

Information Visualization and Semantic Search

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Overview

- Motivations and challenges of information visualization for semantic search
- Useful visualization for search
- Towards meaningful, useful and KOS-based visualization for search and discovery.

Information Visualization

■ Definitions:

- “The use of computer-supported, interactive, visual representation of abstract data to amplify cognition.” (Card, Mackinlay, and Shneiderman, 1999)
- Creation of visual approaches to conveying information in intuitive ways
- Mapping of unstructured, linguistic data to structured visual space for easy understanding and discovery.

Motivations of Visualization

- Taking advantage of human cognitive capability for large amount of information processing, quickly and intuitively
 - Using visual representations to show large amount of information and enable visual inference.
 - Letting computer do mapping and analysis first and show only the most relevant associative information the user.
 - Moving information processing from the data/linguistic level to the cognitive level.

Challenges of Visualization

- “A picture is worth a thousand words” if
 - it is meaningful
 - The picture conveys semantic structures or relationships that the viewer can understand
 - It is trustful
 - The structures and relationships on the picture match the semantic structures of the underlying data.
 - It is useful
 - What users get from the picture will help them do something useful.

Meaningful?



Meaningful!

BACK

FORWARD

brain

LOOK IT UP

SEARCH: EN

DISPLAY: EN

EDIT

PRINT

SHARE

HELP

ON

OFF

HISTORY

WORD SUGGESTIONS (50)

MY WORD LIST

SETTINGS

kill

hit

learning ability

mental capacity

mentality

brainpower

wit

encephalon

variety meat

organs

mastermind

Einstein

genius

psyche

brainiac

head

mind

nous

brain

NOUNS

ON

OFF

that part of the central nervous system that includes all the higher nervous centers; enclosed within the skull; continuous with the spinal cord

mental ability

ADJECTIVES

ON

OFF

VERBS

ON

OFF

hit on the head

kill by smashing someone's skull

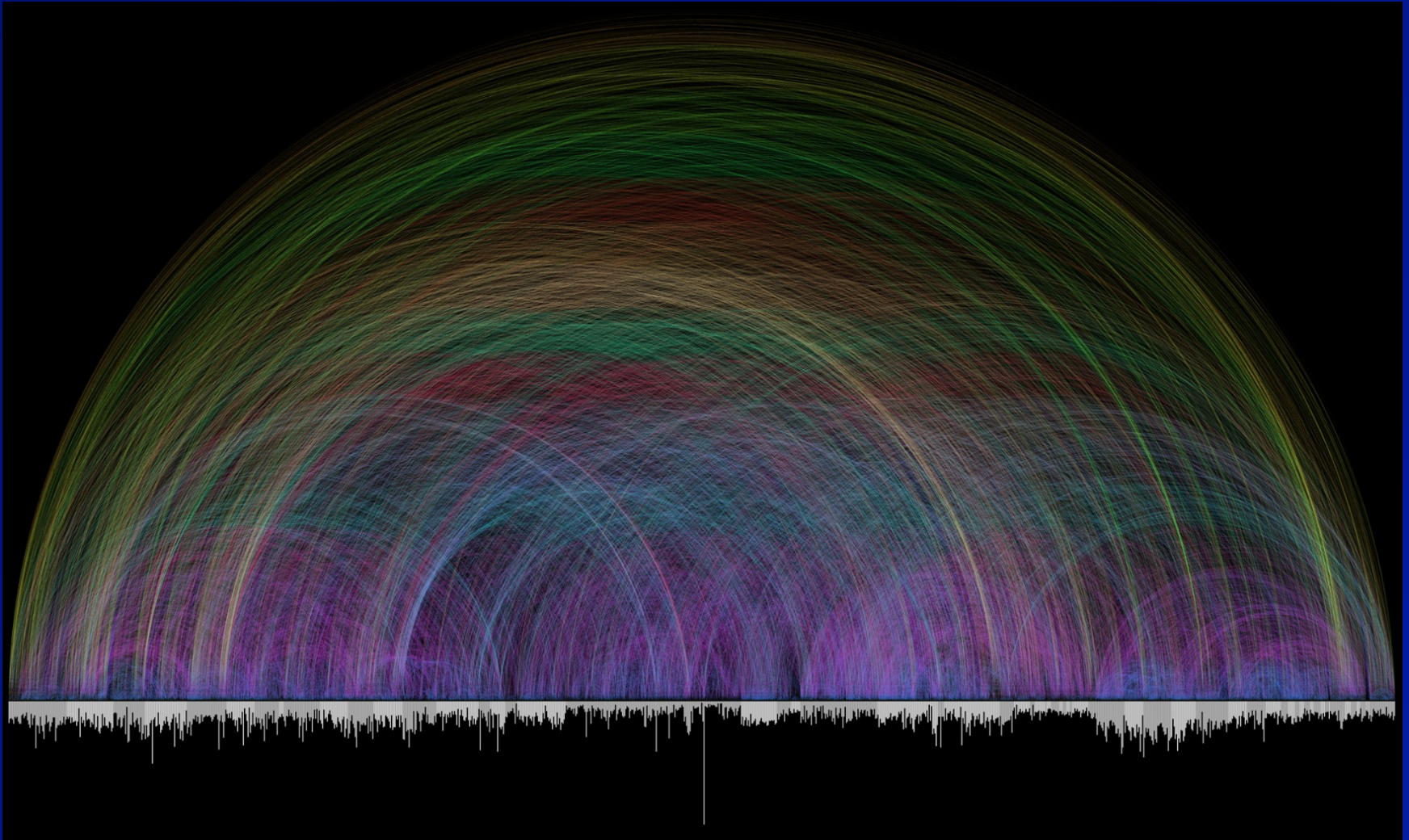
deal a blow to, either with the hand or with an instrument

ADVERBS

ON

OFF

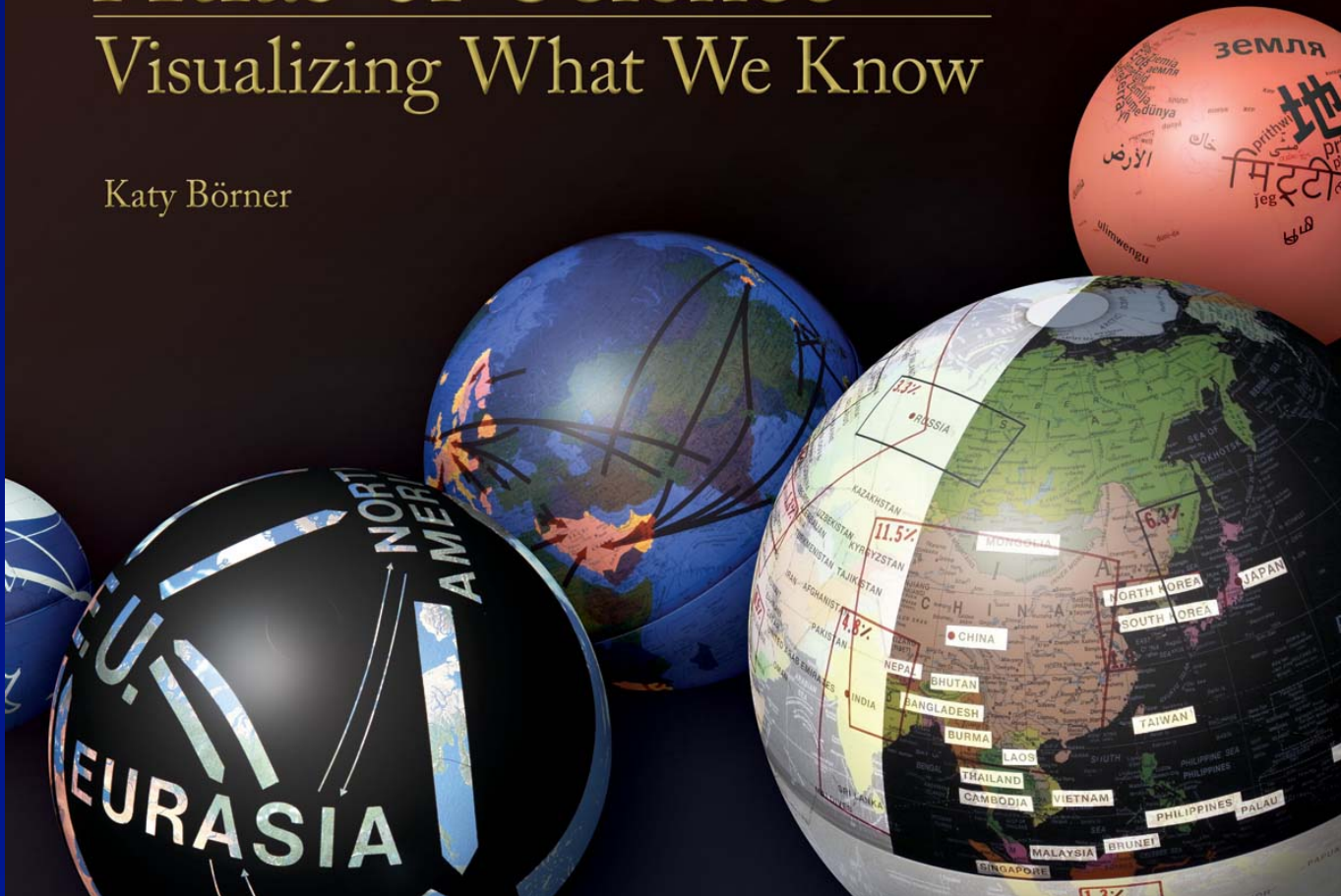
Useful?



Useful!

Atlas of Science Visualizing What We Know

Katy Börner



More Examples

visual
complexity

Search the VC database:

GO

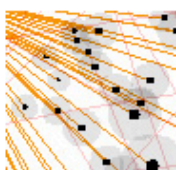
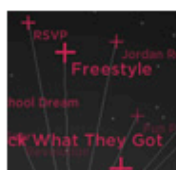
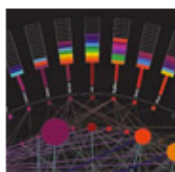
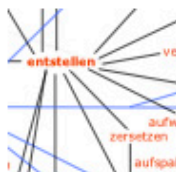
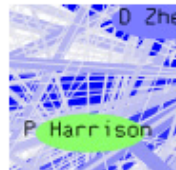
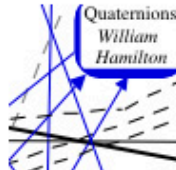
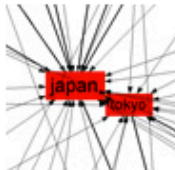
Data Visualization Tools

Business Intelligence Software. 96%
Customer Satisfaction!

QlikView.com/Free-Download AdChoices

Subject: **Semantic Networks (30)**

Indexing **777** projects



Filter by:

SUBJECT

Art (62)

Biology (52)

Business Networks (29)

Computer Systems (33)

Food Webs (8)

Internet (30)

Knowledge Networks (111)

Multi-Domain Representation (62)

Music (39)

Others (63)

Pattern Recognition (28)

Political Networks (22)

Semantic Networks (30)

Social Networks (105)

Transportation Networks (49)

World Wide Web (54)

See All (777)

My Research Questions

- What functions are needed to make visualization useful?
- What characteristics of visualization displays will make the displays meaningful ?
- How to prepare the underlying data to make the visualization trustful and meaningful?

Useful Visualization Functions

■ Overviews

- Overview of large document space
- Search result summary

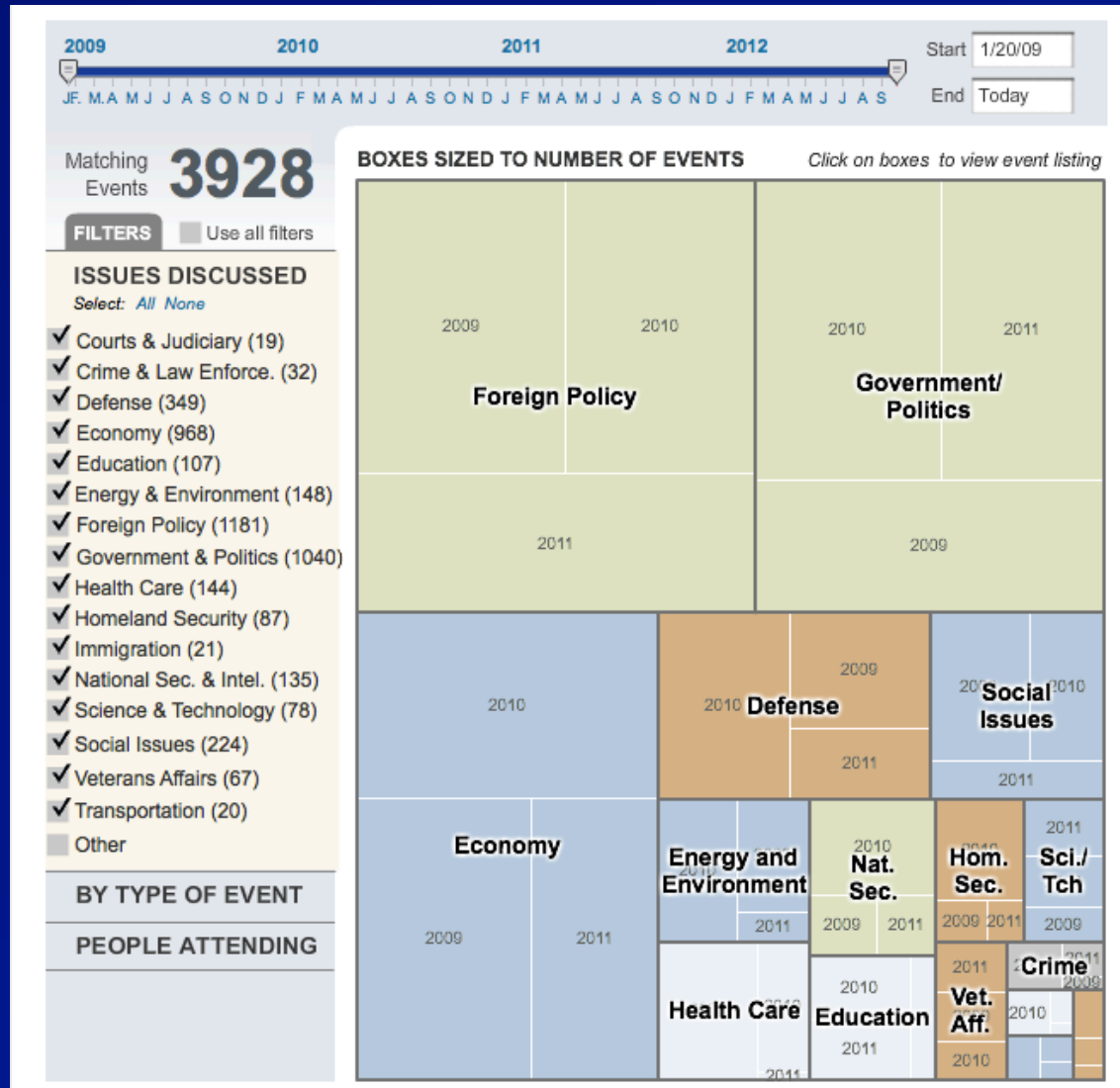
■ Dynamic Interactions

- Network of documents, concepts, citations,
- Neighborhood of the focused point

■ Discovery

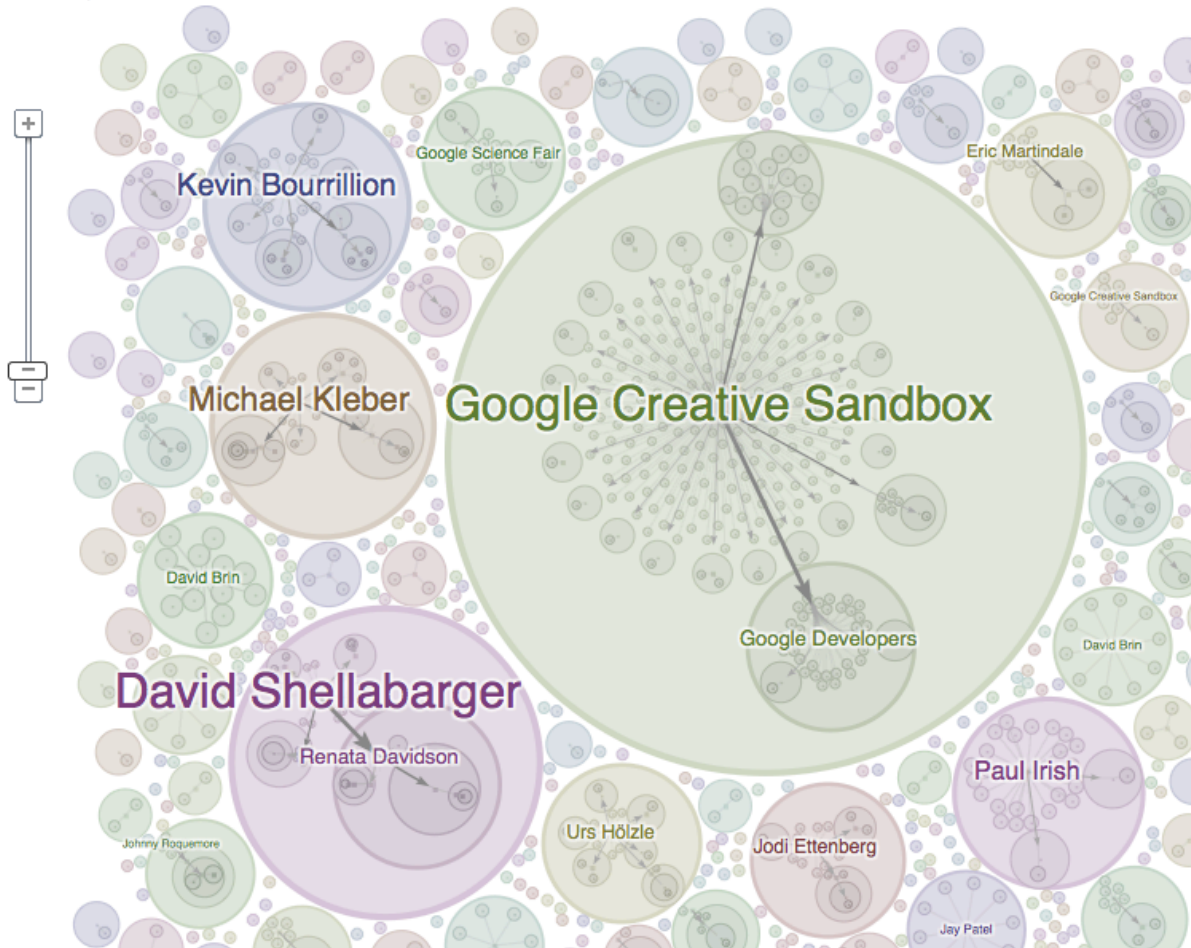
- Visual analytics and discovery tools
- Mapping of data to visual space

Washington Post – POTUS Tracker



Google+ ripples

Showing 1213 public shares.
We don't show private shares.



Public shares



Google Creative Sandbox Aug 30, 2012 View post

See Hurricane Isaac's effect on wind patterns. The Wind Map shows the patterns in real time: <http://hint.fm/wind/>



David Shellabarger Mar 28, 2012 View post

Live Wind Map
<http://hint.fm/wind/>



Renata Davidson Mar 28, 2012 View post
Amazing :) I wish it was available for Europe as well :)



Michael Kleber Mar 28, 2012 View post
Absolutely beautiful map of the wind, by Fernanda Viégas and Martin Wattenberg. (Yes, one of the great things about working at Google



Kevin Bourrillion Mar 29, 2012 View post
This live, animated wind map will.... blow you away. #yeeaaahhh



Google Developers Aug 30, 2012 View post
shared this.



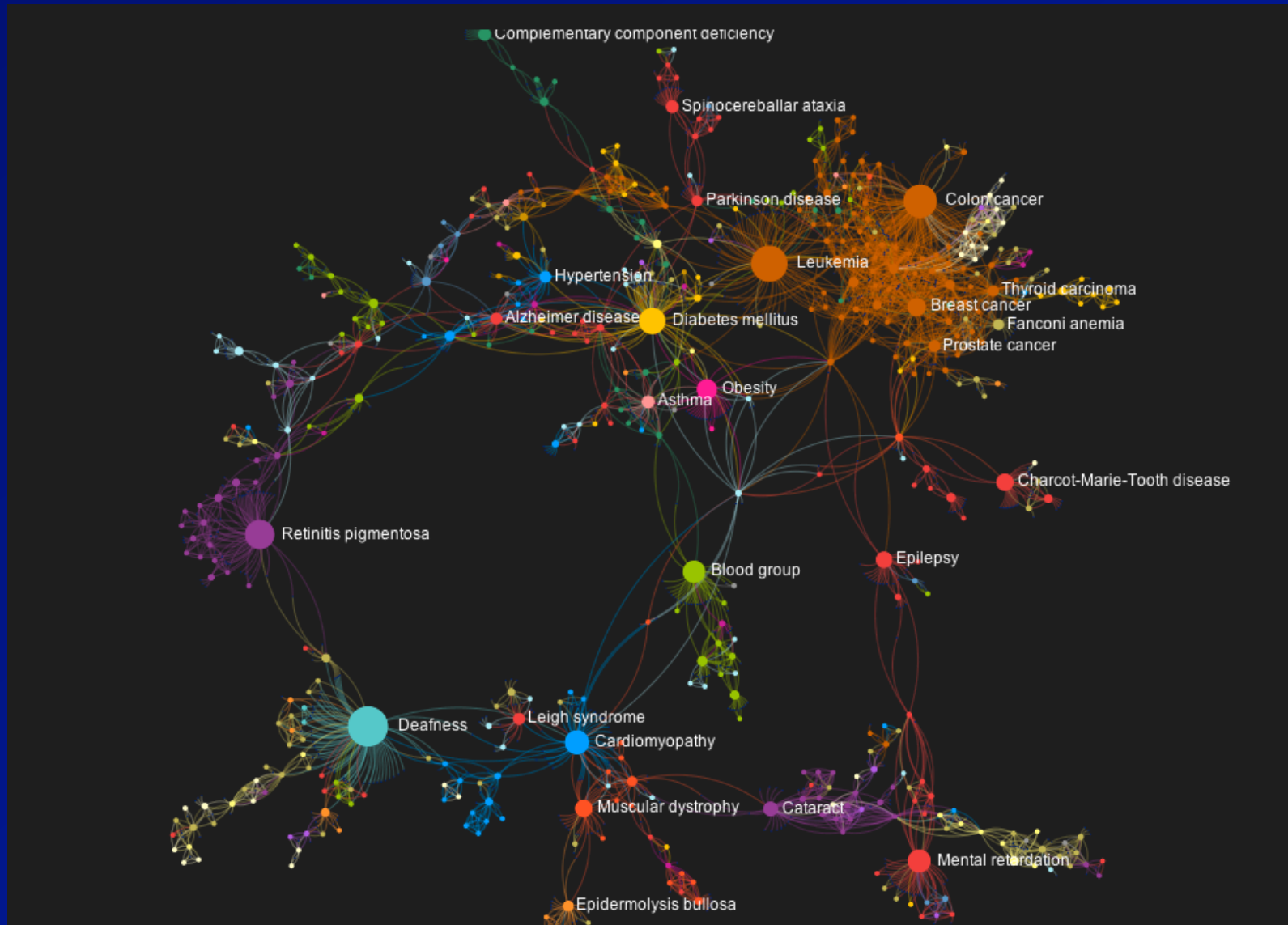
Paul Irish Mar 28, 2012 View post
Beautiful visualization of wind patterns across the US: hint.fm/wind/



Urs Hölzle Apr 14, 2012 View post
Two Googlers created this very cool

Send feedback

Human Disease Network Graph



My Current Projects

- Visual Concept Explorer (VCE)
 - UMLS-based semantic vocabulary visualization and search
- Meaningful Concept Displays (MCD)
 - Getty-vocabulary based visual concept exploration and query expansion
- Visual Semantic Discovery Tools (VSDT)
 - Testbed: A million fulltext documents on neuroscience

Project 1- VCE2

Visual Concept Explorer

Now Exploring: semantic

Search:

Start

Nodes To Display

Link distance

Text size

Outline View

- ▶ Phenomenon or Process
- ▶ Anatomical structure
- ▶ Event or Activity
- ▶ Medical Professionals

Search Boxes (?)

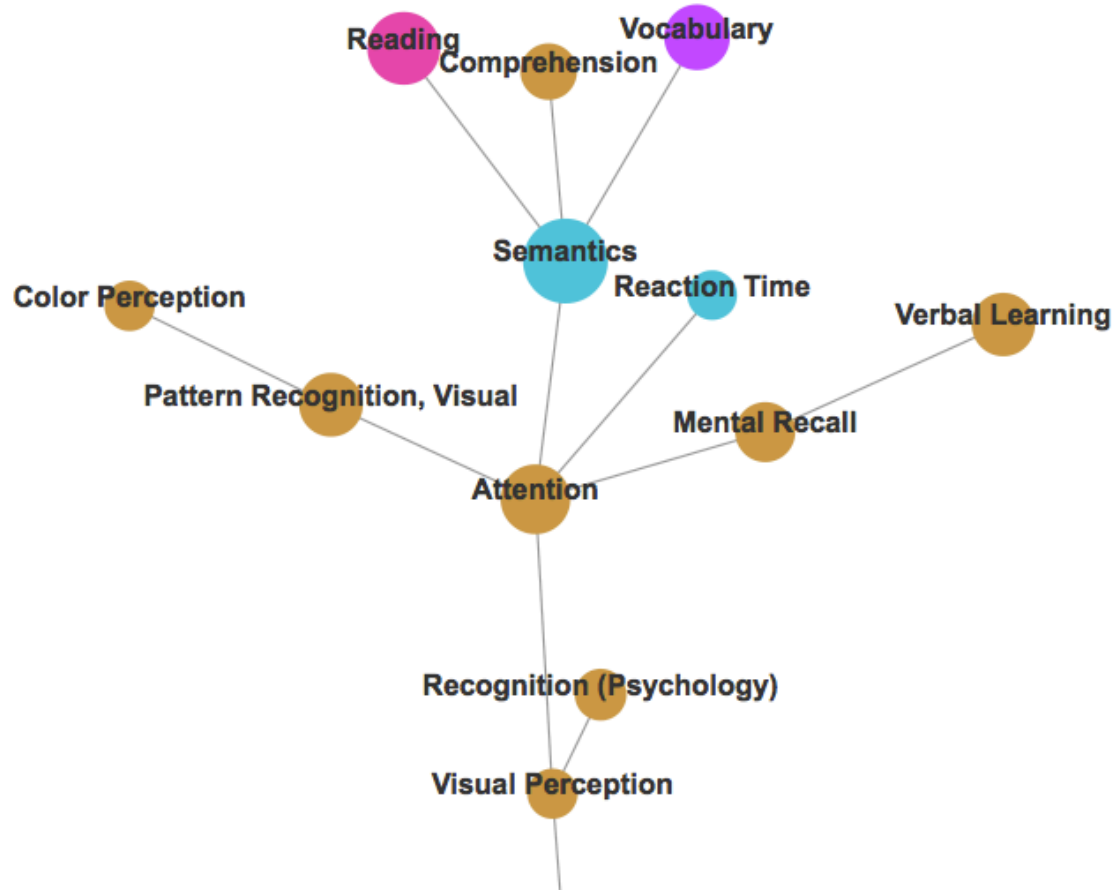
Results: 0

View

Right-click on a node to send the term to one of the boxes.
Terms in the same color box will be ORed and terms in different color box will be ANDed
Click on "View" to see results in a separate window.

Key

- Phenomenon or Process
- Anatomical structure
- Event or Activity
- Medical Professionals



Comparing to ...

BioPortal Browse Search Mappings Recommender Annotator Resource Index Projects

Term Search

Search for a term in multiple ontologies ?

Semantics

Semantics - NCI Thesaurus
<http://ncicb.nci.nih.gov/xml/owl/EVS/Thesaurus.owl#Semantics>
The meaning of a string in some language; of or relating to the study of the meaning of words and sentences.
[details](#) - [visualize](#)

Semantics - Medical Subject Headings (MeSH)
<http://purl.bioontology.org/ontology/MSH/D012660>
The relationships between symbols and their meanings.
[details](#) - [visualize](#)

semantics - CRISP Thesaurus, 2006
<http://purl.bioontology.org/ontology/CSP/1578-6107>
branch of linguistics dealing with the meaning of symbols, including the study of the meaning of words and sentences.
[details](#) - [visualize](#) - [1 more from this ontology](#)

~@http://www.w3.org/2001/XMLSchema#ID LDC
<http://www.semanticweb.org/ontologies/2008/10/languageacquisition>
[details](#) - [visualize](#)

Profile in semantics - Read Codes, Clinical Terms
<http://purl.bioontology.org/ontology/RCD/XM0hN>
[details](#) - [visualize](#)

Profile in semantics - SNOMED Clinical Terms
<http://purl.bioontology.org/ontology/SNOMEDCT/273715004>
[details](#) - [visualize](#)

Show Network Neighborhood

[Full Version](#)

```
graph TD; Semantics[Semantics] -- CHD --> Linguistics[Linguistics];
```

Project 2 - MCD

- IMLS funded project
 - To develop a **Meaningful Concept Display (MCD) Appliance** aiming to improve user's searching, browsing, and learning experience with KOS and relevant content/collections.
 - To test the MCD appliance with ARTstor, Getty, and Indianapolis Museum of Arts (IMA) sites.
 - Collaborating with University of Buffalo, Getty, IMA, and ARTstor.

Demo 2 - VQE

Visual Query Expansion

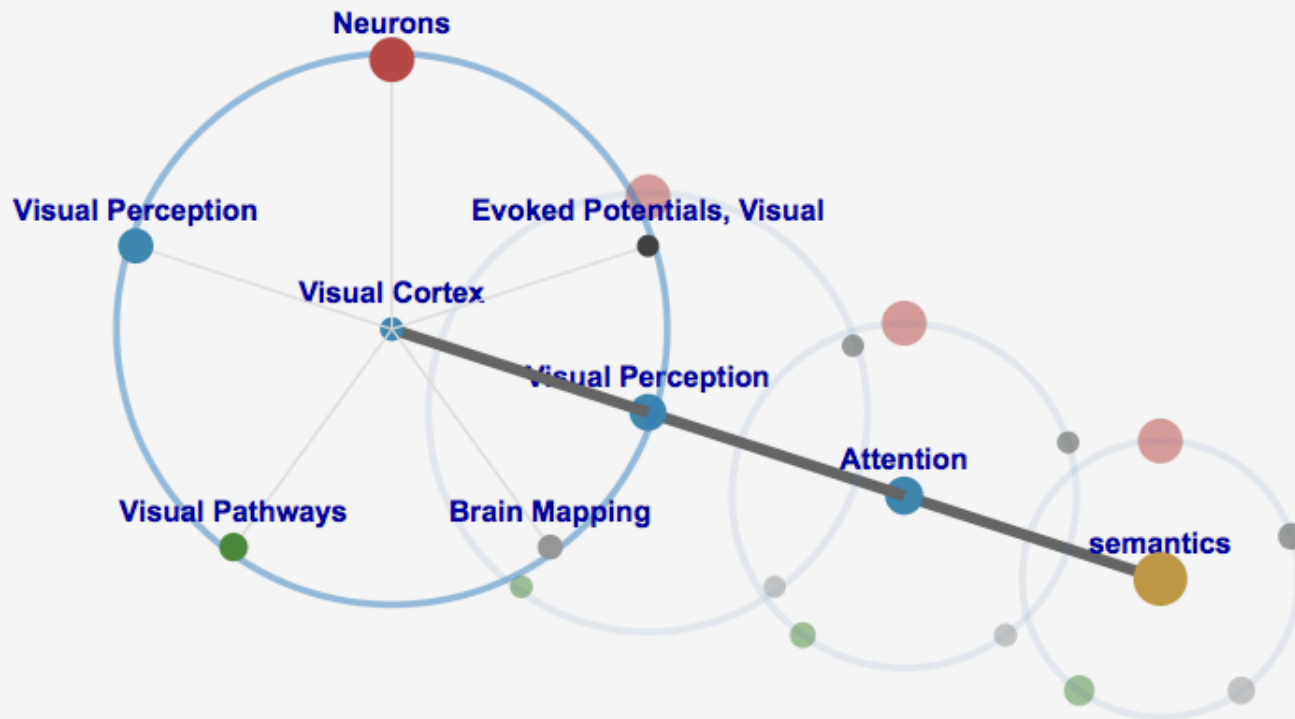
🔍 Please enter your query

semantics

Search

🔍 Expanded search terms

View in PubMed



Project 3 -- VSDT

■ Visual Semantic Discovery Tools

- Develop a triple-store knowledge repository to store the semantic entities and relationships extracted from full-text.
- Design and implement visual analytics methods and interfaces to enable searching and knowledge discovery.

Demo 3 – “Read” with Annotation

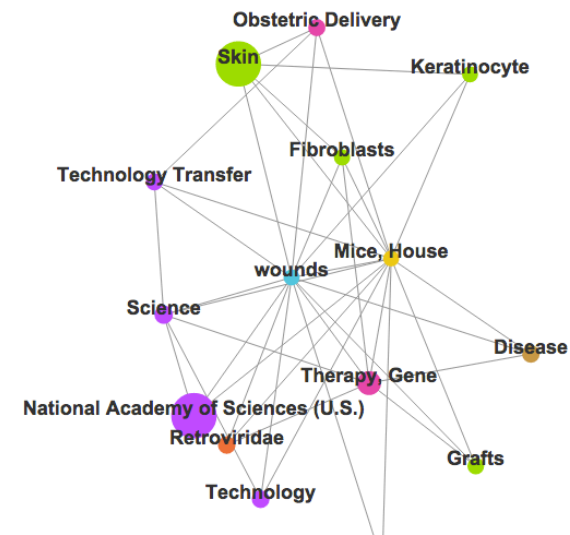
 submit

[Article 1](#)
[Article 2](#)
[Article 3](#)

CHAPTER 11.15 [Gene Therapy](#) (C0017296, T061, T063) in Tissue Engineering [JEFFREY](#) (C1018458, T002) R. [MORGAN](#) (C0582521, T081), [MARTIN](#) (C0313173, T116, T129) L. YARMUSH [Center](#) (C0205099, T082) for Engineering in [Medicine](#) (C0025118, T091), [Massachusetts](#) (C0024874, T083) General [Hospita](#) (C1197494, T007)~ Shriners Burns [Institute](#) (C0021622, T092) and [Harvard](#) (C0167523, T197) [Medical School](#) (C0036378, T073, T093), [Boston](#) (C0006037, T083), [MA](#) (C0812372, T028) 02115, USA [Gene therapy](#) (C0017296, T061, T063), the [transfer](#) (C0728827, T033) of genes to achieve a therapeutic effect, has numerous [applications](#) (C0185125, T058) in many areas of [medicine](#) (C0025118, T091), including tissue engineering. In this chapter, we review the properties and attributes of the various gene [transfer technologies](#) (C0242804, T170) and the [gene delivery](#) (C0872177, T045, T063) [strategies](#) (C0679199, T041) in which these technolo- [gies](#) (C0556636, T081) are being applied. In [addition](#) (C0332287, T169), we review the current research [efforts](#) (C0015264, T040) and in some cases, clinical [efforts](#) (C0015264, T040), which are using [gene therapy](#) (C0017296, T061, T063) [technologies](#) (C0039421, T090) to help achieve the [goals](#) (C0018017, T170) of tissue engineering. This merger of [gene therapy](#) (C0017296, T061, T063) and tissue engineering is being applied in multiple [organ](#) (C0178784, T023)/ tissue/ cell systems for a growing list of [applications](#) (C0185125, T058). The [prominence](#) (C0437936, T033) of [gene therapy](#) (C0017296, T061, T063) [technologies](#) (C0039421, T090) in tissue engineering will continue to increase as gene [transfer technologies](#)

graph here

Graphical Summary



Summary: Visualize Semantics!

- Where do the semantics come from?
 - KOS + context + usage patterns
 - Annotation from text/context
 - citations/co-citations
 - Links/linked data
- How do we present the semantics to the user?
 - Meaningful
 - Trustful
 - Useful