

LEADING Boot Camp

Information Visualization

Erjia Yan

Good resources

- <https://medium.economist.com/mistakes-weve-drawn-a-few-8cdd8a42d368>
- <https://venngage.com/blog/how-to-choose-the-best-charts-for-your-infographic/>
- <https://www.data-to-viz.com/caveats.html>

Introduction

Section I

Information visualization is concerned with the design, development, and application of computer generated interactive graphical representations of information.

Information visualization primarily deals with abstract, nonspatial data.

Transforming such nonspatial data to intuitive and meaningful graphical representations is of fundamental importance to the field.

The transformation is a creative process in which designers assign new meanings into graphical patterns.

The holy grail of information visualization is for users to gain insights.

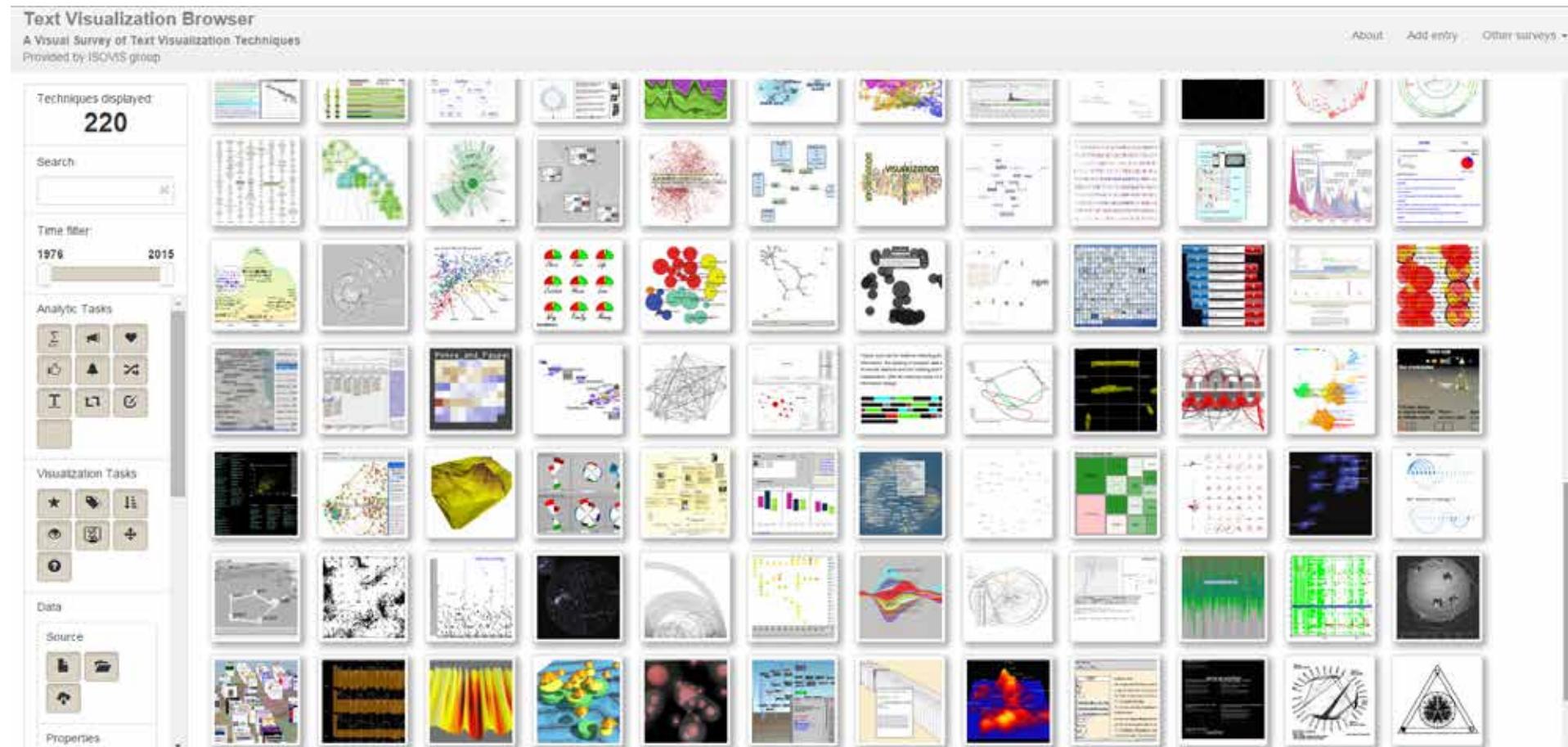
In general, the notion of insight is broadly defined, including

- unexpected discoveries
- a deepened understanding
- a new way of thinking
- eureka-like experiences, and
- other intellectual breakthroughs.

Text Visualization Browser

A Visual Survey of Text Visualization Techniques

<http://textvis.lnu.se/>



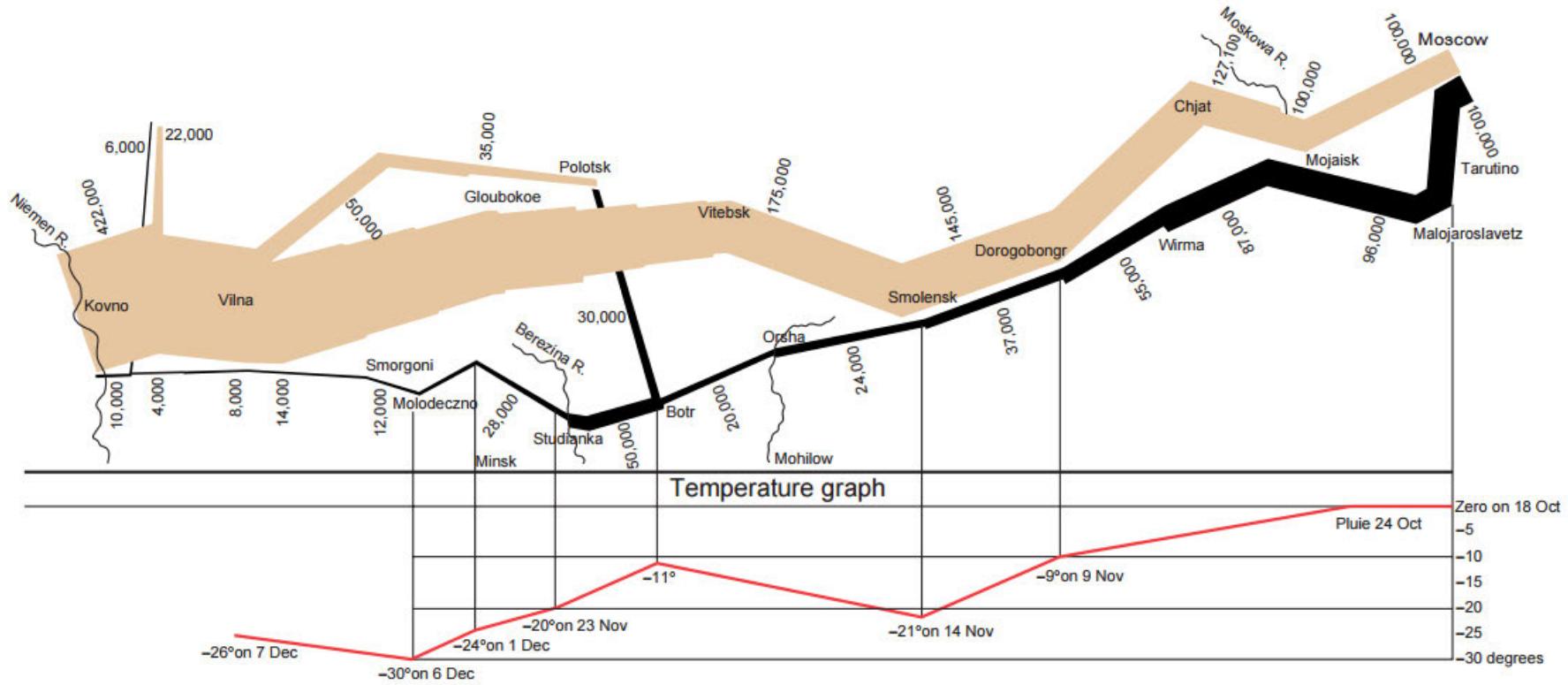


FIGURE 1 | Losses suffered by the Grande Armée during the Russian Campaign.^c

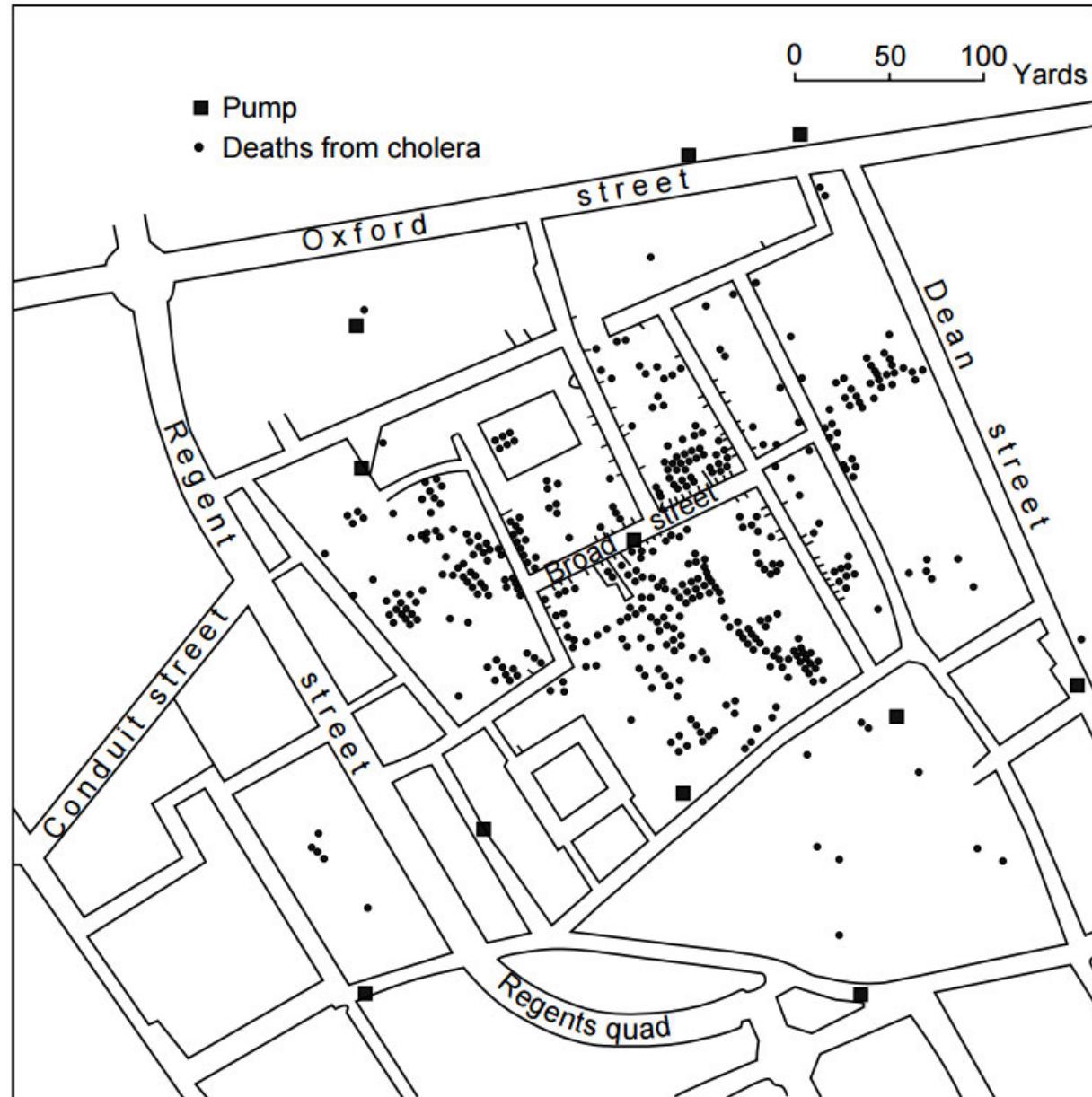
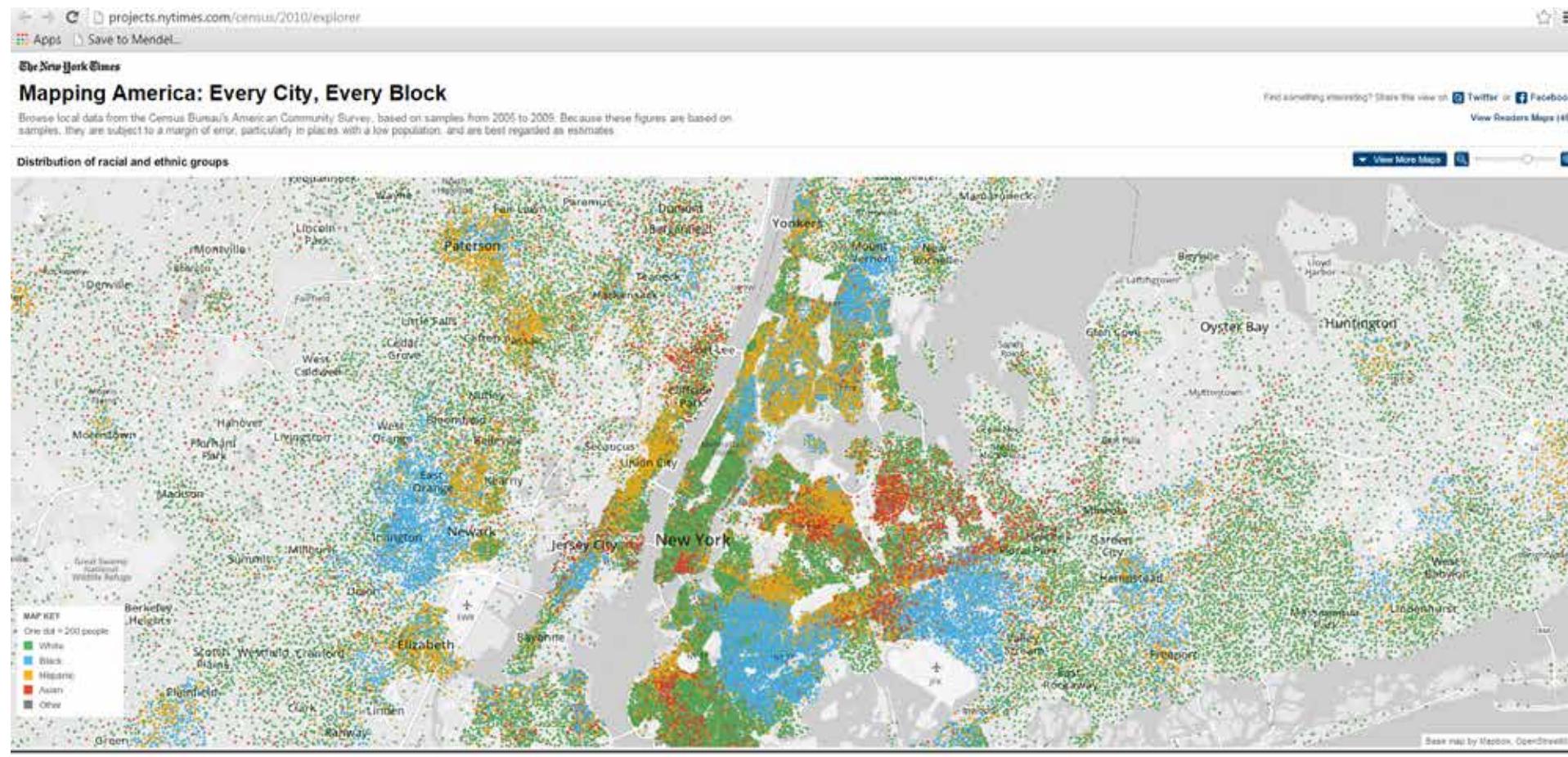


FIGURE 2 | John Snow's dot map of cholera deaths.^d

The HISTOMAP

FOUR THOUSAND YEARS OF WORLD HISTORY
RELATIVE POWER OF CONTEMPORARY STATES, NATIONS AND EMPIRES

B. C. 2000	AEGEANS	Mediterranean People	EGYPTIANS	HITTITES	AMORITES	IRANIANS	INDIANS	Alpine and Proto-Nordic People	Mongolian People	B. C. 2000
1950	Mediterranean Peoples or sea-going Celts of the First Middle Minoan Period	Egyptians have by this time developed agriculture, ship-building, government, commerce, art, law, writing and mathematics. Twelfth Dynasty; Second or Middle Egyptian Period. Unification of Egypt into a strong Herd State under the Theban Kings.	Amenhotep I builds Temple of Amun at Thebes.	Indo-European tribes Indo-Iranian language of dynasts. Hammurabi's code of laws. Standardized later standards of weight.	Early Iranians, Elamites, Mitanni, Kassites, Cossack, etc., probably of same Aryan race.	(Hindus)	The oldest historical records of man known.	China a small empire divided into nine provinces under the dominant rule of one emperor.	1950	
1900	Have developed a culture under Egyptian influence and built monumental city of Crete, capital and ceremonial capital, trading with Egypt and Sumeria.	Sesostris I conquers Nubia. Egyptian culture at zenith; finest and most perfect art form.	Amenhotep II: Classical art and architecture. Canals and canals constructed and land reclaimed by irrigation in the Fayum.	Decline in Art form.	Ancestors of the present Alpine race.	Proto-Nordic stock as Hindus. Katar-Lagamar (Chedorlaomer), King of Elam. Principal cities of Susa and Aszur.	Ancestors of the present Hittites, invaded the Punjab; inhabited	The parent of the Rio or Hsia Dynasty.	1900	
1850	Second Middle Minoan Period	Irrigation in the Fayum. Miners worked for gold, silver, copper, and tin. Foreign conquests. Syria plundered. Sesostris III. Period of wealth.	Amoenhotep IV built temple to Oannes at Abydos.	Established Kingdom in Anatolia.	Babylonians	The Assyrians and other inhabitants of Babylonia absorb the Sumerians and Akkadian cultures of Ur, Eridu and Nippur, retaining the cuneiform writing.	These tribes probably brought the horse to Asia Minor and Mesopotamia, and had bows and arrows as their weapons.	Until now by primitive tribes.	Trappers Yu and Shang-Keng. Recent records are unreliable and confused.	1850
1800	AEGEANS	Cretans the trading sea-power of the Mediterranean.	Worship of sun-god Ra. Prosperity under Amenhotep III. Reservoir of Lake Moeris constructed at Fayum.	Adoption of Indoeuropean language.	IRANIANS	Early Elamites were makers of a finely painted pottery.	Elamites.	Raid by Mongolian and	largely legendary. Assession of Emperor Chou.	1800
1750	Third Middle Minoan Period	Stupendous palaces built at Phoenicia and Malta. Bull-fighting sports at Crete possibly gave rise to bull-ring sports of Centaur possibly.	Princesses of Knossos. XVIIIth Dynasty, a period of internal strife and disorder, but new blood is introduced by invasion of Semitic Nomads (Bedouin) who rule Egypt under name of the Hyksos Kings.	Sumerian cuneiform on tablets, using an Indo-European language.	Kassite Dynasty	Reigned by Kassite Dynasty established by Inanni-Kassites.	Introduced a tribal system of Central Asia.	Development of military strength.	The great drought.	1750
1700	Tamerlane	Tablet of the Master. Polychrome pottery. Cities destroyed, possibly by earthquake.	Worship of the Great Earth Mother.	Hittites	Babylon is now the Royal City of Western Asia, where iron and Merduch are worshipped.	Remains of this ancient culture recently discovered at Susa (Elam) and Anzu (Turkestan).	Government, and practical agriculture.	Scythians, or Scythians.	Rebelious under Tang. End of Hsia Dynasty.	1700
1650	Reavers	at power of the Sea-Kings. Introduction of horses. Military resources developed under King Khan who levied heavy tribute of corn from vessel states and left many monuments.	History of Hittites largely unknown.	AMORITES	Large fortified city of Khatti, the present Bagdad.	India-Sel, Elamite King, noted for building palaces.	Elamite influence on Indian buildings in the Panjab.	Tangut; Yu-chi; Hi-chi, etc.	and beginning of Shang Dynasty. Emperor Cheng-Tang.	1650
1600	and most advanced of civilization to most backward period of Minoan culture brought to Agam by excavations of Sir Arthur Evans.	Archaic period in art.	XVIIth Dynasty. Hyksos expelled by Amosis I with aid of army raised in Ethiopia.	Semitic alphabet on use on clay tablets.	Elamites	Elamites press into India in search of gold and copper.	Indian buildings in the Panjab.	HUNS	Tai-Chu.	1600
1550	Cities again destroyed. Settled farming communities under rule of despotic monarchs with hereditary court.	Palaces of Agam Tribute and Phoenicia.	Abraha I with aid of army raised in Ethiopia.	Imposing palaces and temples.	Astarte an independent city.	Excavations of Susa indicate well-built houses and drainage systems.	Worship of India.	Tangut nomads were particularly active at this time, raiding the Shu-King.	In the books of the Shu-King.	1550



Taxonomy

Section II

A Task by Data Type Taxonomy

- Shneiderman, B. (1996) The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. Proc. of IEEE Symposium on Visual Languages, Los Alamos, pp. 336-343.
- This is a classic paper in the field of information visualization.
- It proposed a taxonomy in terms of what types of actions would be appropriate for a few common types of data structures.

7 Data Types

- 1-dimensional
 - Textual documents, program source code, lists
- 2-dimensional
 - Geographic maps, floorplans, newspaper layouts
- 3-dimensional
 - Molecules, the human body, buildings
- Temporal
 - Medical records, project management, timeline
- Multidimensional
 - Relational and statistical multivariate data sources
- Tree
 - Parent-children structures, family trees
- Network
 - Node-link structures

7 Tasks

Overview: Gain an overview of the entire collection.

Zoom : Zoom in on items of interest

Filter: filter out uninteresting items.

Details-on-demand: Select an item or group and get details when needed.

Relate: View relationships among items.

History: Keep a history of actions to support undo, replay, and progressive refinement.

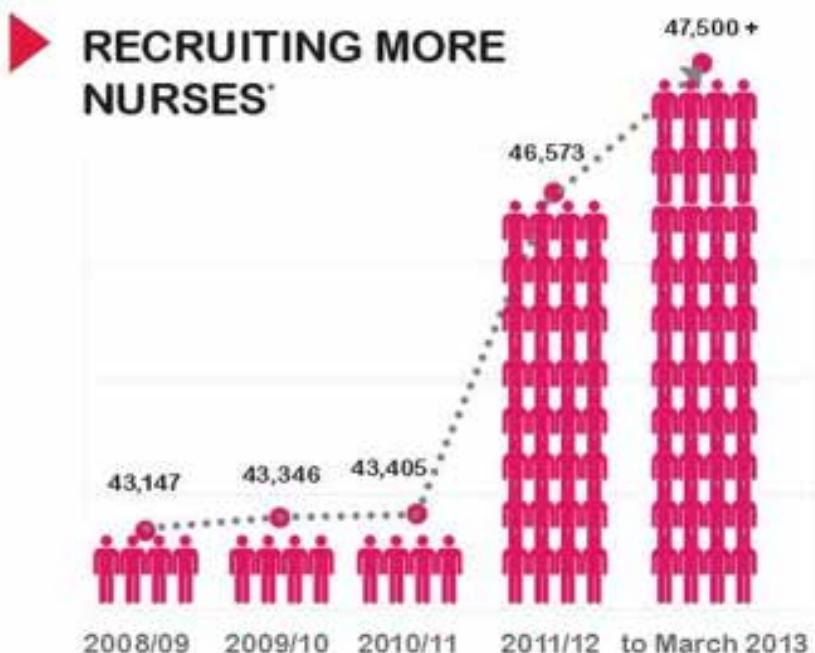
Extract: Allow extraction of sub-collections and of the query parameters.

Mental models

Section III



The NSW Health system is...



* Nursing headcount figures at June includes non casual staff and 3rd schedule

Some Important Properties

Mind-sets tend to be quick to form but resistant to change.

Once events have been perceived one way, there is a natural resistance to other perspectives.

New information is assimilated to existing images.

So, don't rush it.

Gradual, evolutionary change often goes unnoticed.

It takes more information, and more unambiguous information, to recognize an unexpected phenomenon than an expected one.

*Be aware what you are
expecting*

Mental models are easy to form, but hard to change

The early but incorrect impression tends to persist because the amount of information necessary to invalidate a hypothesis is considerably greater than the amount of information required to make an initial interpretation.

People form impressions on the basis of very little information, but once formed, they do not reject or change them unless they obtain rather solid evidence.

Analysts might seek to limit the adverse impact of this tendency by suspending judgment for as long as possible as new information is being received.

Keeping an Open Mind

- Major intelligence failures are usually caused by failures of analysis, not failures of collection.
- Relevant information is discounted, misinterpreted, ignored, rejected, or overlooked because it fails to fit a prevailing mental model or mind-set.

Strategies for Creative Thinking

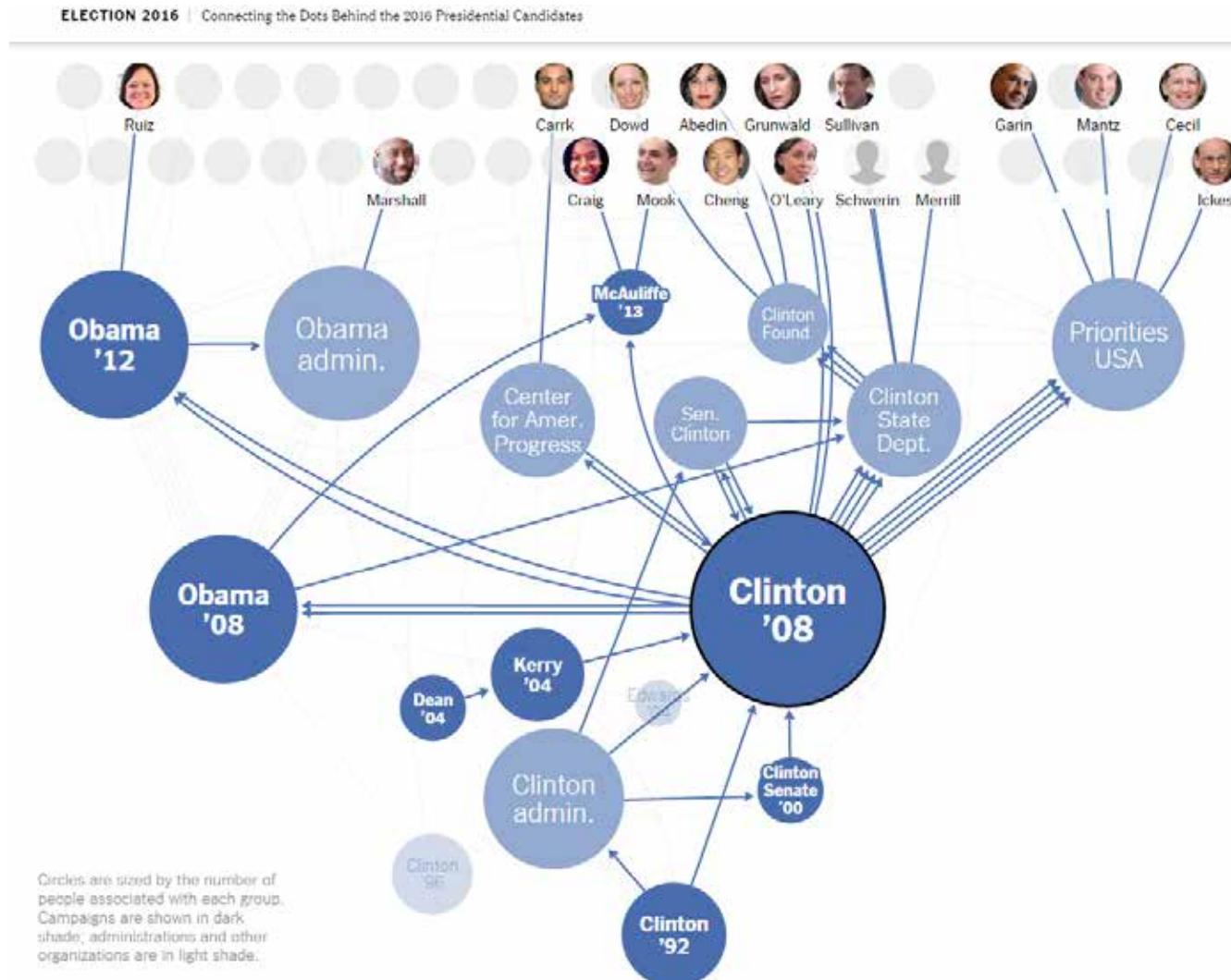
- **Deferred Judgment.** The principle of deferred judgment is undoubtedly the most important. The idea generation phase of analysis should be separated from the idea-evaluation phase, with evaluation deferred until all possible ideas have been brought out.
- This approach runs contrary to the normal procedure of thinking of ideas and evaluating them concurrently. Stimulating the imagination and critical thinking are both important, but they do not mix well.
- A judgmental attitude dampens the imagination, whether it manifests itself as self-censorship of one's own ideas or fear of critical evaluation by colleagues or supervisors. Idea generation should be a freewheeling, unconstrained, uncritical process.

Network visualizations

Section IV

Connecting the Dots Behind the 2016 Presidential Candidates

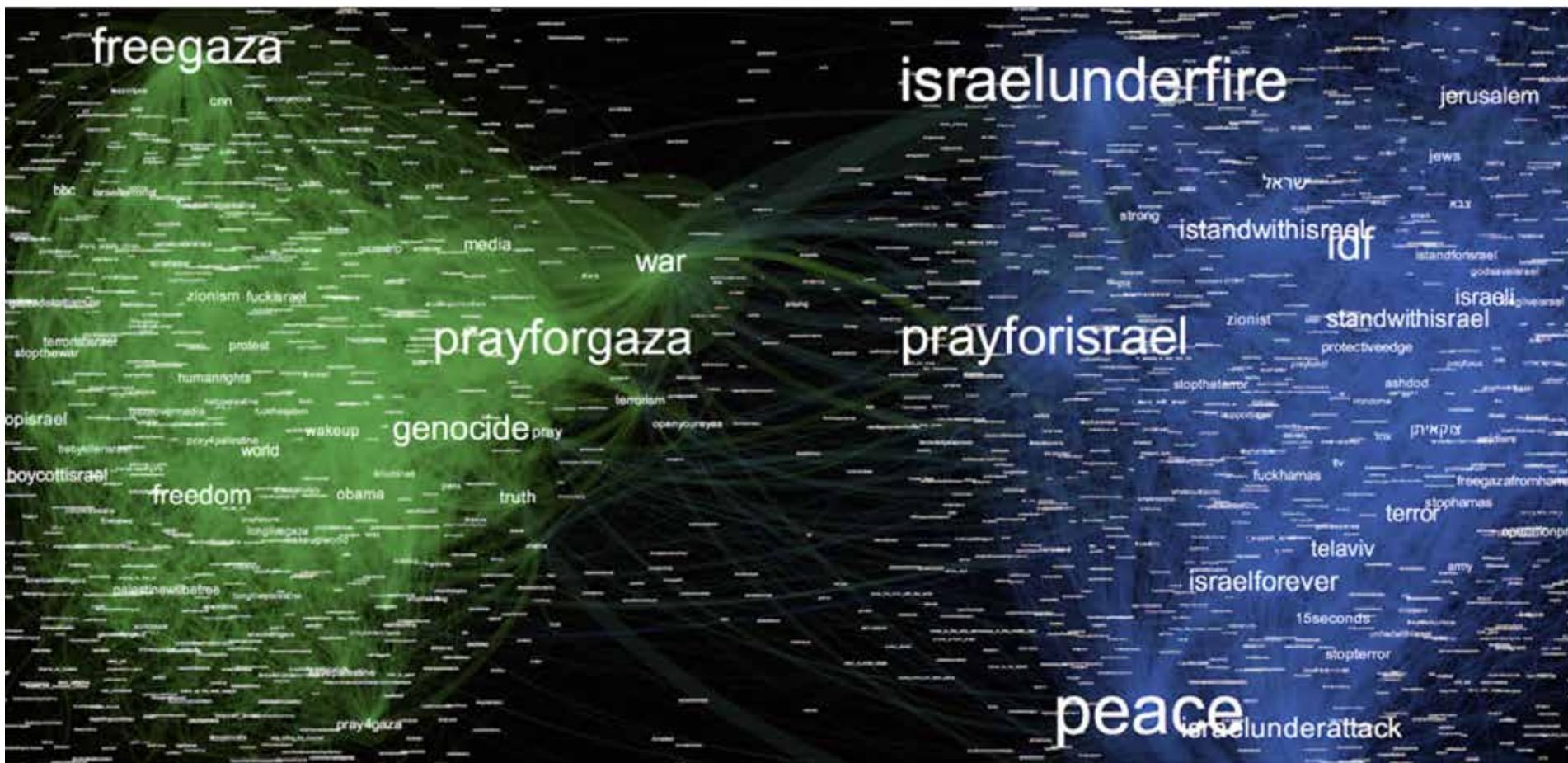
<http://www.nytimes.com/interactive/2015/05/17/us/elections/2016-presidential-campaigns-staff-connections-clinton-bush-cruz-paul-rubio-walker.html>



Israel, Gaza, War & Data

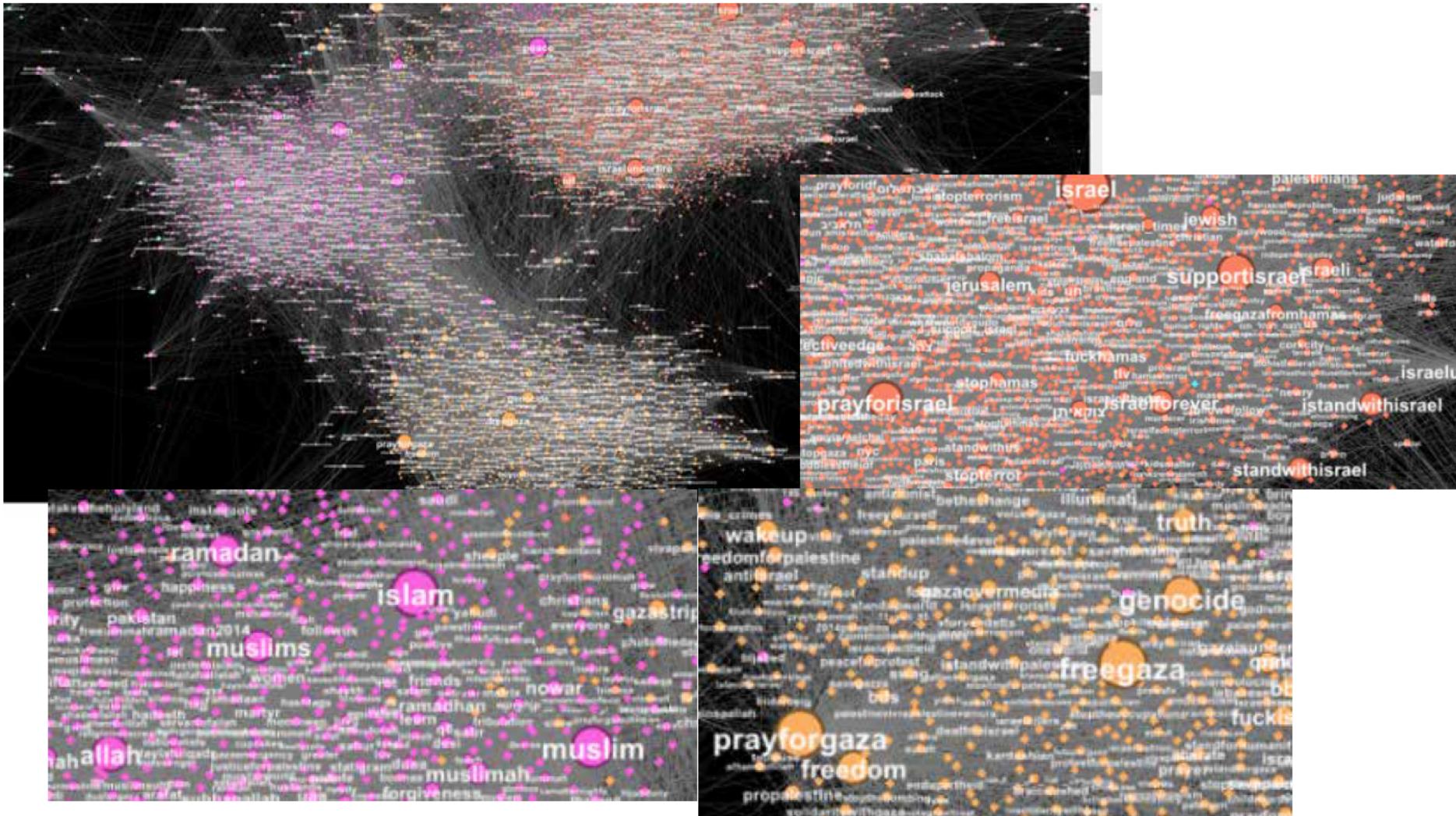
social networks and the art of personalizing propaganda

https://medium.com/i-data/israel-gaza-war-data-a54969aeb23e?_ga=1.225686554.1873778177.1371244953

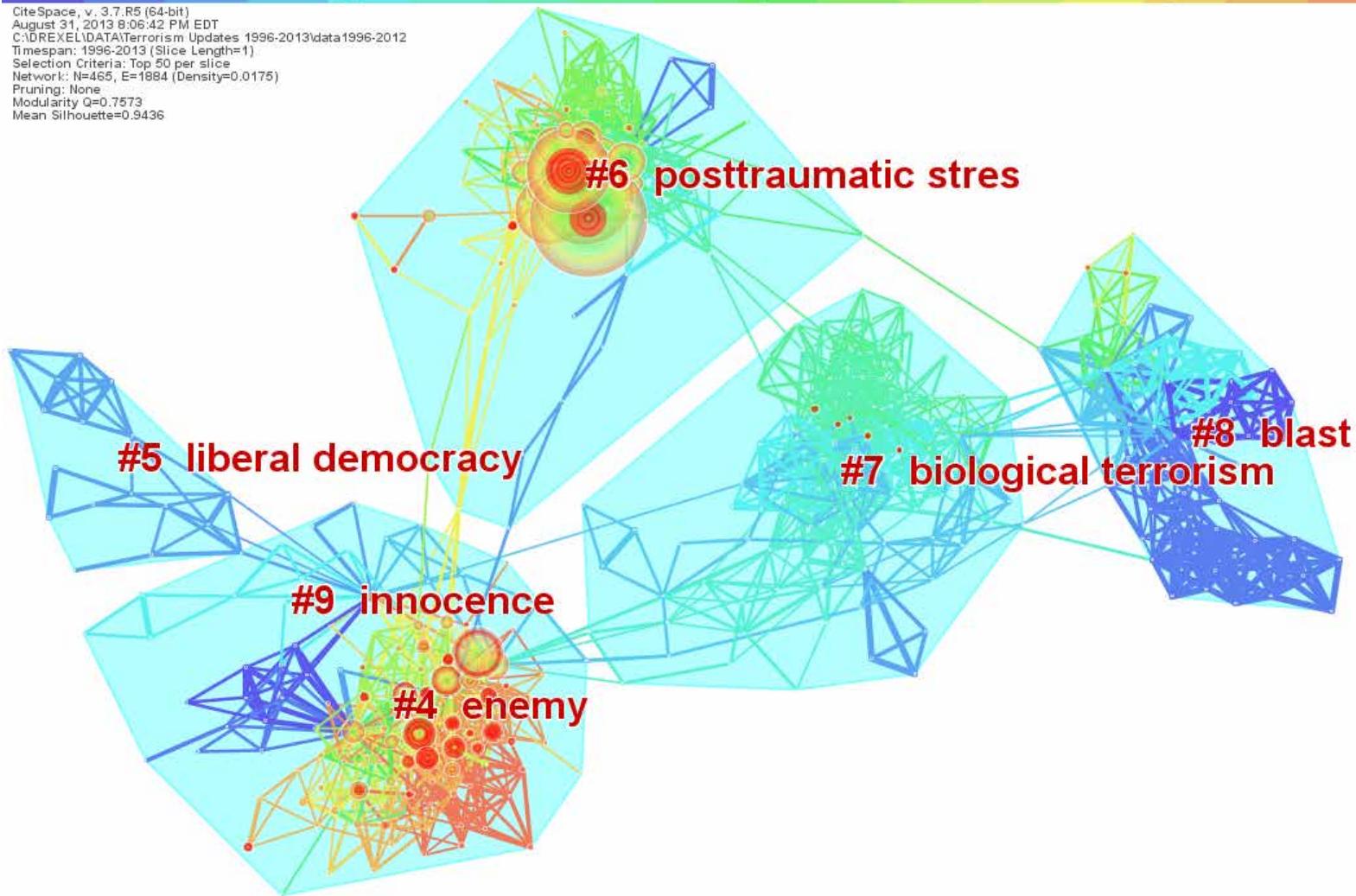


Instagram co-tag graph

pro-Israeli (Orange), pro-Palestinian (Yellow), and Religious / muslim (Purple)



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C:\DREXEL1\DATA\Terrorism Updates 1996-2013\data1996-2012
Timespan: 1996-2013 (Slice Length=1)
Selection Criteria: Top 50 per slice
Network: N=465, E=1884 (Density=0.0175)
Pruning: None
Modularity Q=0.7573
Mean Silhouette=0.9436



Structural Holes and Good Ideas¹

Ronald S. Burt

University of Chicago

This article outlines the mechanism by which brokerage provides social capital. Opinion and behavior are more homogeneous within than between groups, so people connected across groups are more familiar with alternative ways of thinking and behaving. Brokerage across the structural holes between groups provides a vision of options otherwise unseen, which is the mechanism by which brokerage becomes social capital. I review evidence consistent with the hypothesis, then look at the networks around managers in a large American electronics company. The organization is rife with structural holes, and brokerage has its expected correlates. Compensation, positive performance evaluations, promotions, and good ideas are disproportionately in the hands of people whose networks span structural holes. The between-group brokers are more likely to express ideas, less likely to have ideas dismissed, and more likely to have ideas evaluated as valuable. I close with implications for creativity and structural change.

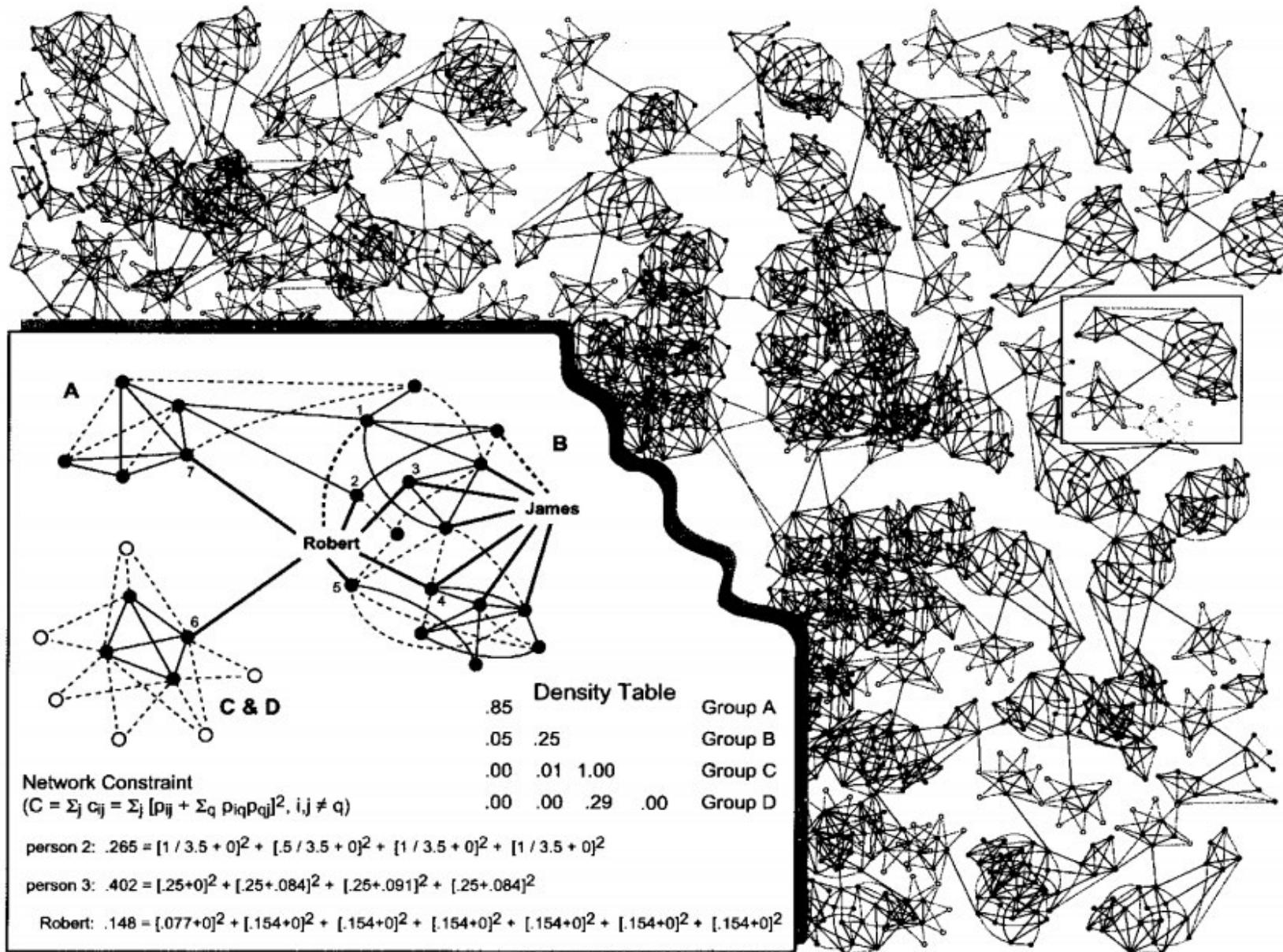
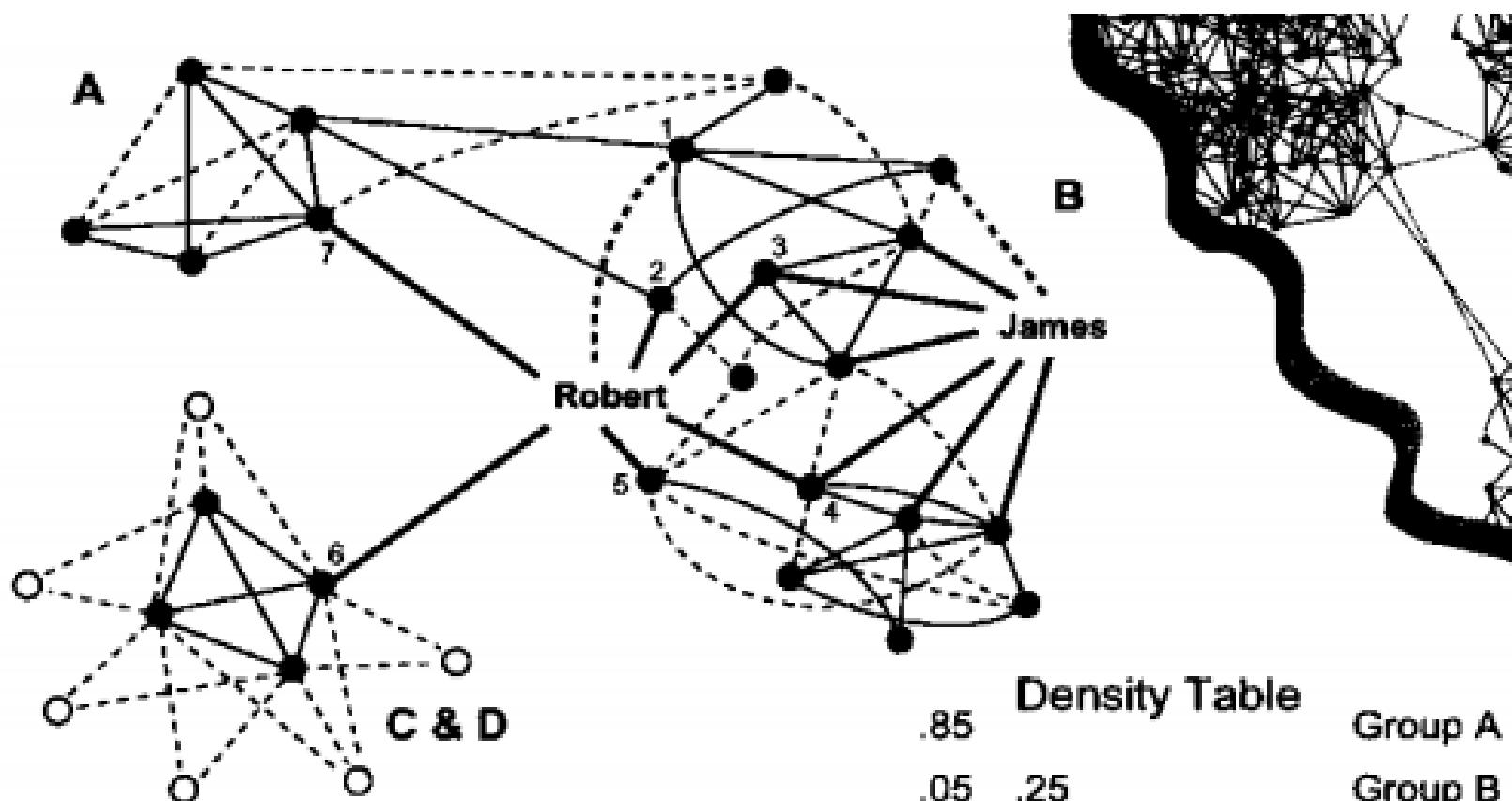


FIG. 1.—The small world of markets and organizations

People whose networks span structural holes have early access to diverse, often contradictory, information and interpretations, which gives them a competitive advantage in seeing good ideas.



Density Table

	.85	.05	.00	.01	1.00	
Group A						
Group B						
Group C						
Group D						

Network Constraint

$$(C = \sum_j c_{ij} = \sum_j [p_{ij} + \sum_q p_{iq}p_{qj}]^2, i, j \neq q)$$

person 2: $.265 = [1 / 3.5 + 0]^2 + [.5 / 3.5 + 0]^2 + [1 / 3.5 + 0]^2 + [1 / 3.5 + 0]^2$

person 3: $.402 = [.25+0]^2 + [.25+.084]^2 + [.25+.091]^2 + [.25+.084]^2$

Robert: $.148 = [.077+0]^2 + [.154+0]^2 + [.154+0]^2 + [.154+0]^2 + [.154+0]^2 + [.154+0]^2$

Brokerage ~ Best Idea

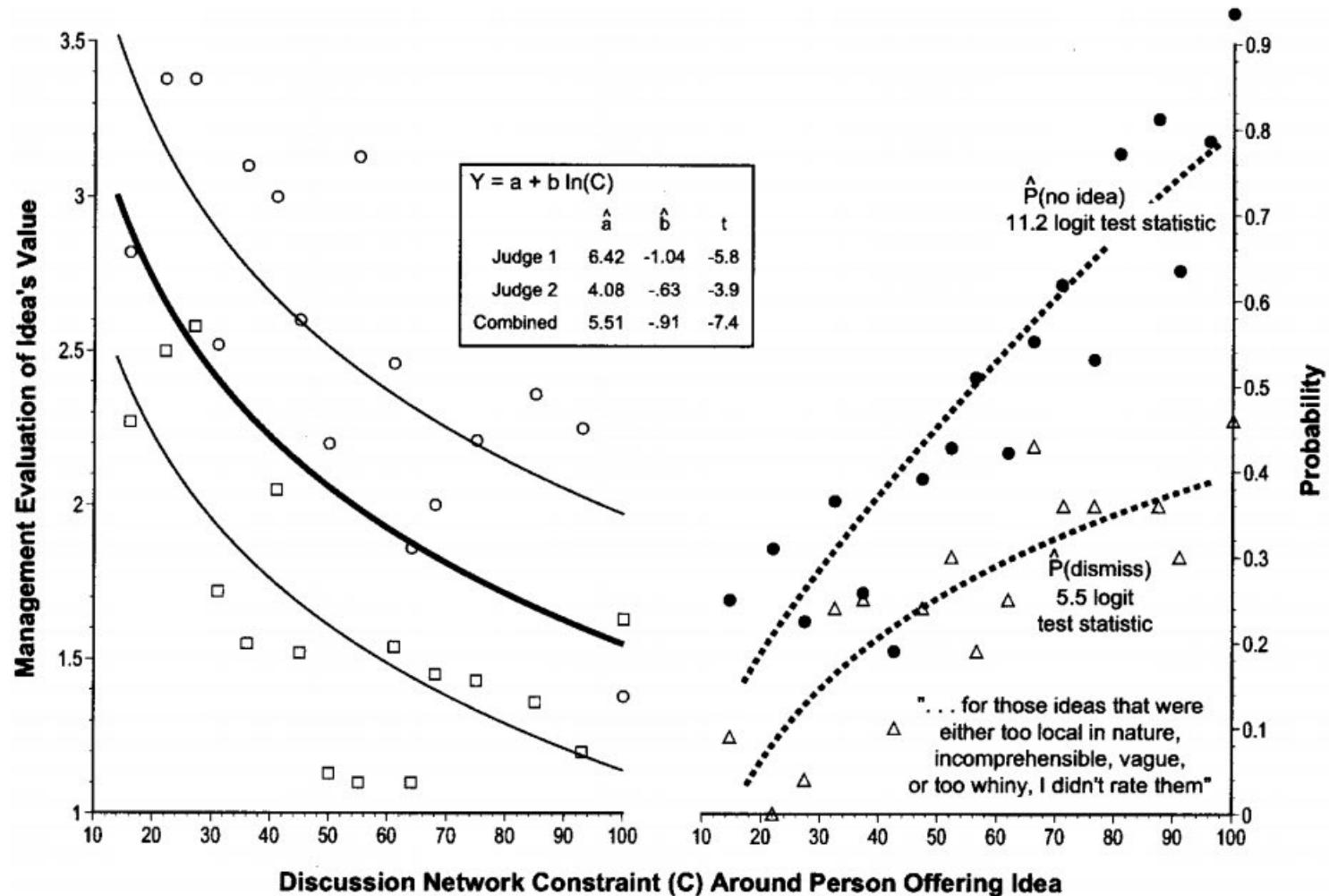
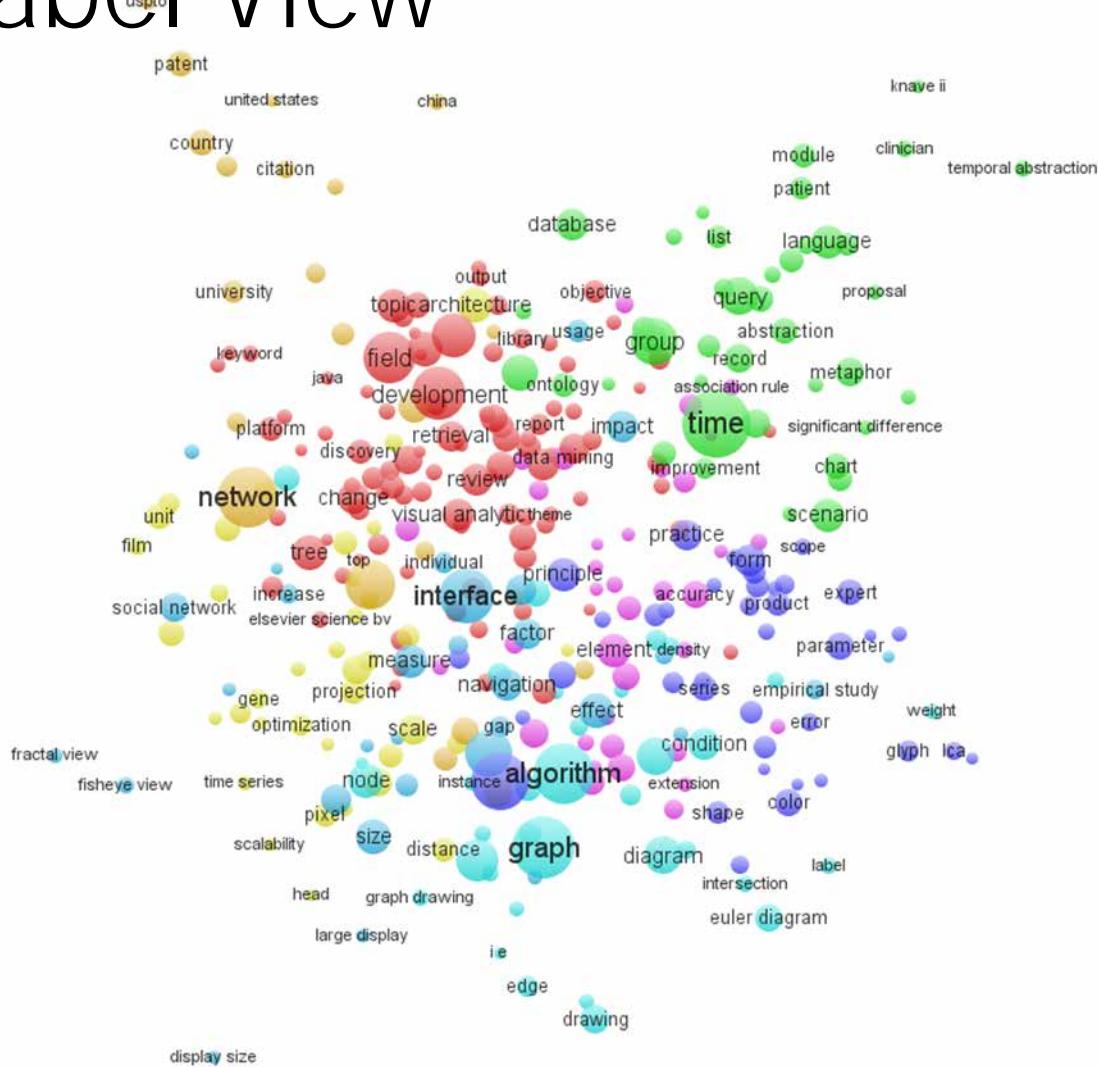
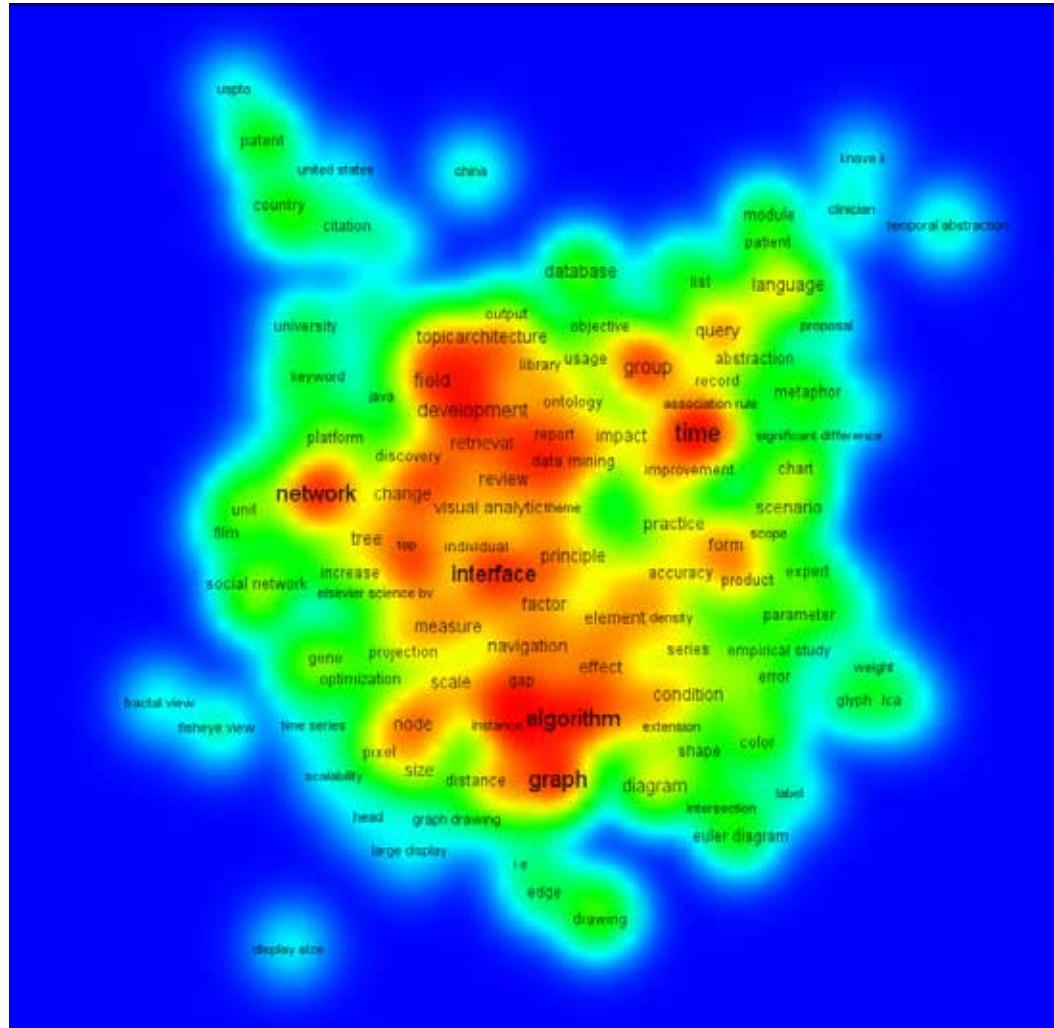


FIG. 5.—Brokerage and employee best idea

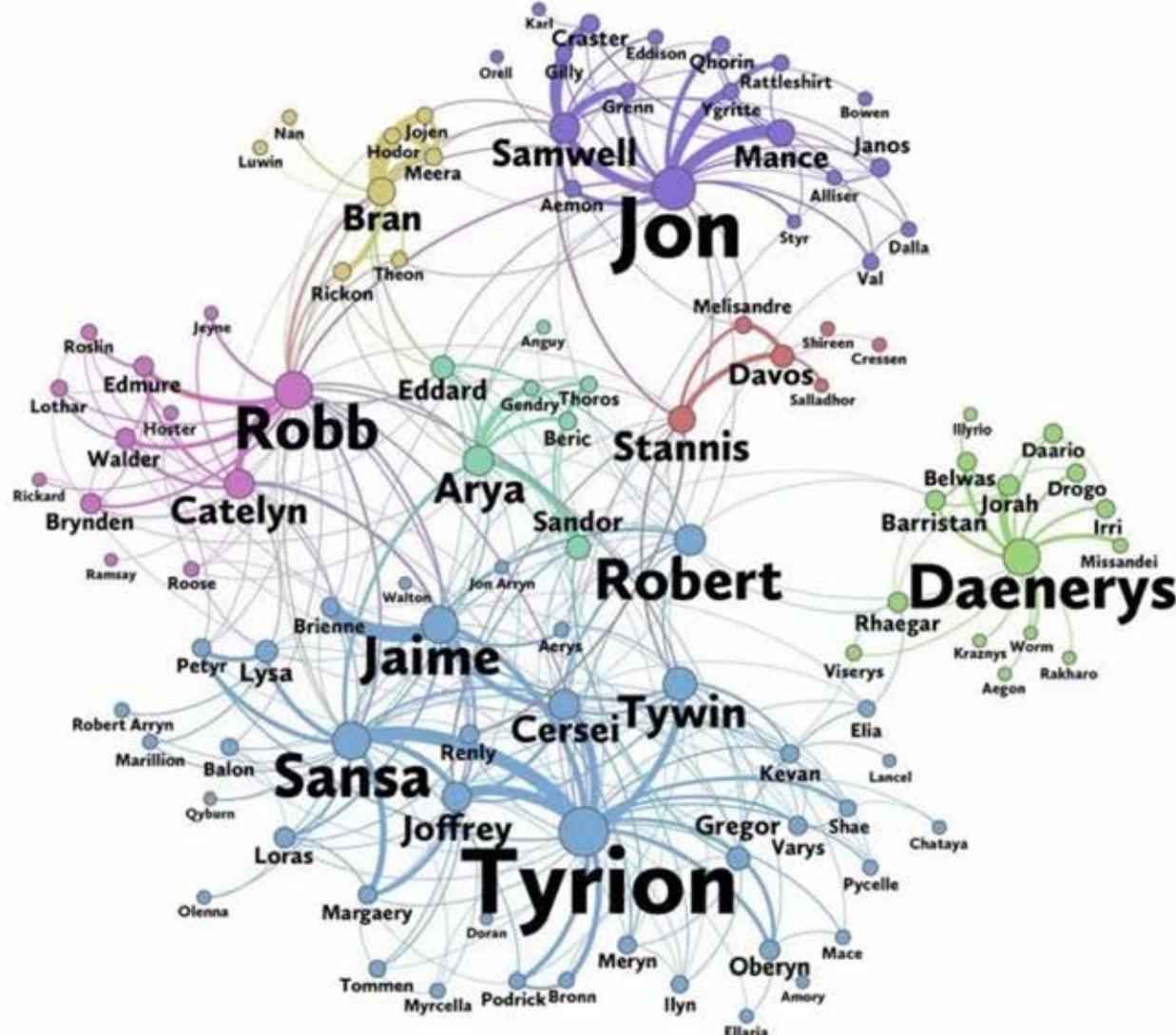
VOSViewer: Label View



VOSViewer: Density View



Gephi: Game of Thrones co-mention



Coordinated views

Section VI

Trulia real estate

Calculate your commute time from this home

District, Aldi, Districto within 1 mile of this home

45 median age, 28% married, 13% college graduate in this area

See 2 schools assigned to this home: Locke Alain School, ...

See reported crimes near this home

Date	Type	Description
10/30/2016	Other	All Other Offenses. DC Number: 201616045727
10/29/2016	Theft	Fraud. DC Number: 201618080190
10/29/2016	Assault	Aggravated Assault Firearm. DC Number: 201619098574
10/29/2016	Assault	Aggravated Assault No Firearm. DC Number: 201616045699
10/29/2016	Other	Disorderly Conduct. DC Number: 201618080164
10/29/2016	Other	Disorderly Conduct. DC Number: 201618080163
10/29/2016	Theft	Thefts. DC Number: 201616045687

Data provided by SpotCrime.com and CrimeReports.com.

Crime Risk

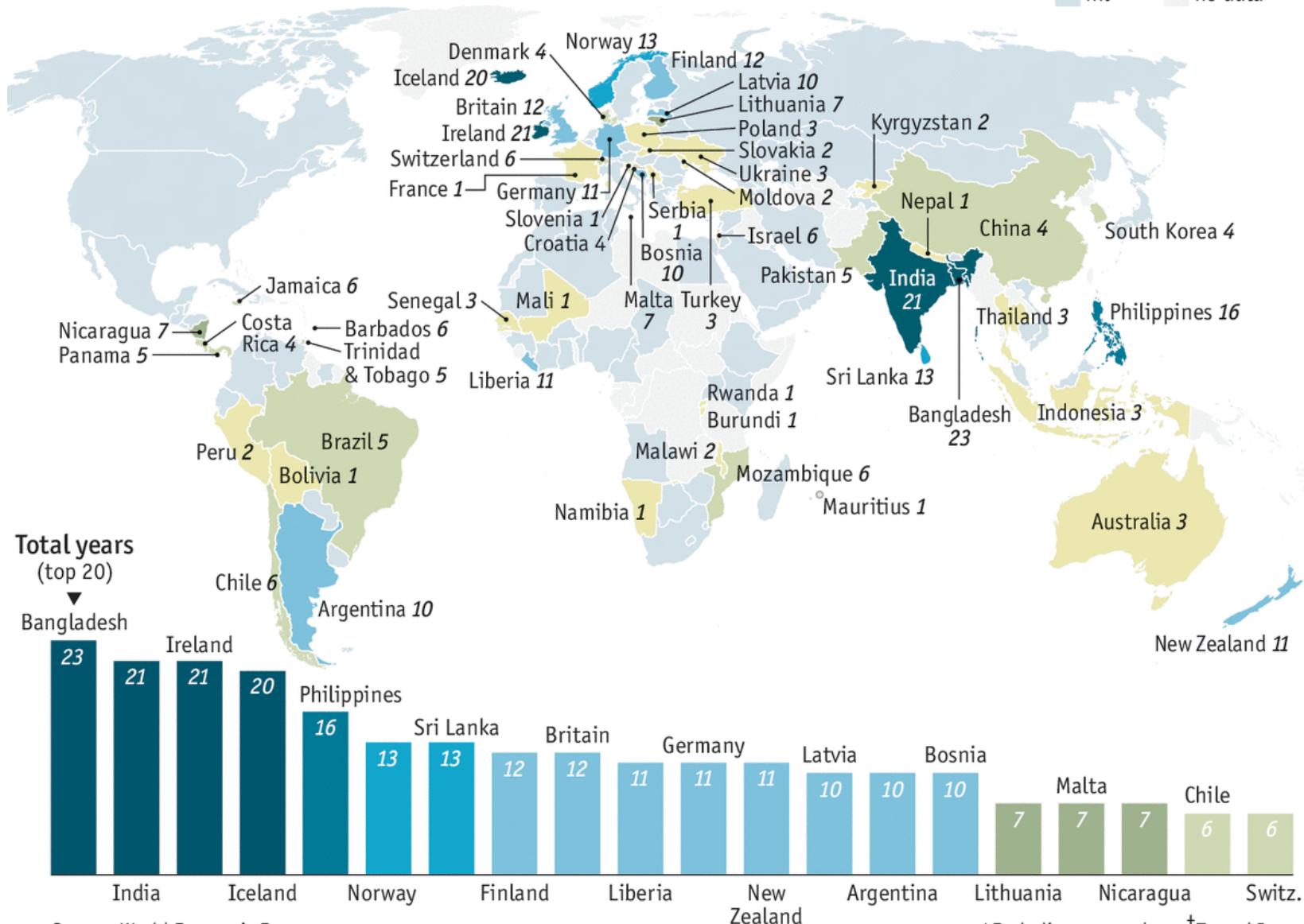
Google

Less safe

Safer

She's the boss

Female head of state or government*, years
1966-2016†



Source: World Economic Forum

*Excluding monarchs †To end June

Tobacco smoking in the U.S.

Americans have been smoking fewer cigarettes every year for nearly 70 years running, but some states, age groups and demographics have been better about kicking the habit, or never even picking up the butt.

Who smokes where

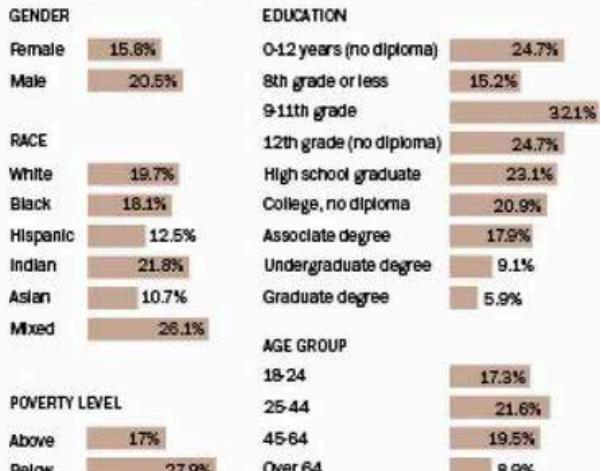
Kentucky has the highest percentage of smokers among U.S. states; the Midwest has the highest percentage among regions.

PERCENTAGE WHO SMOKE BY STATE



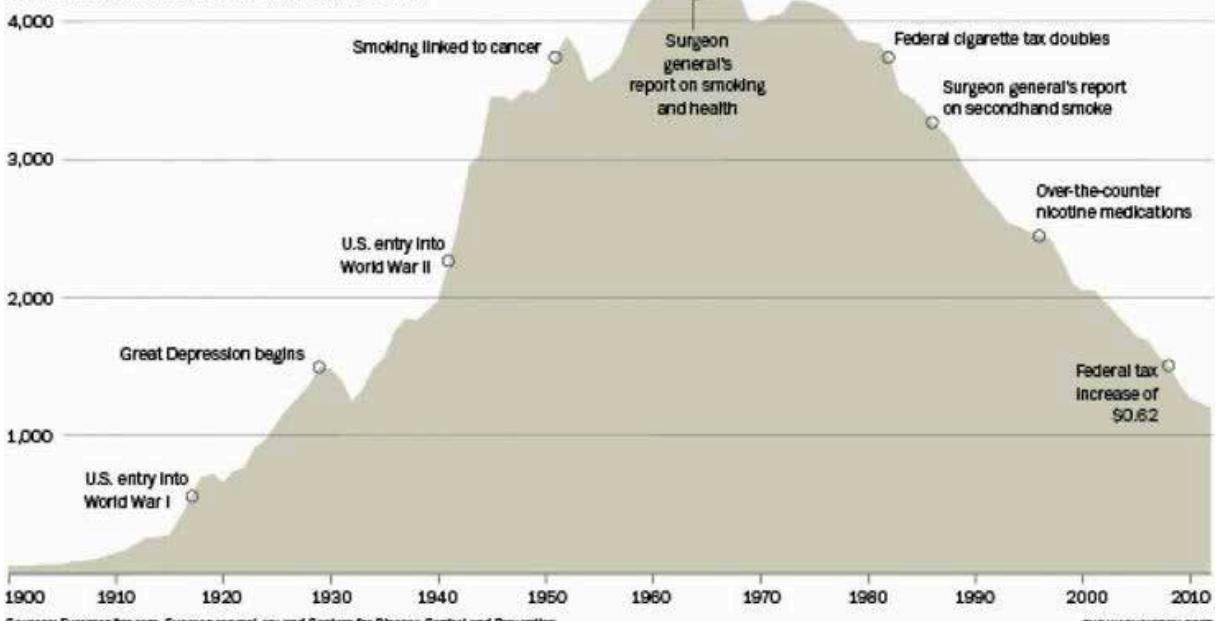
What makes a smoker

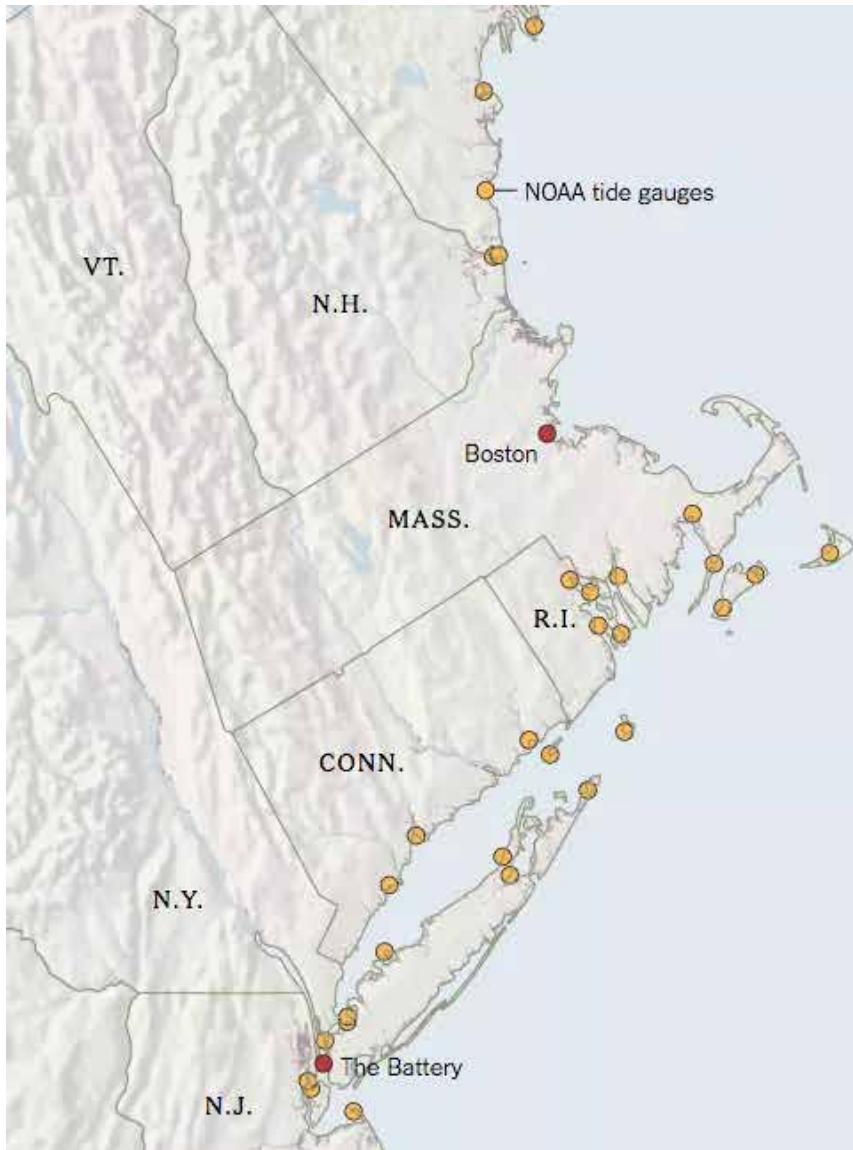
Percentage who reported smoking at least 100 cigarettes during their lifetime and who reported smoking every day or some days.



Historic cigarette consumption

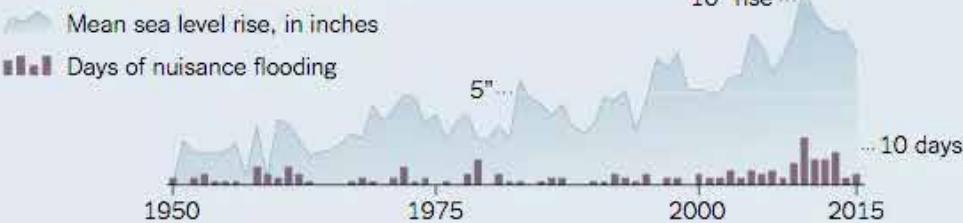
ADULT PER CAPITA CIGARETTE CONSUMPTION, 1900 - 2012





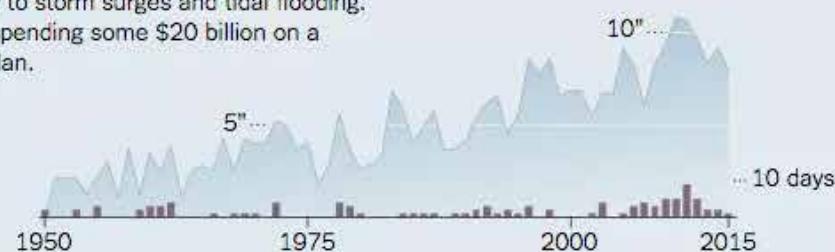
Boston

The city has not been hit by tidal flooding as hard as cities farther south, but it is working on a plan to combat flooding and sea-level rise.



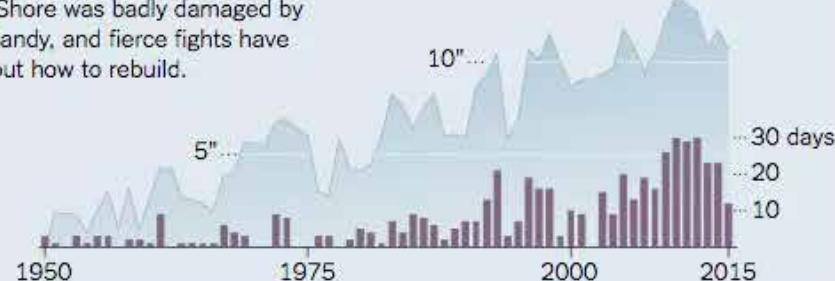
The Battery, New York City

In 2012, Hurricane Sandy laid bare the city's vulnerability to storm surges and tidal flooding. The city is spending some \$20 billion on a resilience plan.



Atlantic City

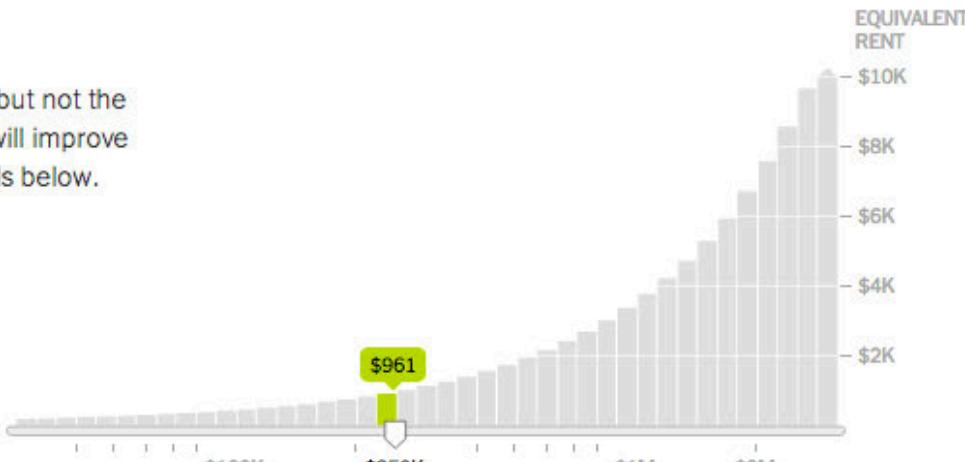
The Jersey Shore was badly damaged by Hurricane Sandy, and fierce fights have erupted about how to rebuild.



Home Price

A very important factor, but not the only one. Our estimate will improve as you enter more details below.

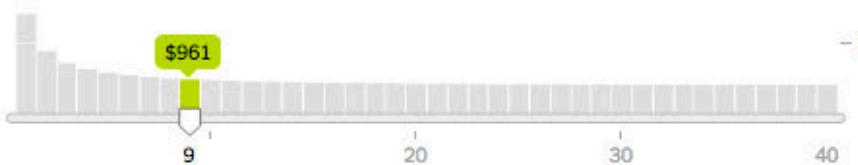
\$250,000



How Long Do You Plan to Stay?

Buying tends to be better the longer you stay because the upfront fees are spread out over many years.

9 years



What Are Your Mortgage Details?

In addition to the interest rate and down payment, the calculator takes into account the mortgage-interest tax deduction.

If you can rent a similar home for less than ...

\$961 PER MONTH

... then renting is better.

	Rent	Buy
Initial costs	\$961	\$60,000
Recurring costs	\$116,288	\$169,889
Opportunity costs	\$16,742	\$45,506
Net proceeds	-\$961	-\$142,366
Total	\$133,029	\$133,029

How to Read the Charts Charts that are relatively flat indicate factors that are not particularly important to the outcome. Conversely, the factors that have steep slopes have a large impact.

Demos

Section VII

Demos

- Tableau
 - Earthquake data
- VOSViewer
 - Web of Science data
- Gephi
 - Game of Thrones data