY	0.9142
AM J HYPERTENS	MICROCIRCULATION	0.9114
AM J CARDIOL	J CARDIOVASC ELECTR	0.884
J HUM HYPERTENS	AM J HYPERTENS	0.8725
J HEART LUNG TRANSPL	J HEART LUNG TRANSPL	0.8443
HEART FAIL REV	BASIC RES CARDIOL	0.8256
THROMB HAEMOSTASIS	EUR J HEART FAIL	0.8135
CURR OPIN CARDIOL	CURR VASC PHARMACOL	0.8124
J CARD FAIL	ANN THORAC SURG	0.8106
SEMIN THROMB HEMOST	J VASC INTERV RADIOL	0.81
NAT CLIN PRACT CARD	SHOCK	0.7737
J VASC RES	NAT CLIN PRACT CARD	0.7577
PROG CARDIOVASC DIS	J ENDOVASC THER	0.7486
MICROVASC RES	EUR J CARDIO-THORAC	0.7438
J NUCL CARDIOL	CEREBROVASC DIS	0.7366
MICROCIRCULATION	J VASC RES	0.715
J VASC INTERV RADIOL	CURR OPIN CARDIOL	0.6874
ENDOTHELIUM-J ENDOTH	EUR J VASC ENDOVASC	0.6705
ANN THORAC SURG	CARDIOVASC PATHOL	0.6496
INT J CARDIOL	MICROVASC RES	0.624
REV ESP CARDIOL	SEMIN THROMB HEMOST	0.6239
EUR J VASC ENDOVASC	CURR HYPERTENS REP	0.6018
J ENDOVASC THER	J CARDIOVASC PHARM T	0.5659
CIRC J	INT J CARDIOL	0.562
EUR J CARDIO-THORAC	EUR J CARDIOV PREV R	0.5586
RESP MED	RESP MED	0.5499
THROMB RES	THROMB RES	0.549
CEREBROVASC DIS	J HUM HYPERTENS	0.5461
CURR HYPERTENS REP	J HEART VALVE DIS	0.5361
EUR J CARDIOV PREV R	J AM SOC ECHOCARDIOG	0.5171
CARDIOVASC PATHOL	CATHETER RADIO INTE	0.5131
KIDNEY BLOOD PRESS R	CARDIOLOGY	0.4743
NUTR METAB CARDIOVAS	CURR PROB CARDIOLOGY	0.465
CARDIOLOGY	VASC MED	0.4613
J CARDIOVASC MAGN R	ANN VASC SURG	0.4502
CARDIOVASC DRUG REV	J CARDIOVASC PHARM	0.4498
J AM SOC ECHOCARDIOG	ENDOTHELIUM-J ENDOTH	0.4372
J CARDIOVASC PHARM	J NUCL CARDIOL	0.4315
CATHETER RADIO INTE	HYPERTENS RES	0.4223
CORONARY ARTERY DIS	EUROPACE	0.3904
EUR HEART J SUPPL	CARDIOVASC DRUG THER	0.3865
EUROPACE	HYPERTENS PREGNANCY	0.384
CARDIOL CLIN	CURR CONTR TRIALS C	0.3809
BLOOD PRESS MONIT	CORONARY ARTERY DIS	0.3804
CARDIOVASC DRUG THER	CARDIOVASC INTER RAD	0.3689
ANN NONINVAS ELECTRO	CAN J CARDIOL	0.3513
CURR CONTR TRIALS C	NUTR METAB CARDIOVAS	0.3434

What is my impact on science?

**\$7,933,670,366**



# The **H-index** impact on science...



**Jure Leskovec**

Professor of Computer Science, [Stanford University](#)  
[Data mining](#), [Social Network Analysis](#), [Information Networks](#)  
Verified email at cs.stanford.edu - [Homepage](#)



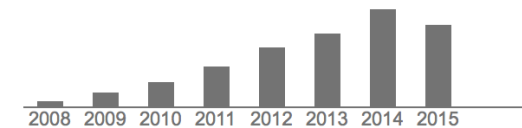
Title	1–20	Cited by	Year
<a href="#">Graphs over time: densification laws, shrinking diameters and possible explanations</a>	J Leskovec, J Kleinberg, C Faloutsos Proceedings of the eleventh ACM SIGKDD international conference on Knowledge ...	1373	2005
<a href="#">The dynamics of viral marketing</a>	J Leskovec, LA Adamic, BA Huberman ACM Transactions on the Web (TWEB) 1 (1), 5	1338	2007
<a href="#">Cost-effective outbreak detection in networks</a>	J Leskovec, A Krause, C Guestrin, C Faloutsos, J VanBriesen, N Glance Proceedings of the 13th ACM SIGKDD international conference on Knowledge ...	887	2007
<a href="#">Meme-tracking and the dynamics of the news cycle</a>	J Leskovec, L Backstrom, J Kleinberg Proceedings of the 15th ACM SIGKDD international conference on Knowledge ...	885	2009
<a href="#">Graph evolution: Densification and shrinking diameters</a>	J Leskovec, J Kleinberg, C Faloutsos ACM Transactions on Knowledge Discovery from Data (TKDD) 1 (1), 2	853	2007
<a href="#">Friendship and mobility: user movement in location-based social networks</a>	E Cho, SA Myers, J Leskovec Proceedings of the 17th ACM SIGKDD international conference on Knowledge ...	728	2011

[Community structure in large networks: Natural cluster sizes and the absence](#)

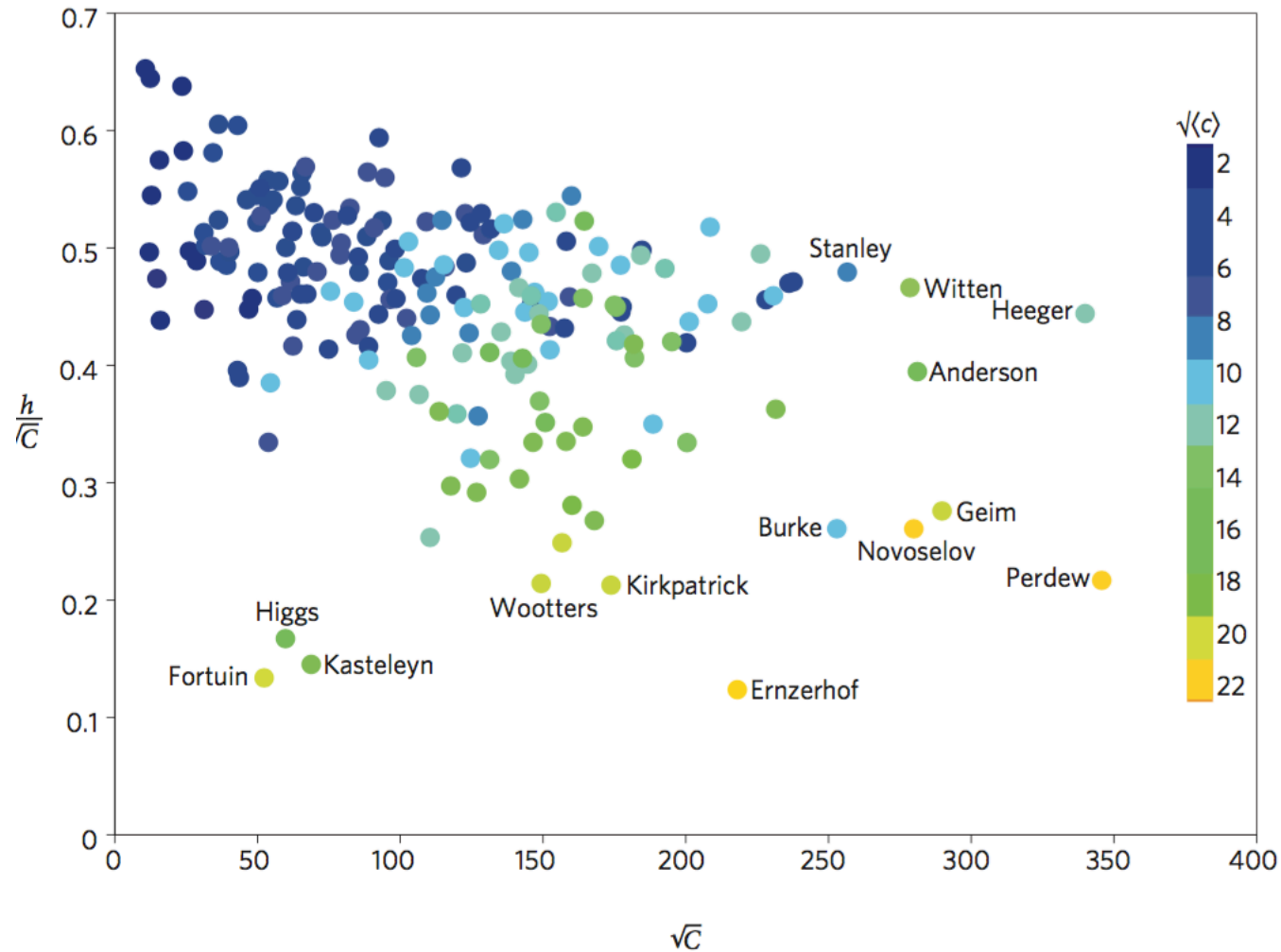
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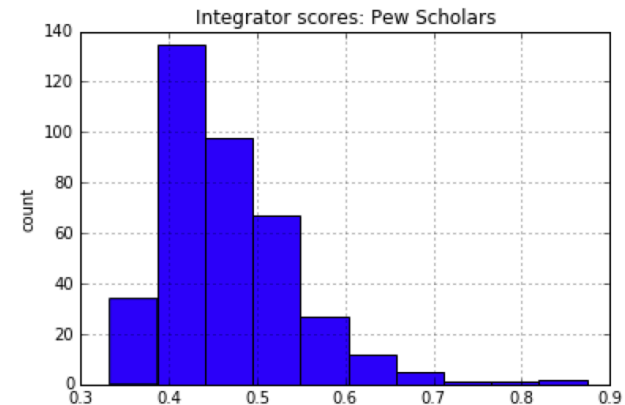
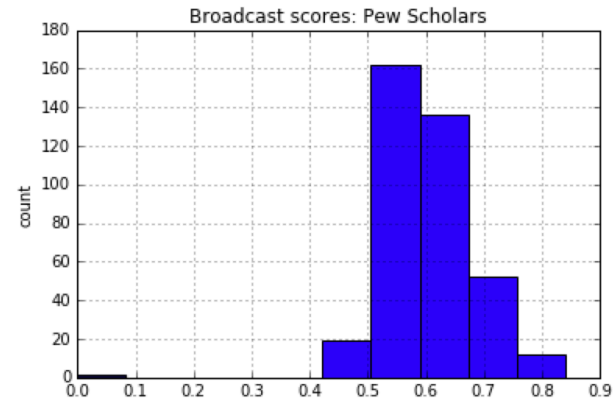
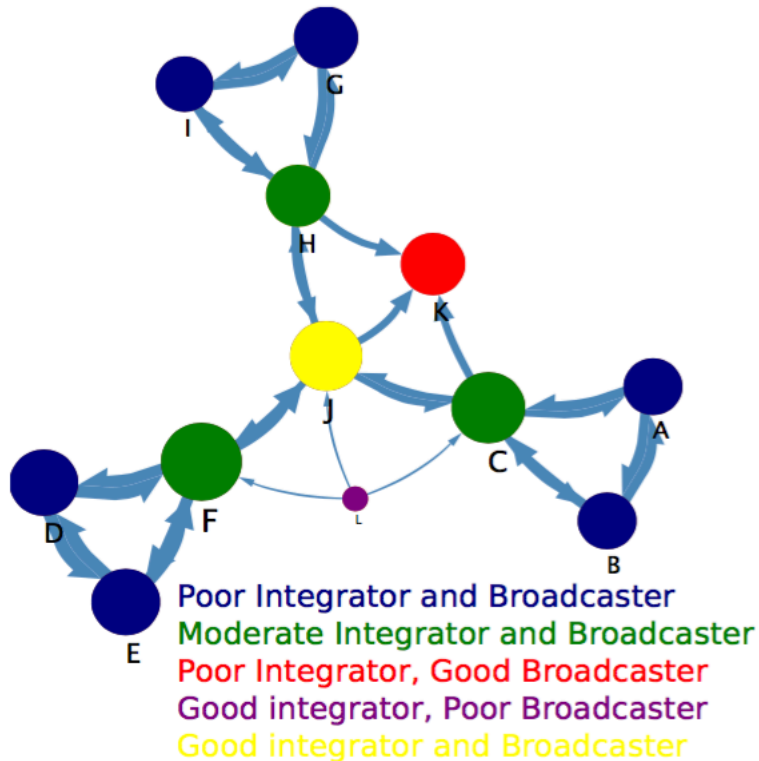
Citation indices	All	Since 2010
Citations	19409	17853
h-index	59	56
i10-index	103	101



# An evisceration of the H-index...



# Measuring Interdisciplinarity



Bergstrom, CT, Foster, J, Portenoy, J, A. Misra, West, JD. (2016). Measuring interdisciplinarity without subject categories. (in prep)

# Visualizing Scholarly Influence Over Time

*Influence of Pew Scholars*

Roberta A. Gottlieb

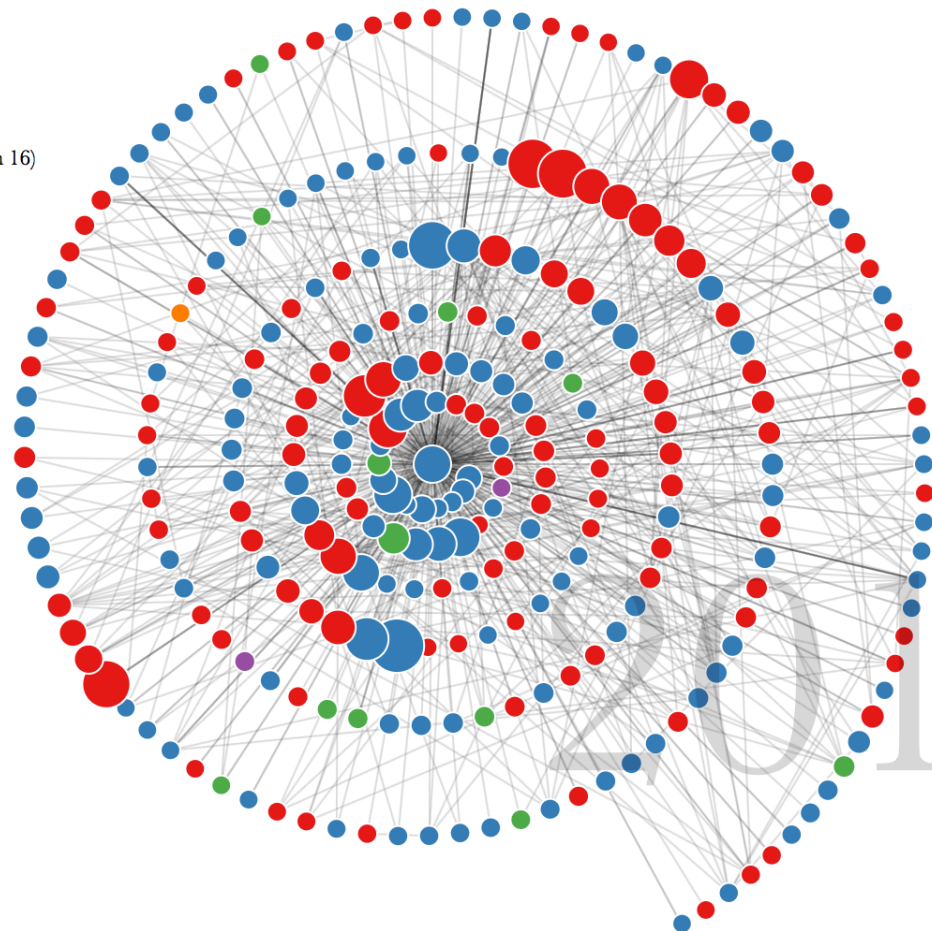
[Learn More](#)

- Papers in category "Medicine" (domain 6)
- Papers in category "Biology" (domain 4)
- Papers in category "Chemistry" (domain 5)
- Papers in category "Unknown" (domain 0)
- Papers in category "Agriculture Science" (domain 16)

Roberta A.  
Gottlieb



Pew Scholar  
1997



2012



**[scholar.eigenfactor.org](https://scholar.eigenfactor.org)**

username: PewScholar

password: 1N!kdG

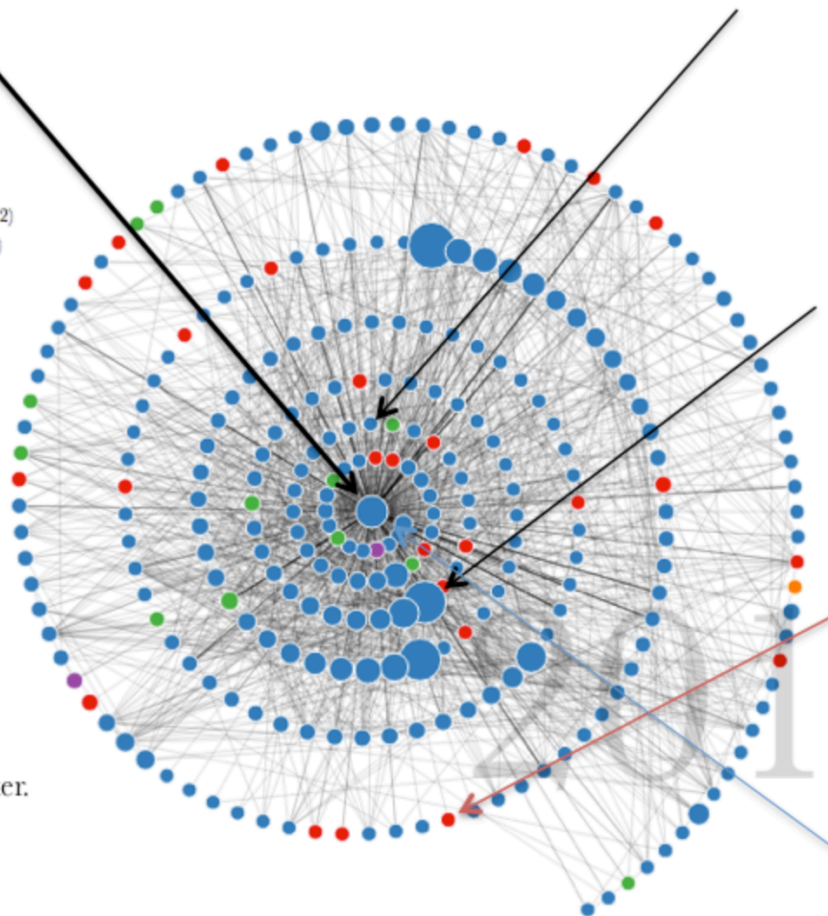
Jeivin West, [jevinw@uw.edu](mailto:jevinw@uw.edu)

# Pew Influence

The **center node** represents all of the papers authored by the scholar of interest.

Surrounding nodes represent papers that have cited work by the scholar of interest. Lines between the nodes show citations between papers.

- Papers in category "Biology" (domain 4)
- Papers in category "Medicine" (domain 6)
- Papers in category "Chemistry" (domain 5)
- Papers in category "Computer Science" (domain 2)
- Papers in category "Multidisciplinary" (domain 1)



Papers are revealed by year in a spiral formation, so that earlier papers appear closer to the center.

## Showing a scholar's influence

The size of each node is scaled by the *Eigenfactor score* of that paper—a metric of influence that takes into account its position in the total citation network. Bigger nodes represent the most influential papers that have cited the central scholar.

The color of each node shows the academic discipline of the paper. A more colorful network means that the impact of the central scholar's work has extended out to a wider range of fields.

The **color** of the **center node** represents the dominant field of the central scholar—the most common field of all the scholar's publications.



# Citation Data



49 million scholarly publications

260 million citations

354 Pew Scholars

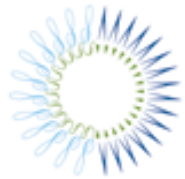
22,000 publications

62 publications/scholar

Pew EF 3 times the average EF

field classification





THE  
**PEW**  
CHARITABLE TRUSTS

Scholars Program  
*in the* Biomedical Sciences

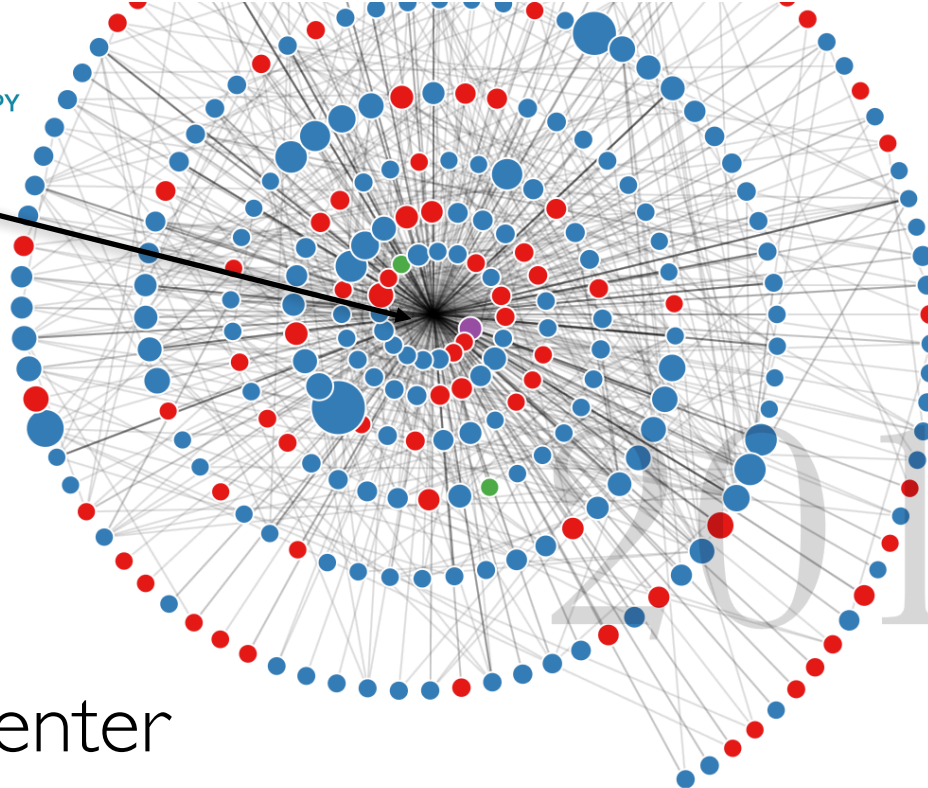
# Science

~ 37 citations/paper

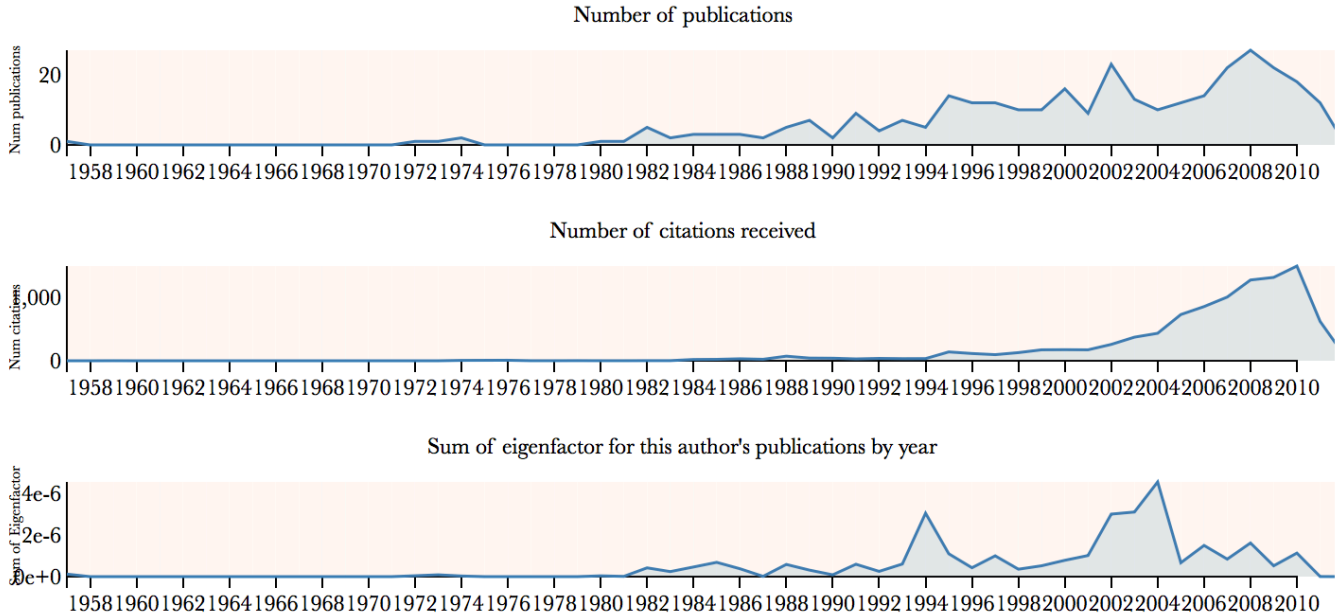
median citations = 11

~ 5 citations/paper

median citations = 0



# Institution as Center



# Visualizing Scholarly Influence Over Time

*Influence of Pew Scholars*

Mark W. Grinstaff

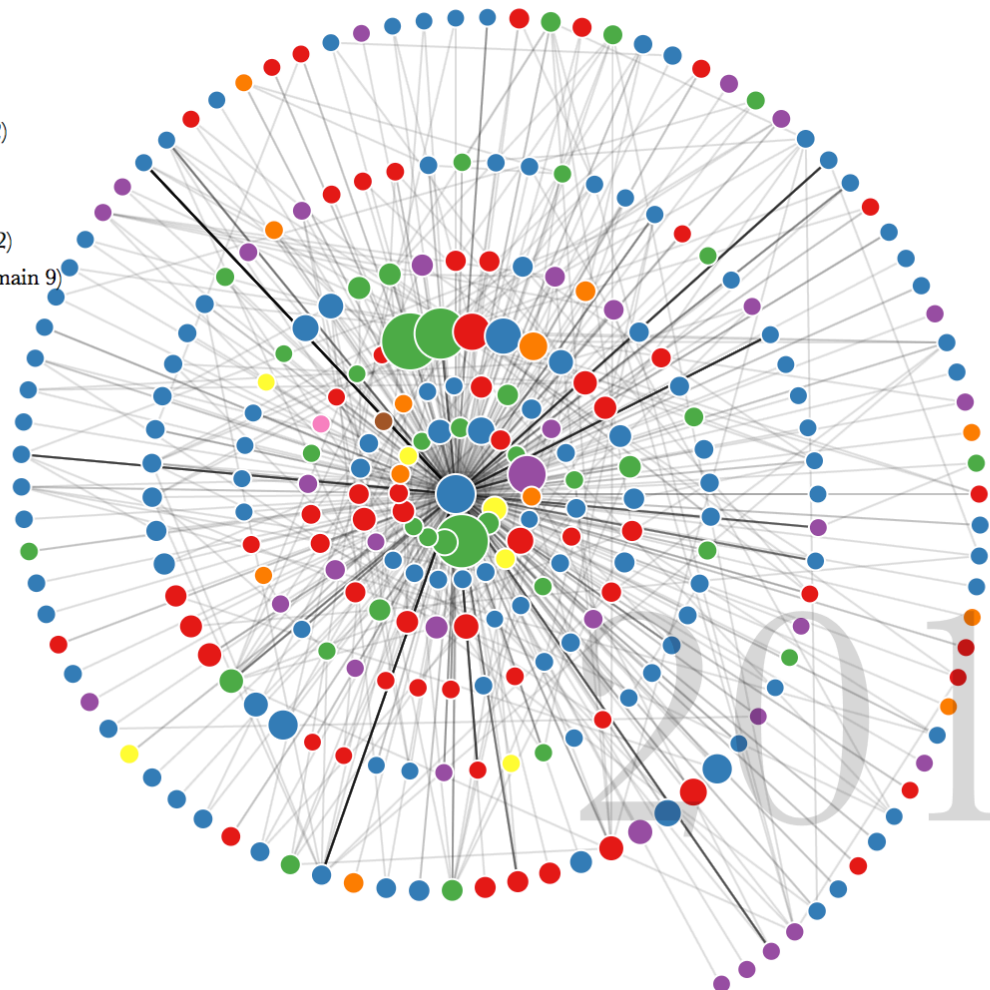
[Learn More](#)

- Papers in category "Chemistry" (domain 5)
- Papers in category "Medicine" (domain 6)
- Papers in category "Biology" (domain 4)
- Papers in category "Material Science" (domain 12)
- Papers in category "Engineering" (domain 8)
- Papers in category "Physics" (domain 19)
- Papers in category "Computer Science" (domain 2)
- Papers in category "Environmental Sciences" (domain 9)

Mark W.  
Grinstaff



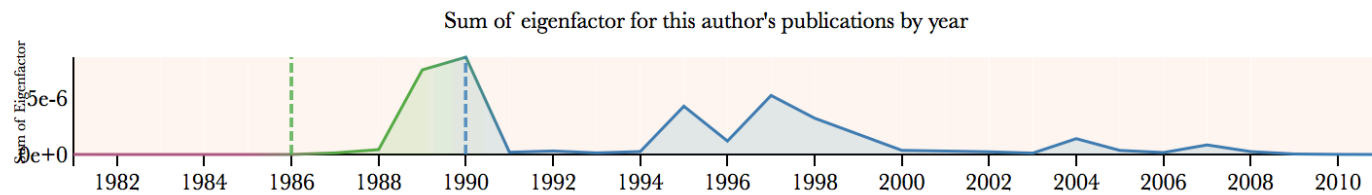
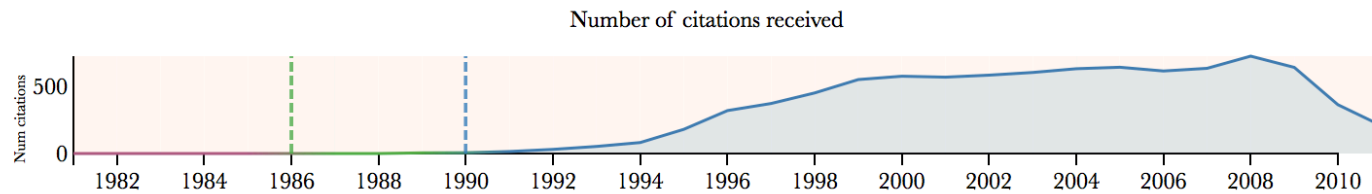
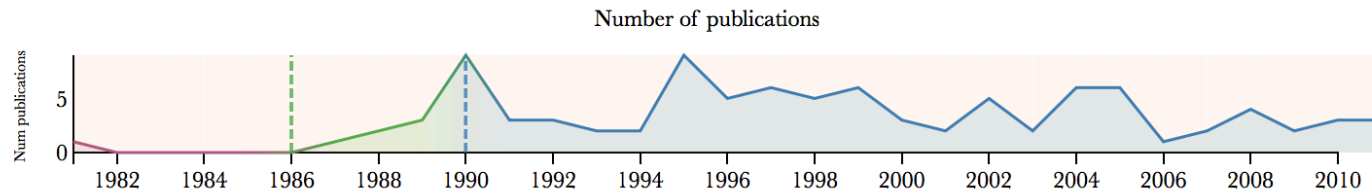
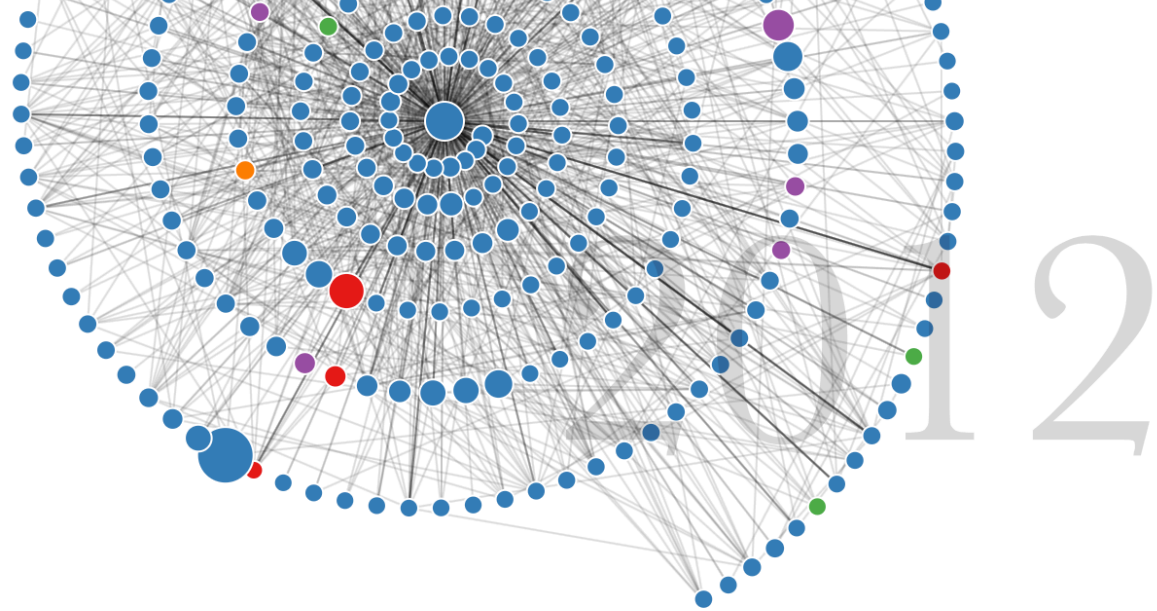
Pew Scholar  
1999



Philip A.  
Hieter



Pew Scholar  
1986



Funding

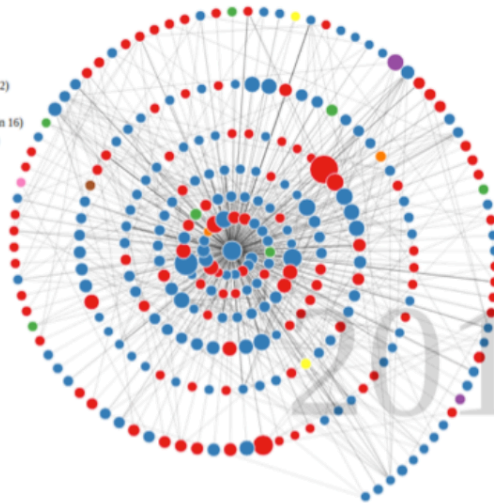


# Visualizing Interdisciplinarity



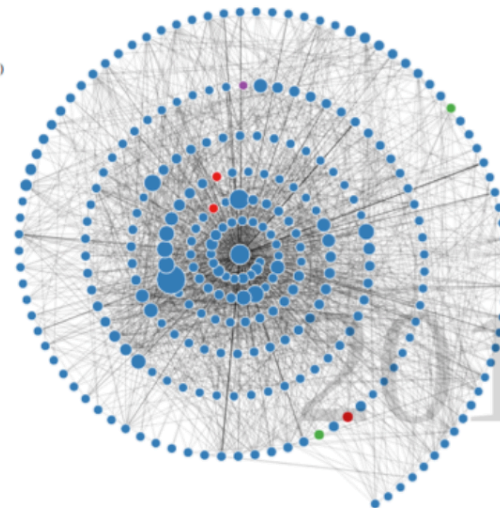
Jason Portenoy

- Papers in category "Medicine" (domain 6)
- Papers in category "Biology" (domain 4)
- Papers in category "Chemistry" (domain 5)
- Papers in category "Engineering" (domain 8)
- Papers in category "Material Science" (domain 12)
- Papers in category "Physics" (domain 19)
- Papers in category "Agriculture Science" (domain 16)
- Papers in category "Social Science" (domain 22)



A denser network means that the papers that cite the central author also tend to cite each other.

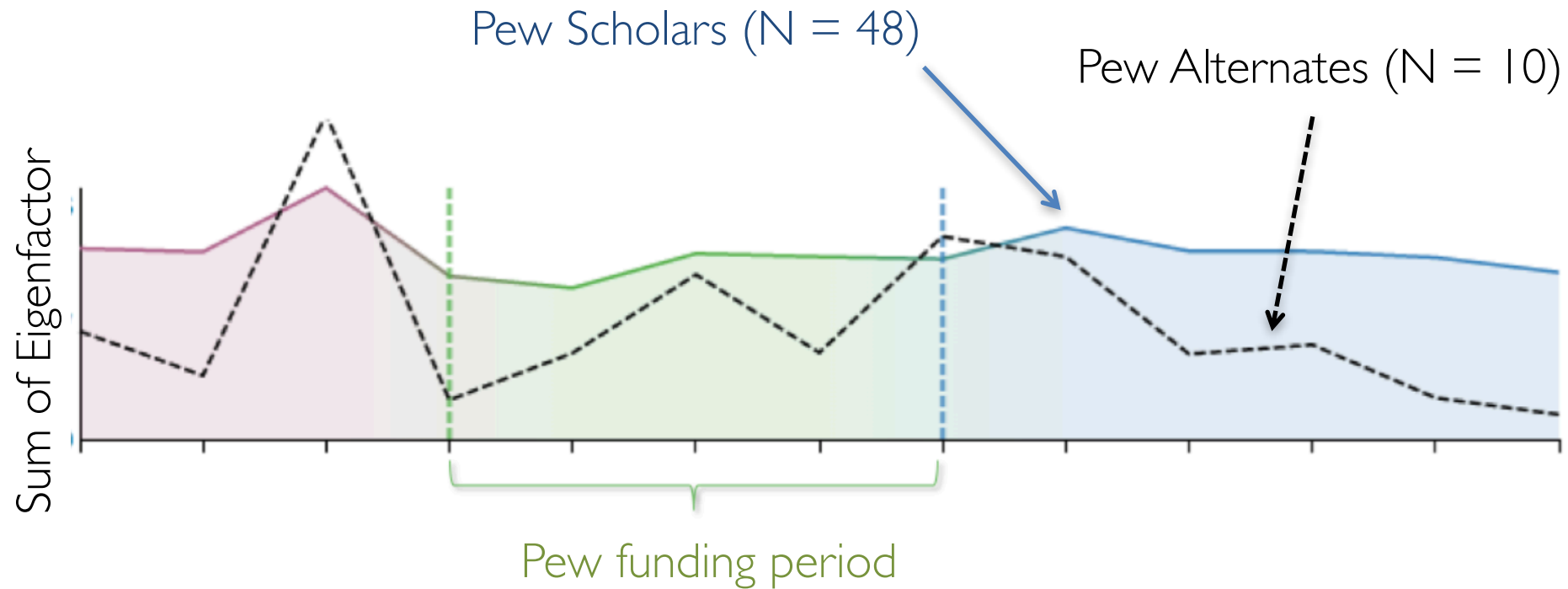
- Papers in category "Biology" (domain 4)
- Papers in category "Medicine" (domain 6)
- Papers in category "Chemistry" (domain 5)
- Papers in category "Social Science" (domain 22)



A more sparse network indicates fewer citations between papers shown in the network. This could be a result of the central scholar having impact across a wider set of academic communities.

The Pew Impact...

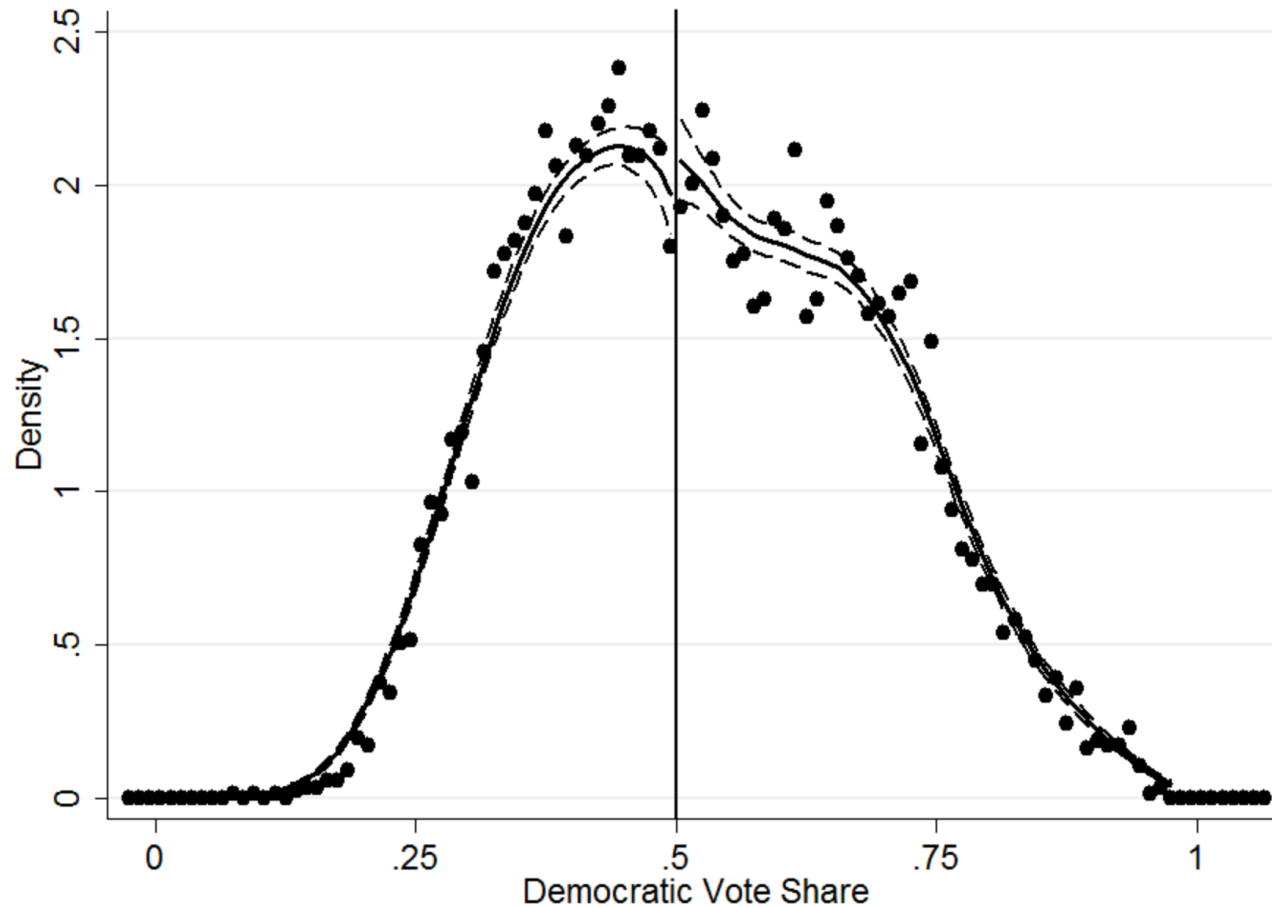
# Comparing Alternates



\* Includes scholars and alternates from cohort years: 1997, 1999, 2000, 2001, 2002

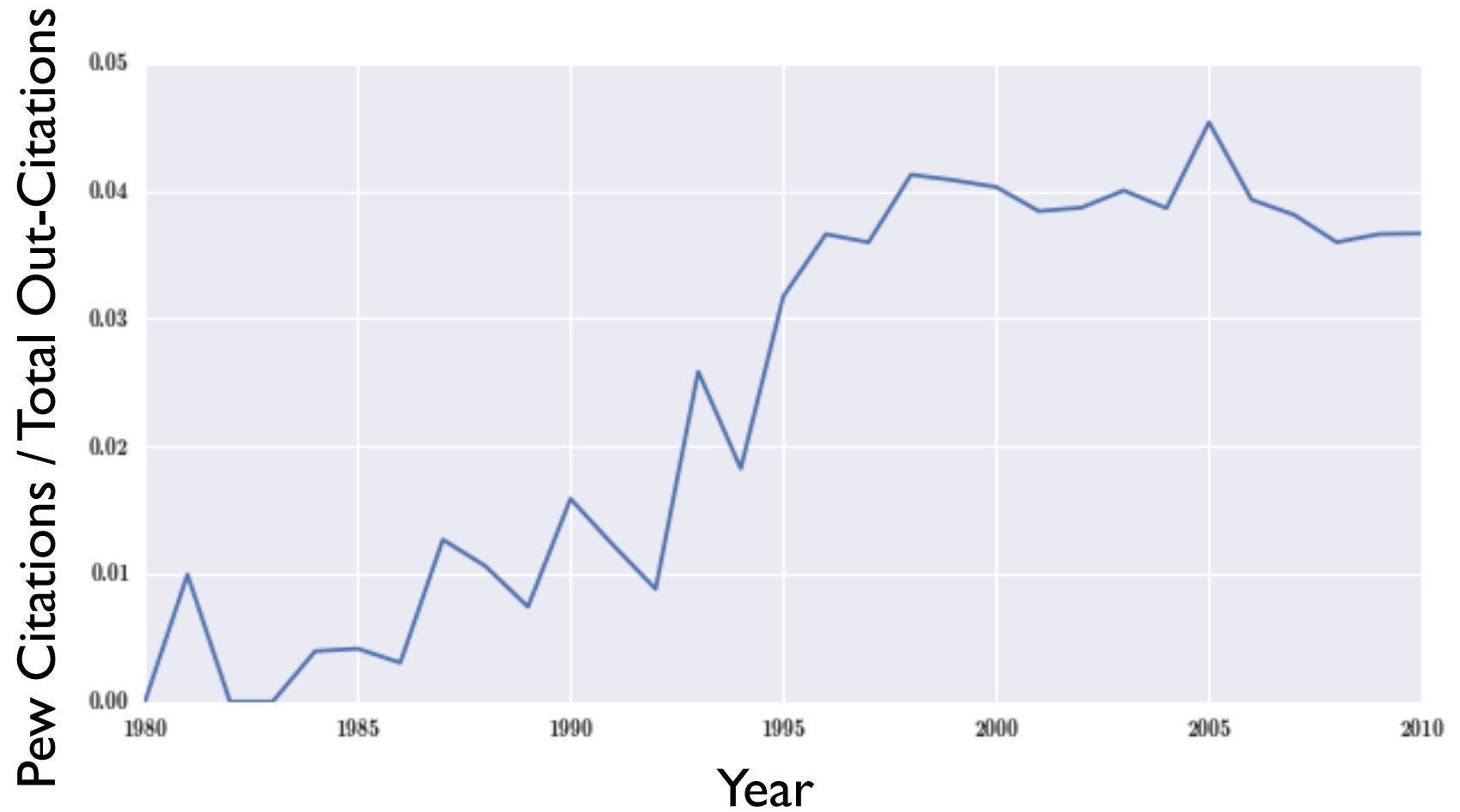


# Regression discontinuity design



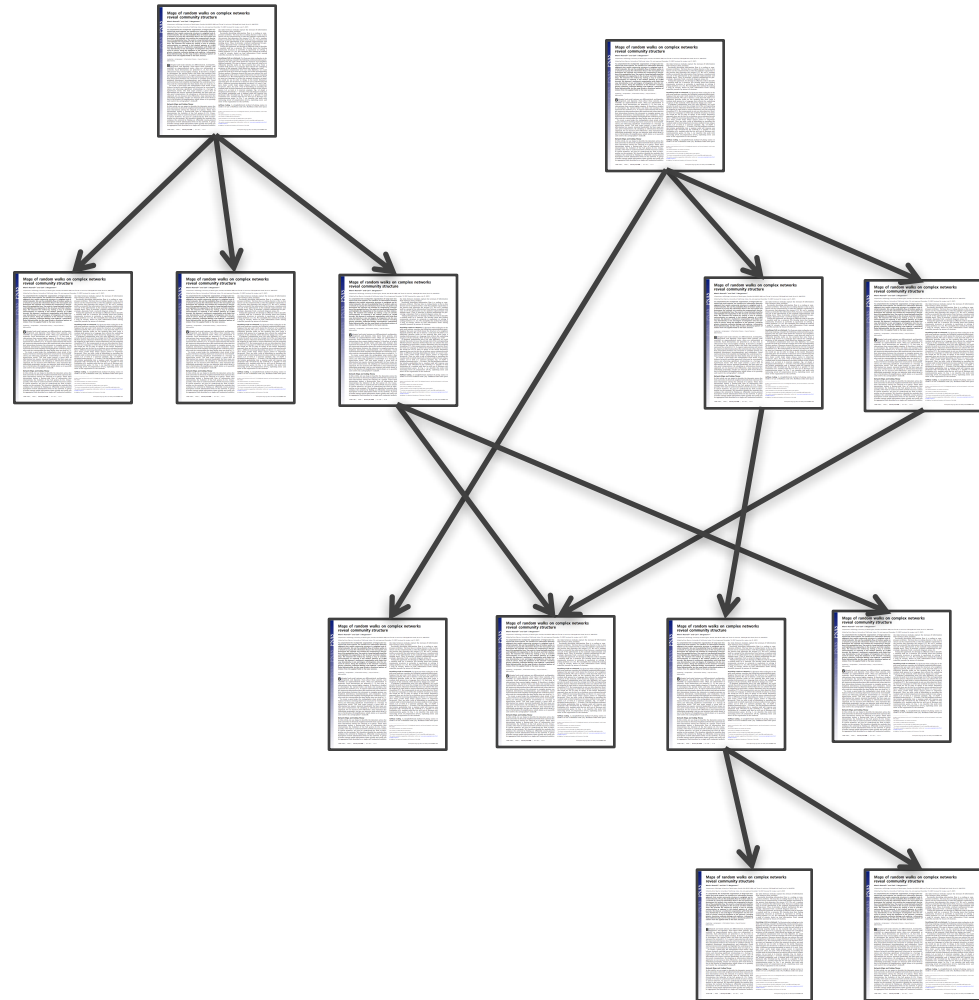
McCrary (2008)<sup>[10]</sup> density test on data from Lee, Moretti, and Butler (2004).

# Community Effect



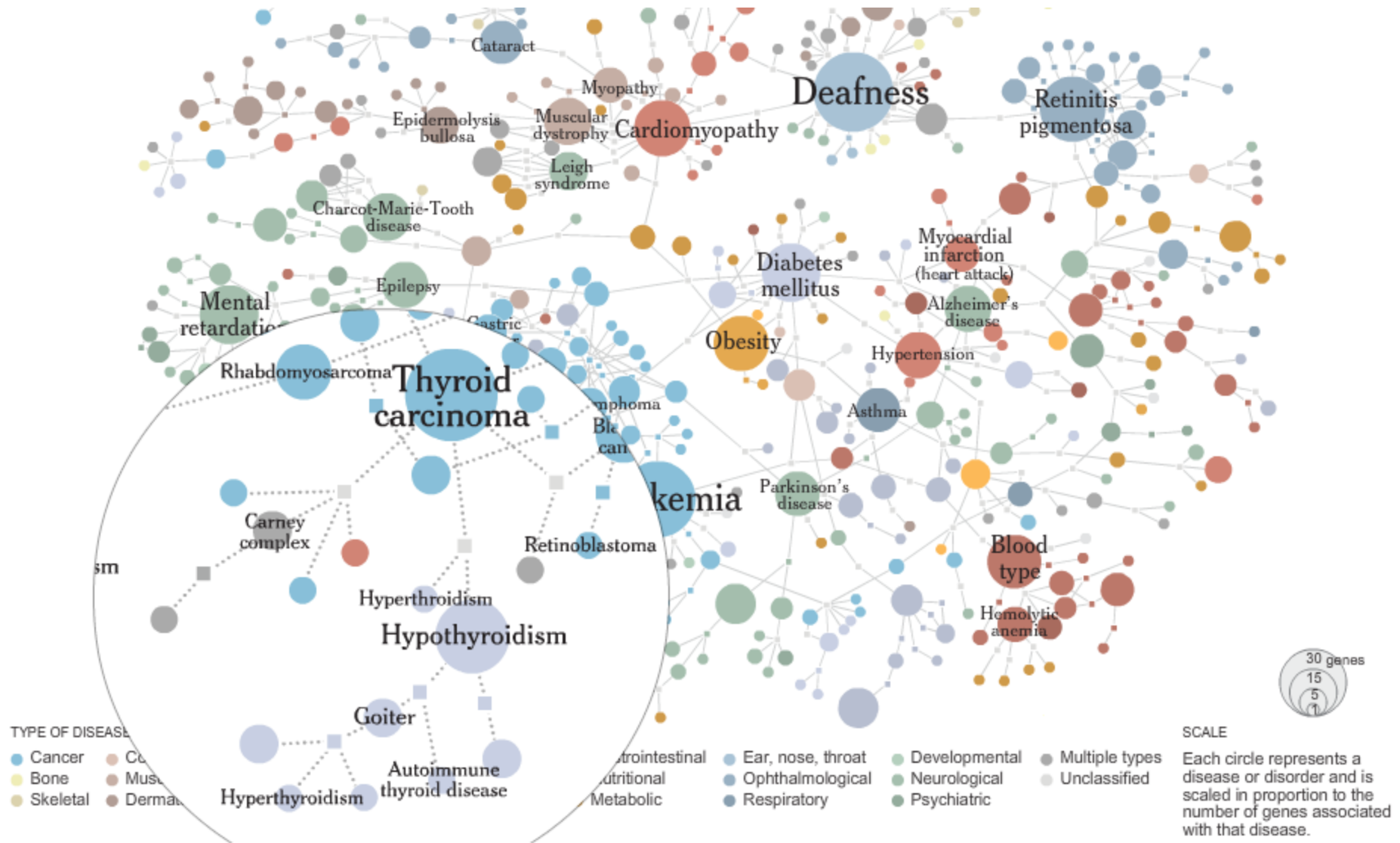
Moving beyond single metric summaries to rich, interactive (hypothesis-driven) visualizations

# Citations form a vast network



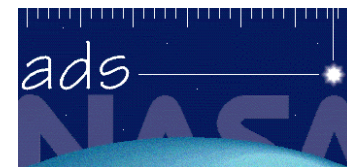
de Solla Price, *Science* (1965)

# Disease association network





# The Scholarly Graph



THOMSON REUTERS

PatentVector™



PNAS







# The Scholarly Graph



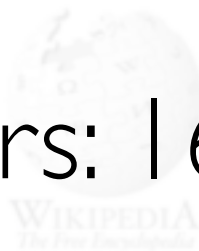
Tens of millions articles, patents, books

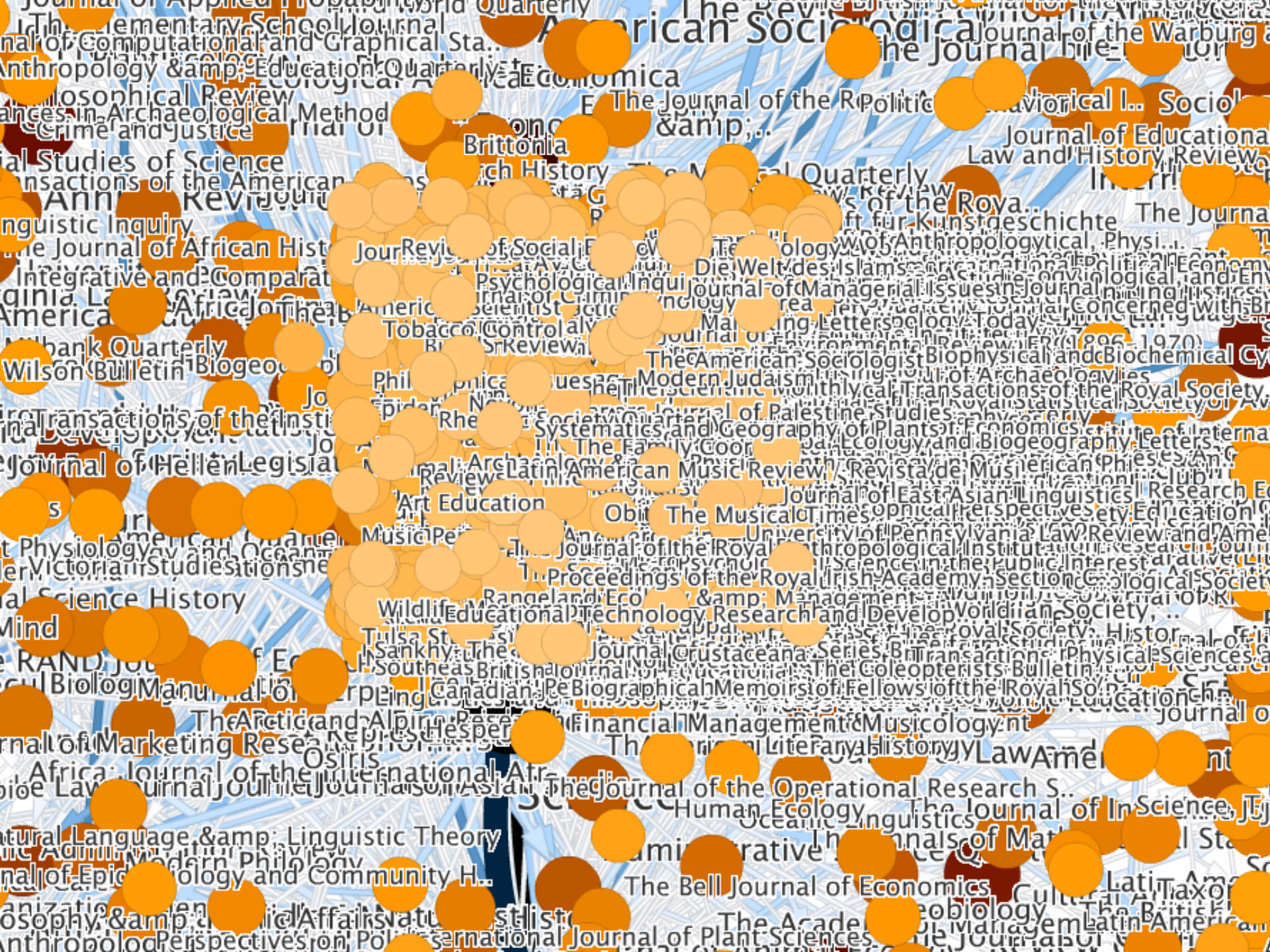


Billions of citation links



Years: 1600 - 2016



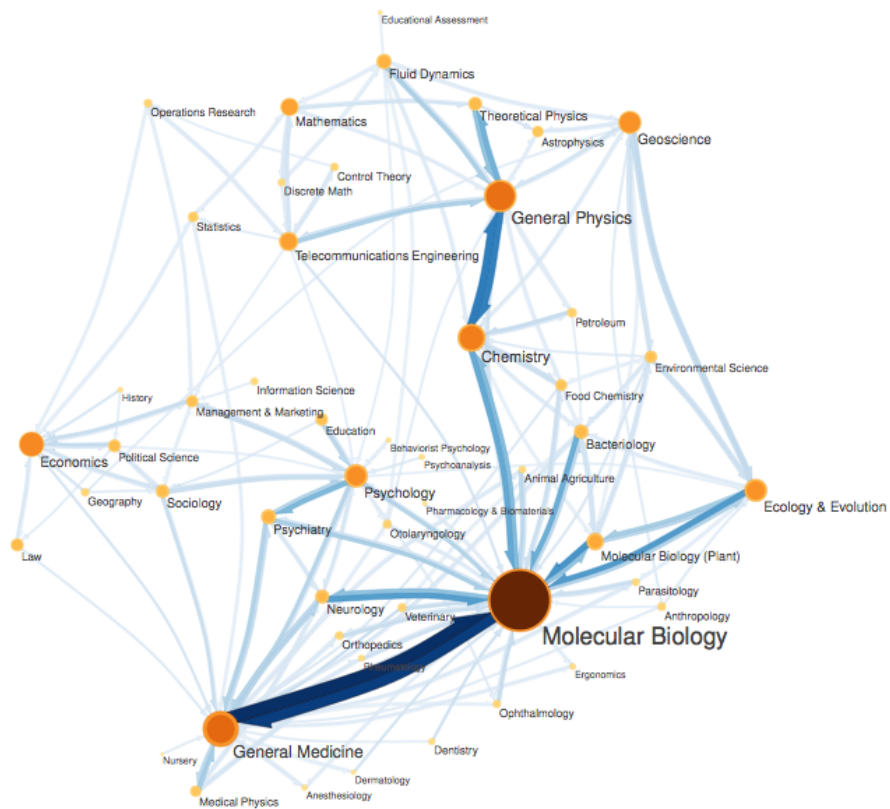


# The map equation

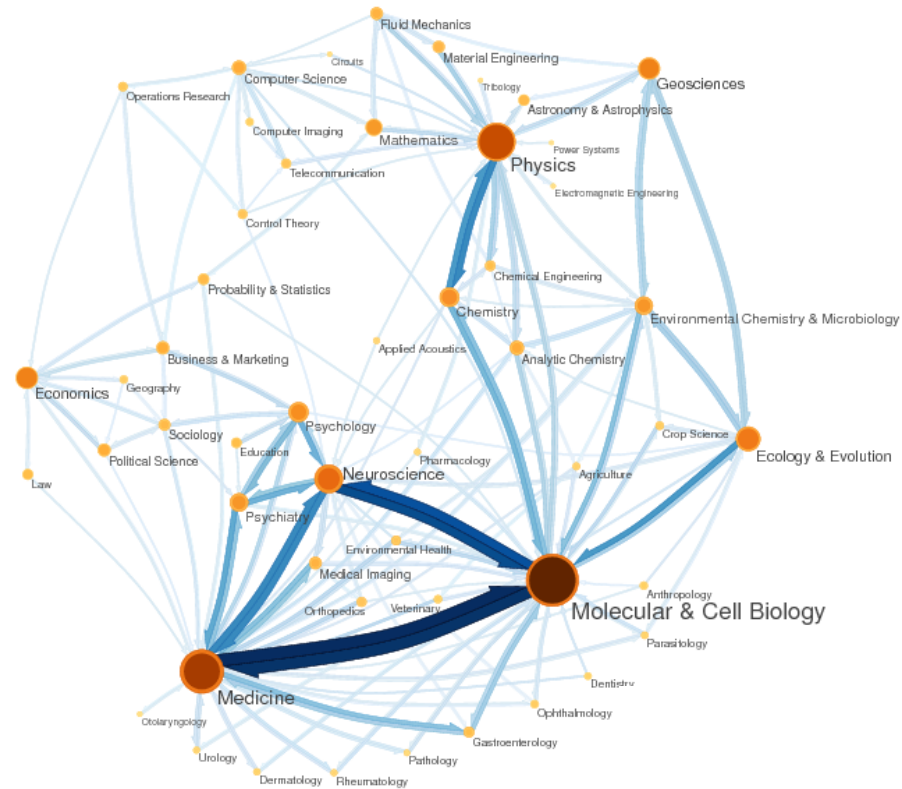
$$L(\mathbf{M}) = q_{\curvearrowright} H(\mathcal{Q}) + \sum_{i=1}^m p_{\circlearrowright}^i H(\mathcal{P}^i)$$



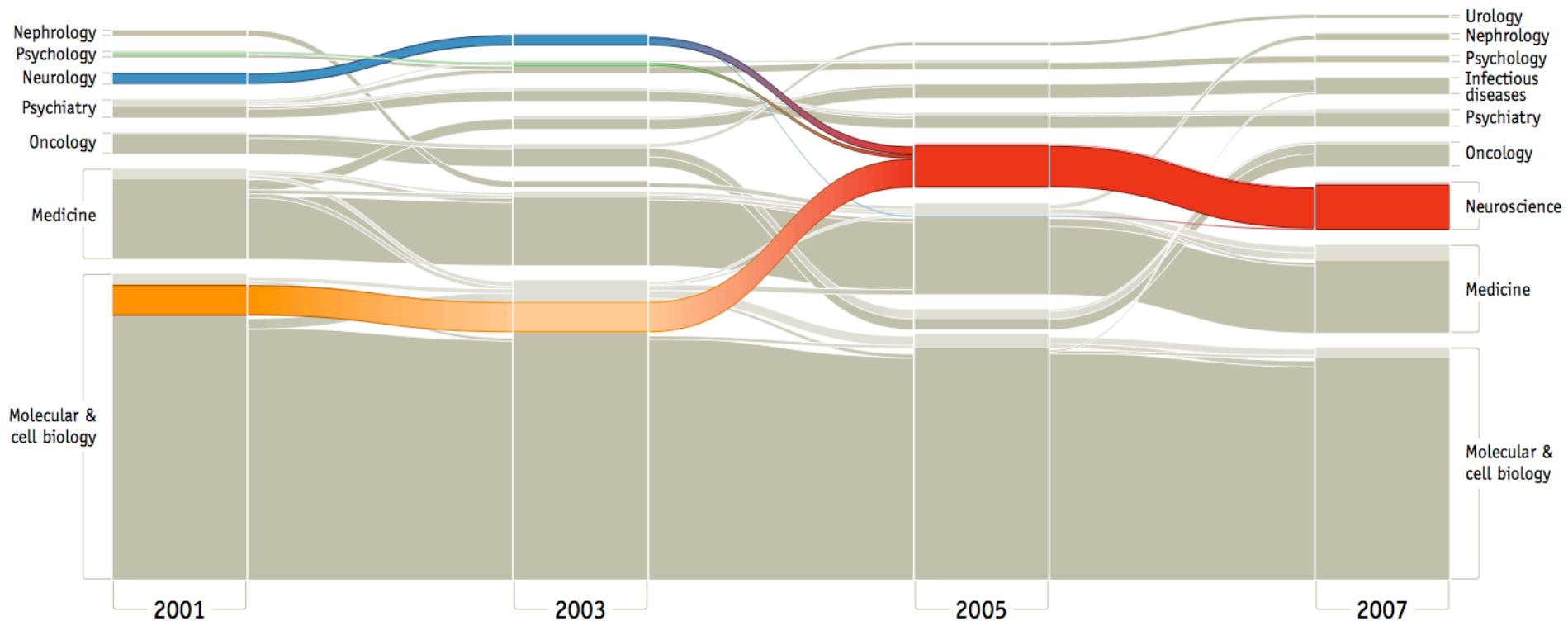
# 1995

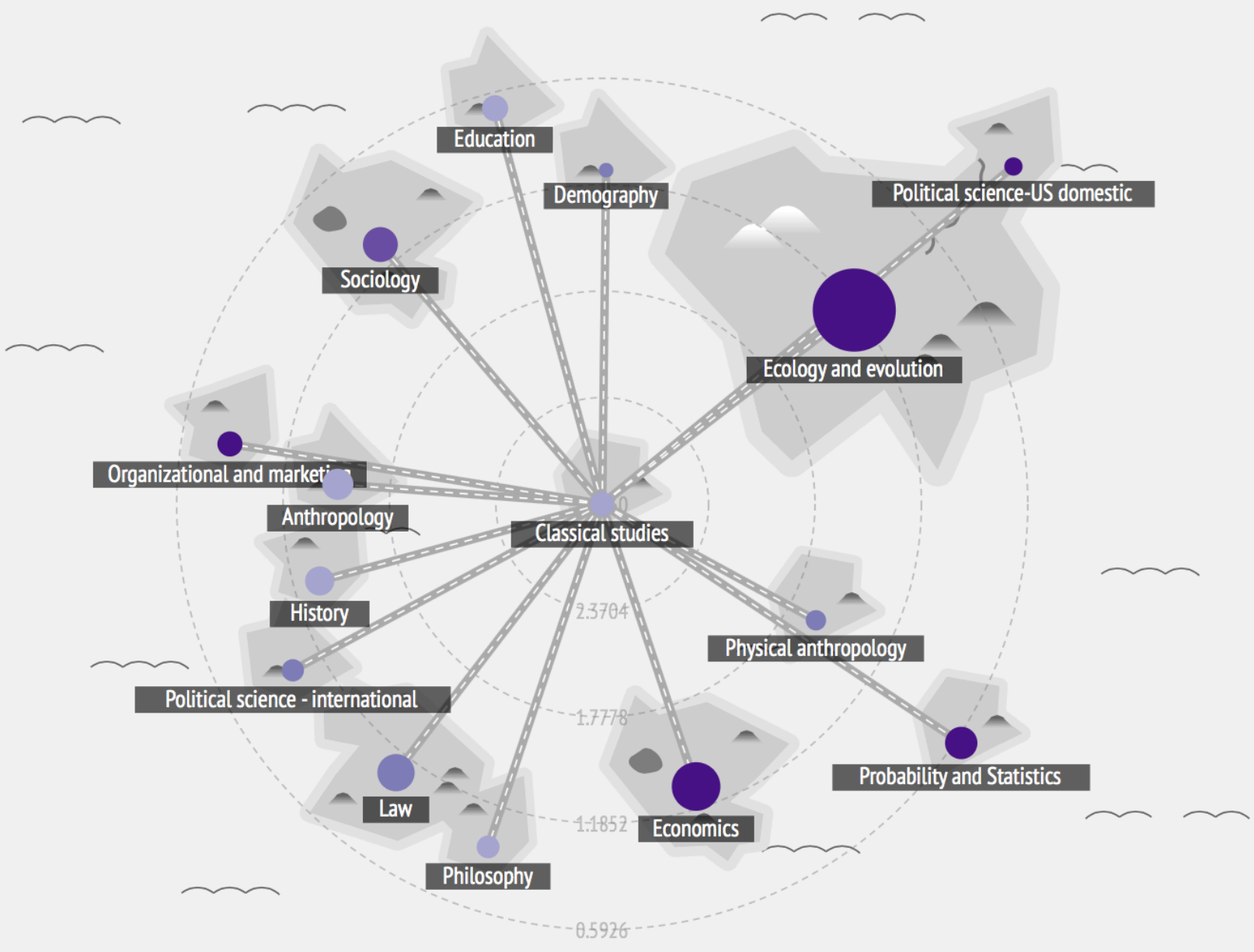


# 2004





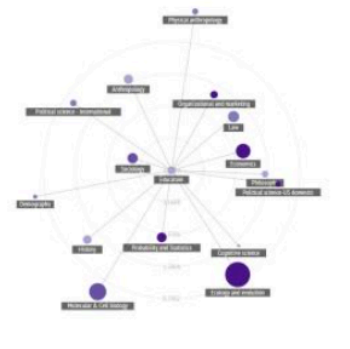
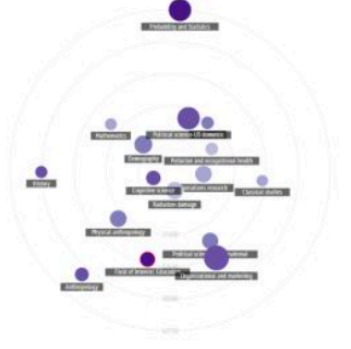
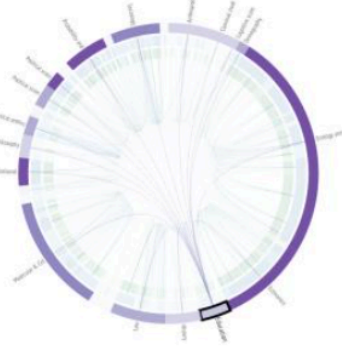
# Citation networks over time





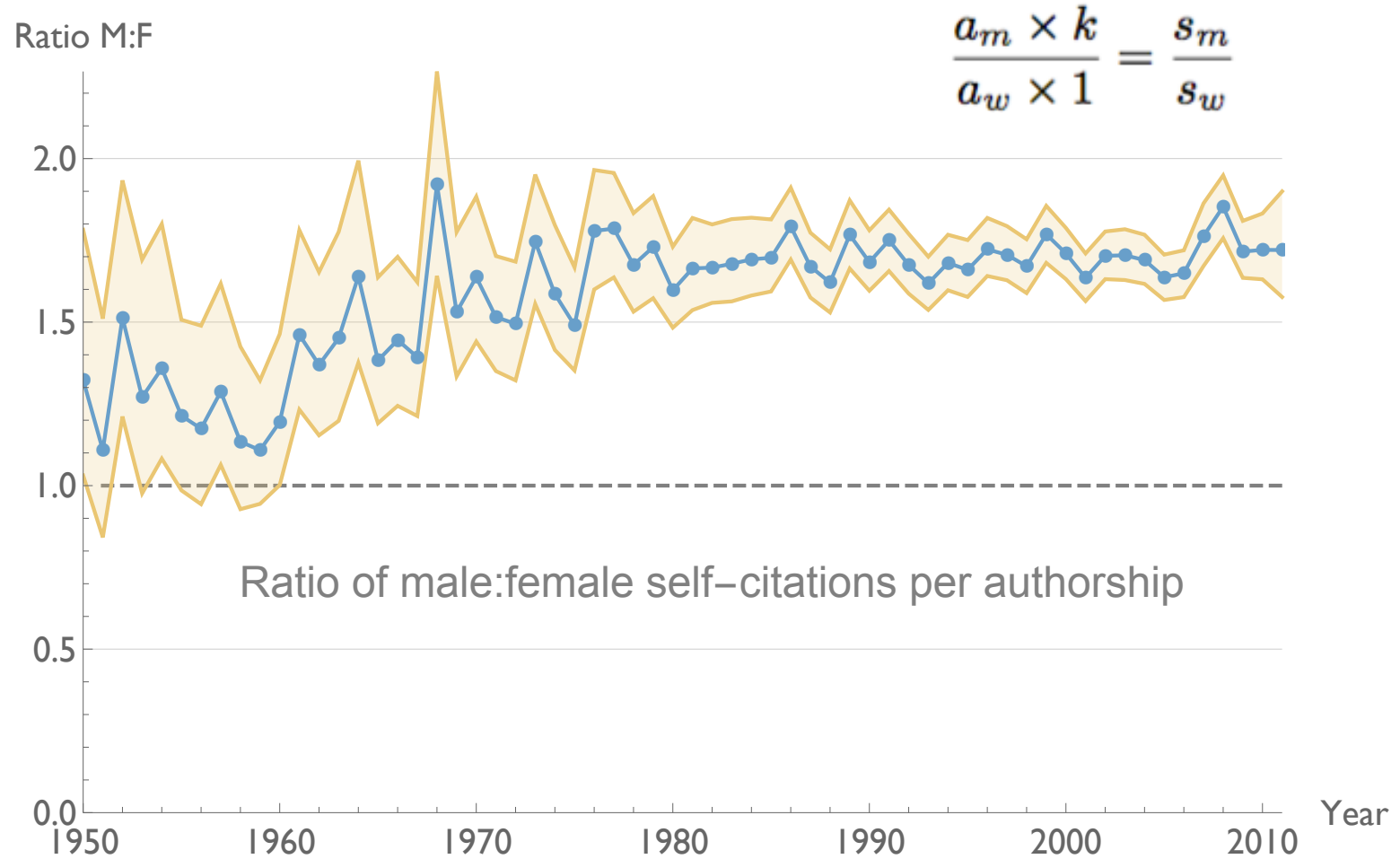


# Navigating Hierarchical Knowledge Networks

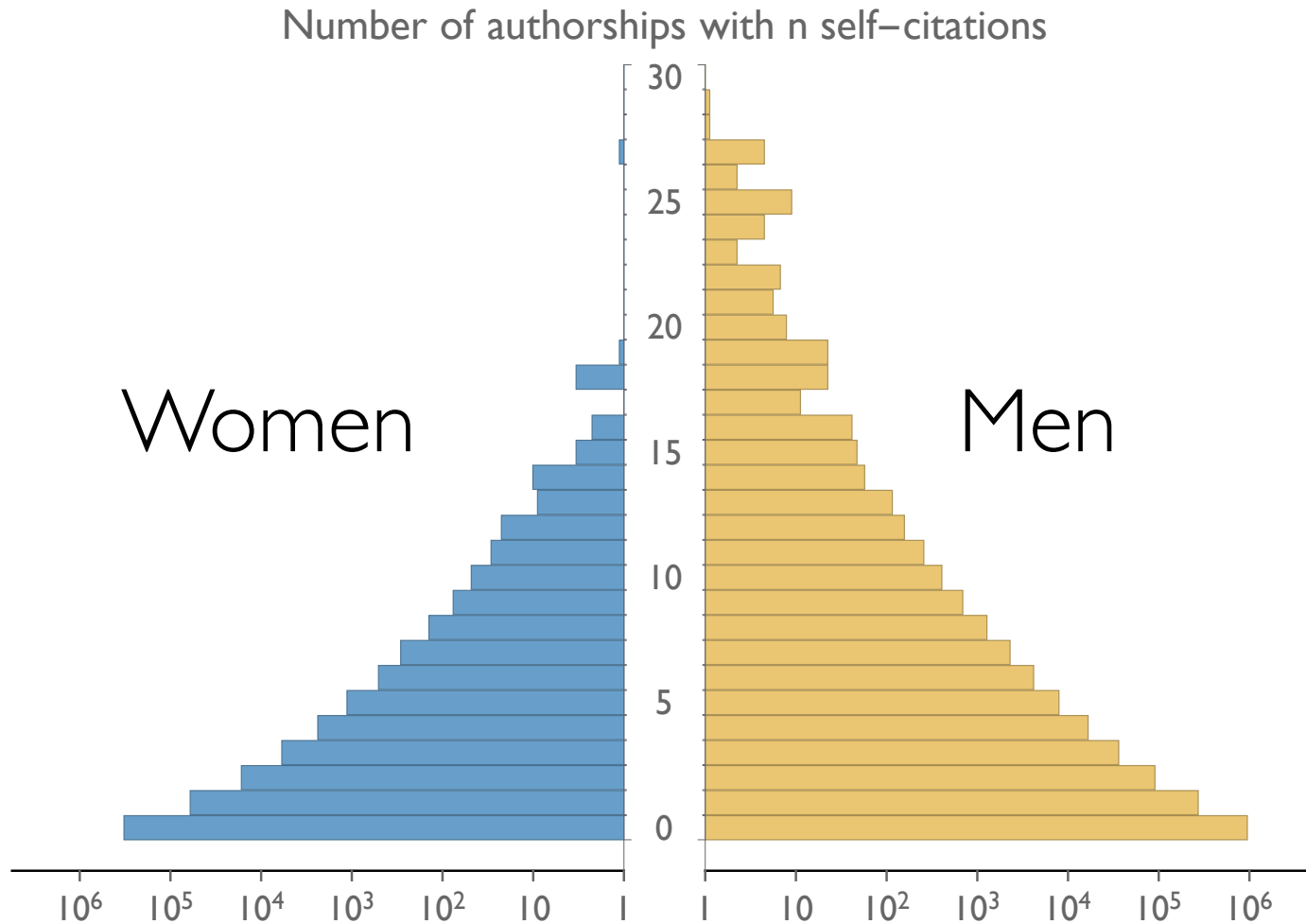
1. Congruent Landscape	2. Incongruent Landscape	3. Congruent Abstract	4. Incongruent Abstract	5. Designer Baseline
				
<p>Landscape visualization with data properties mapped to visual elements according to applicable image schemata</p>	<p>Landscape visualization with data properties mapped to visual elements deliberately breaking with image schemata</p>	<p>Identical to the Congruent Landscape tool but with all realistic details and overt “landscape” visuals removed</p>	<p>Identical to the Incongruent Landscape tool but with all realistic details and overt “landscape” visuals removed</p>	<p>Visualization designed by a hypothesis-blind designer attempting to make an effective visualization but without special emphasis on metaphor</p>

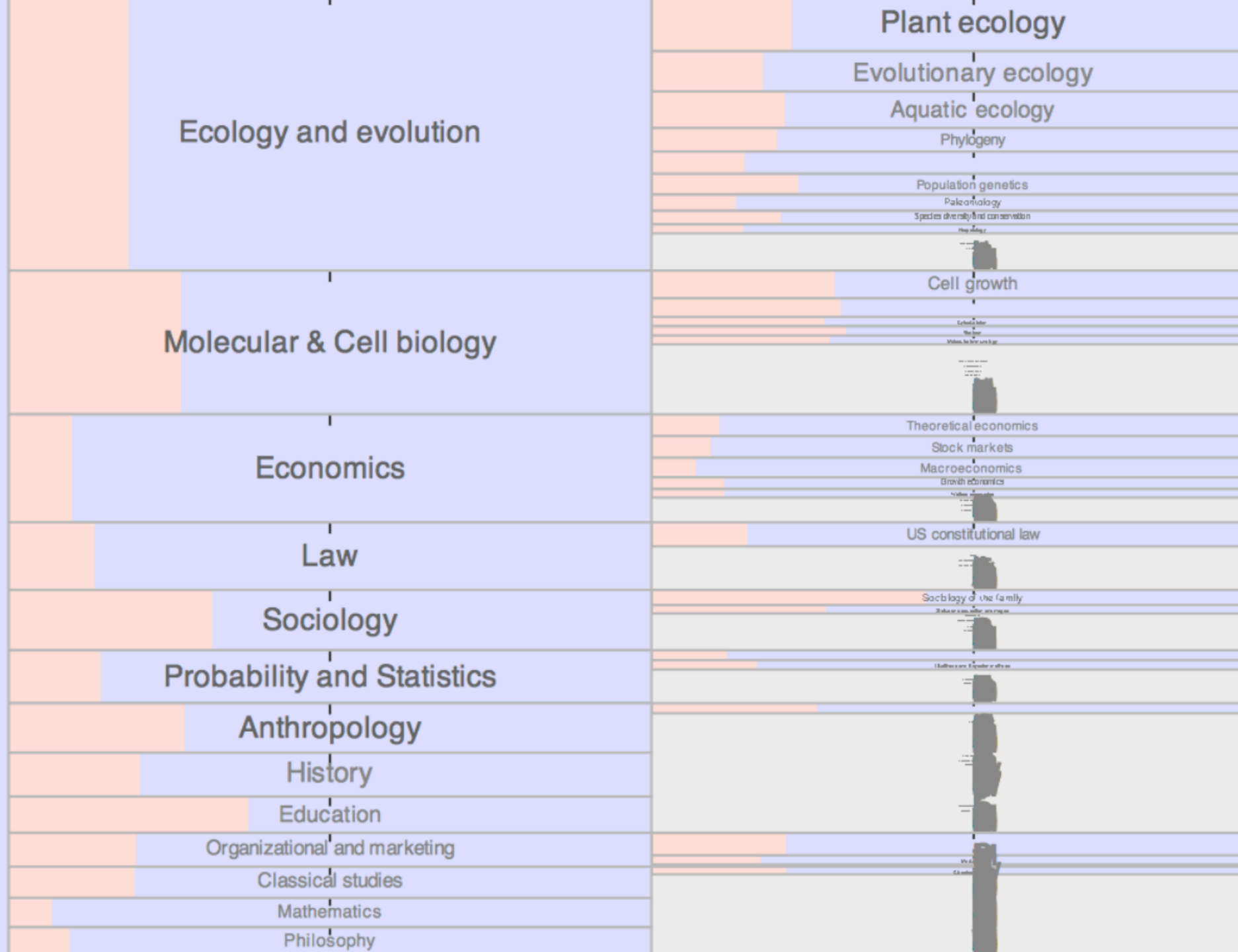
Moving beyond single metric summaries to rich, interactive (hypothesis-driven) visualizations

# Self-citation over time



# Gender and Self Citation

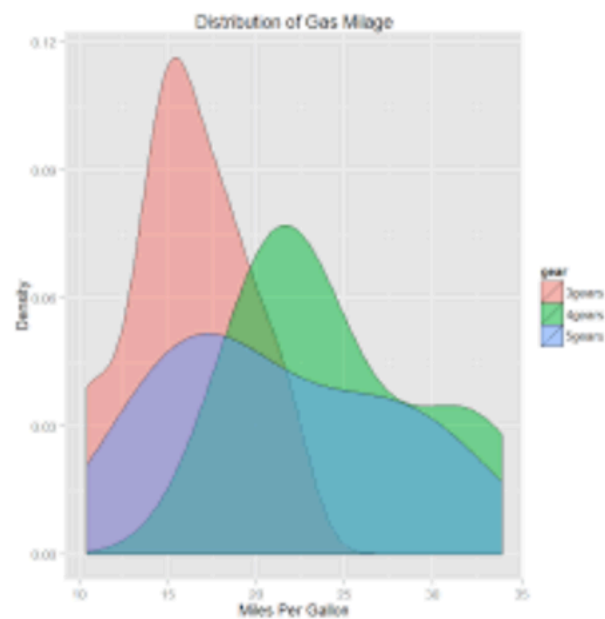
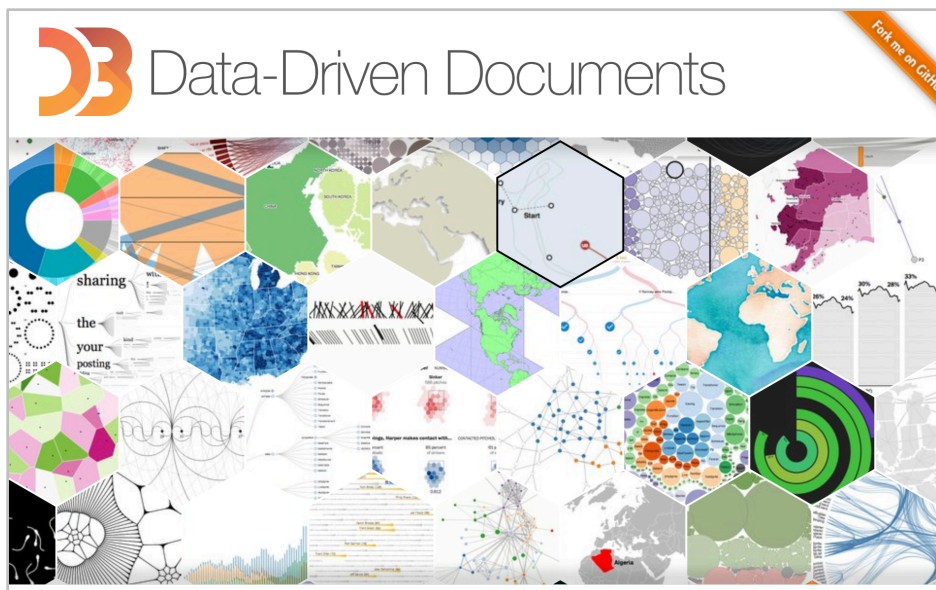






+ a b l e a u<sup>®</sup>

ggplot in R

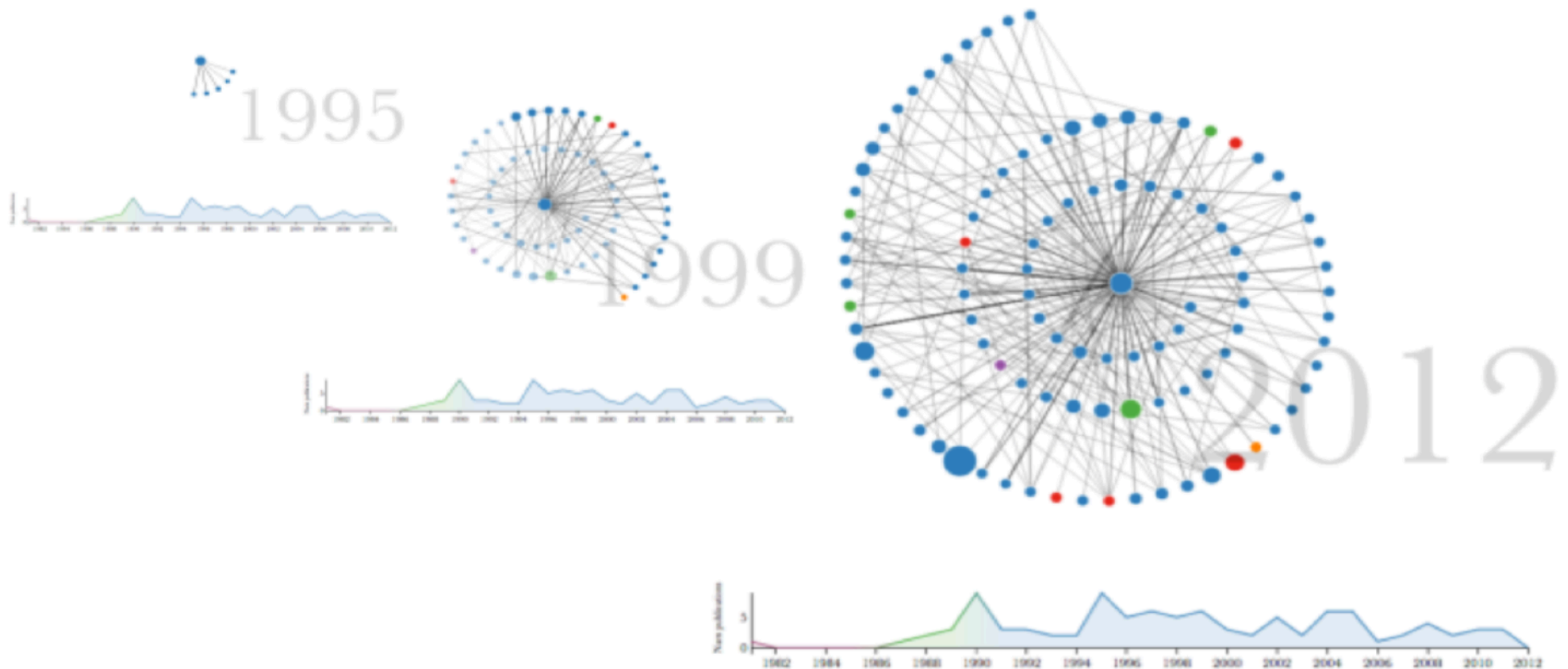




# Summary

- Study the *Science of Science* and use visualizations for exploring questions
- Ask questions about the origin and evolution of ideas and fields, interdisciplinarity, impact assessment and sociology of science
- Single metrics to interactive visualization
- Building statistical and visualization tools that improve navigation, make relevant connections and facilitate knowledge discovery
- Tools: R, python, D3
- Challenges: scaling, mechanism
- Eigenfactor.org, Viziometrics.org, Scholar.eigenfactor.org

# Explore the data ***[scholar.eigenfactor.org](http://scholar.eigenfactor.org)***



\* Please use Chrome web browser for best results

**[scholar.eigenfactor.org](https://scholar.eigenfactor.org)**

username: PewScholar

password: 1N!kdG

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Carl Bergstrom, Department of Biology, University of Washington

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