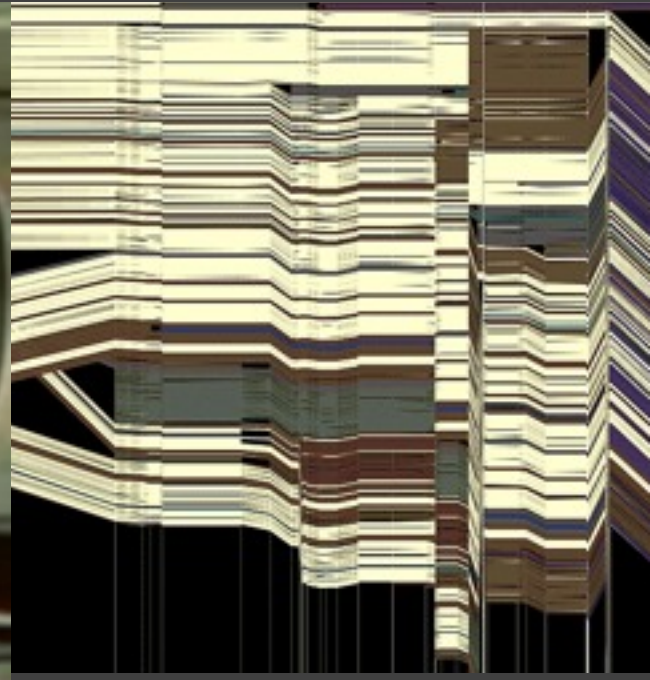
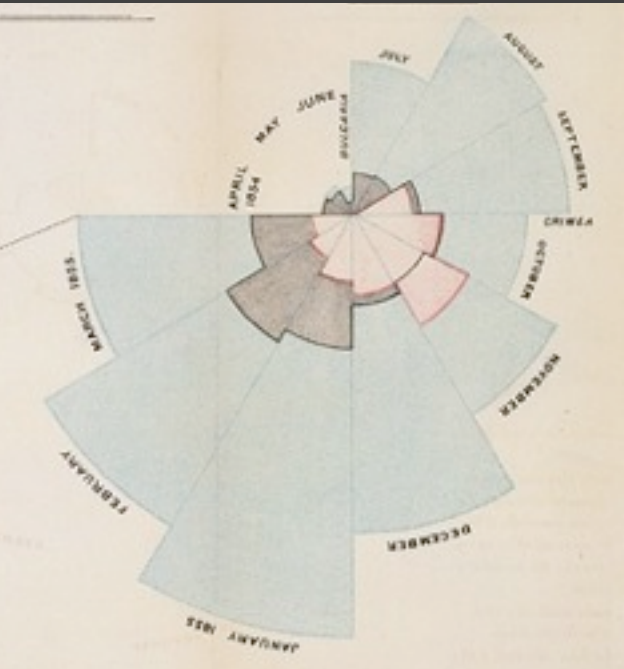


CSE512 :: 11 Mar 2014

Collaborative Analysis



Jeffrey Heer University of Washington

A Tale of Two Visualizations

vizster



community >>

Enable

search >>

Zephoria

User ID 21721

Friends 288

Age ??

Gender Female

Status Single

Location San Francisco, CA

Hometown Lancaster, PA

Occupation researcher: social networks, identity, context

Interests apophenia, observing people, culture, questioning power, reading, buddhism, ipseity, computer-mediated communication, social networks, technology, anthropology, stamping

Music psytrance/goa/trance [Infected Mushroom, Son K9e... Iboga/Digital Structures], Ani DiFranco, downtempo, Thievery Corporation, Beth Orton, Morcheeba, Ween, White Stripes

Books Authors: Erving Goffman, Stanley Milgram, Jeanette Winderson, Eric Schlosser, Leslie Feinberg, Dorothy Allison, Italo Calvino, Hermann Hesse

TV Shows ??

Movies Koyaanisqatsi, Amelie, Waking Life, Tank Girl, The Matrix, Clockwork Orange, American Beauty, Fight Club, Boys Don't Cry

Member Since ??

Last Login 2003-10-21

Last Updated 2003-10-21

About [Some know me as danah...]

I'm a geek, an activist and an academic, fascinated by people and society. I see life as a very large playground and enjoy exploring its intricacies. I revel in life's chaos, while simultaneously providing my own insane element.

My musings:
<http://www.zephoria.org/though>
<http://www.zephoria.org/though>

Want to Meet

Someone who makes life's complexities seem simply elegant.

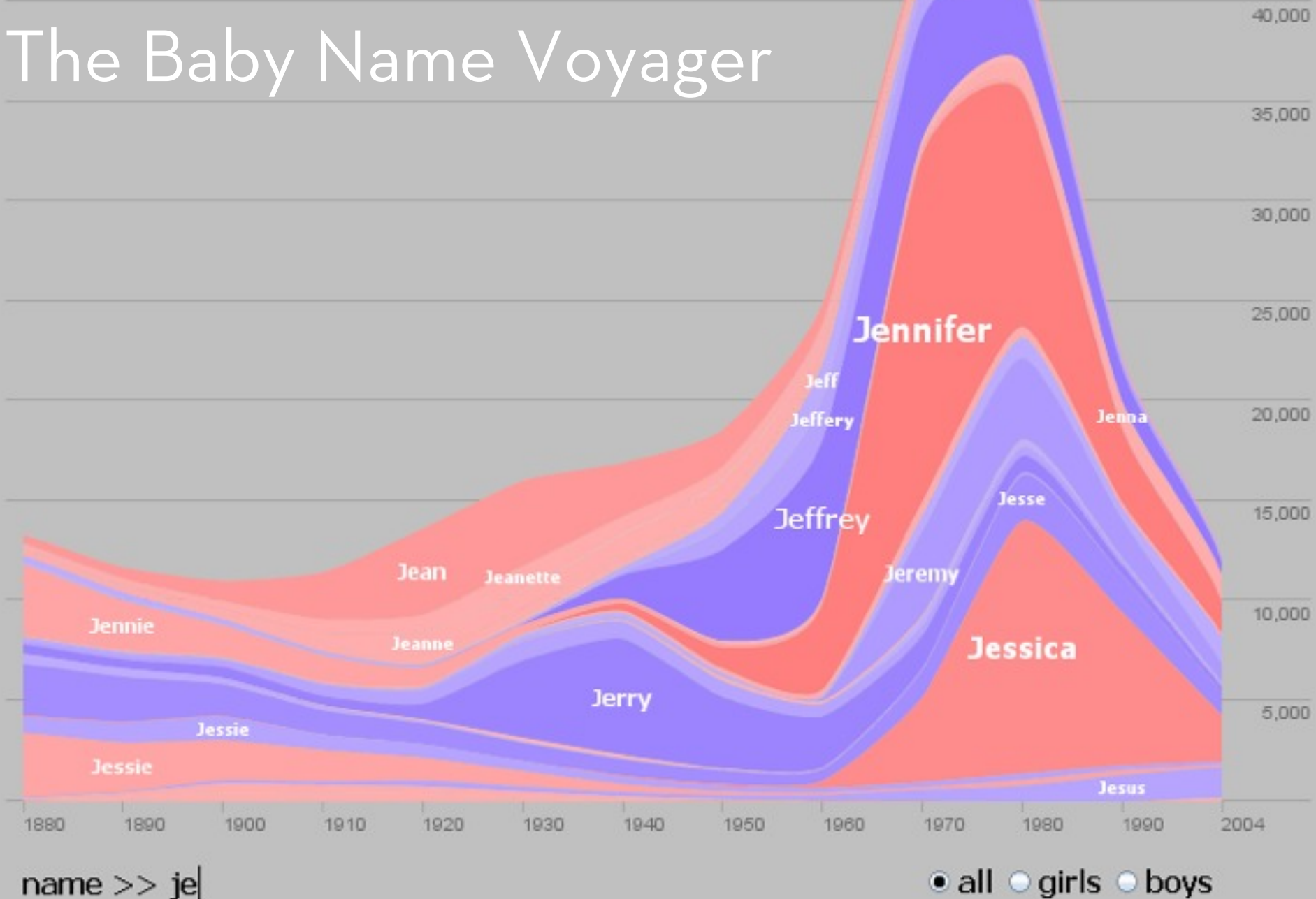
Observations

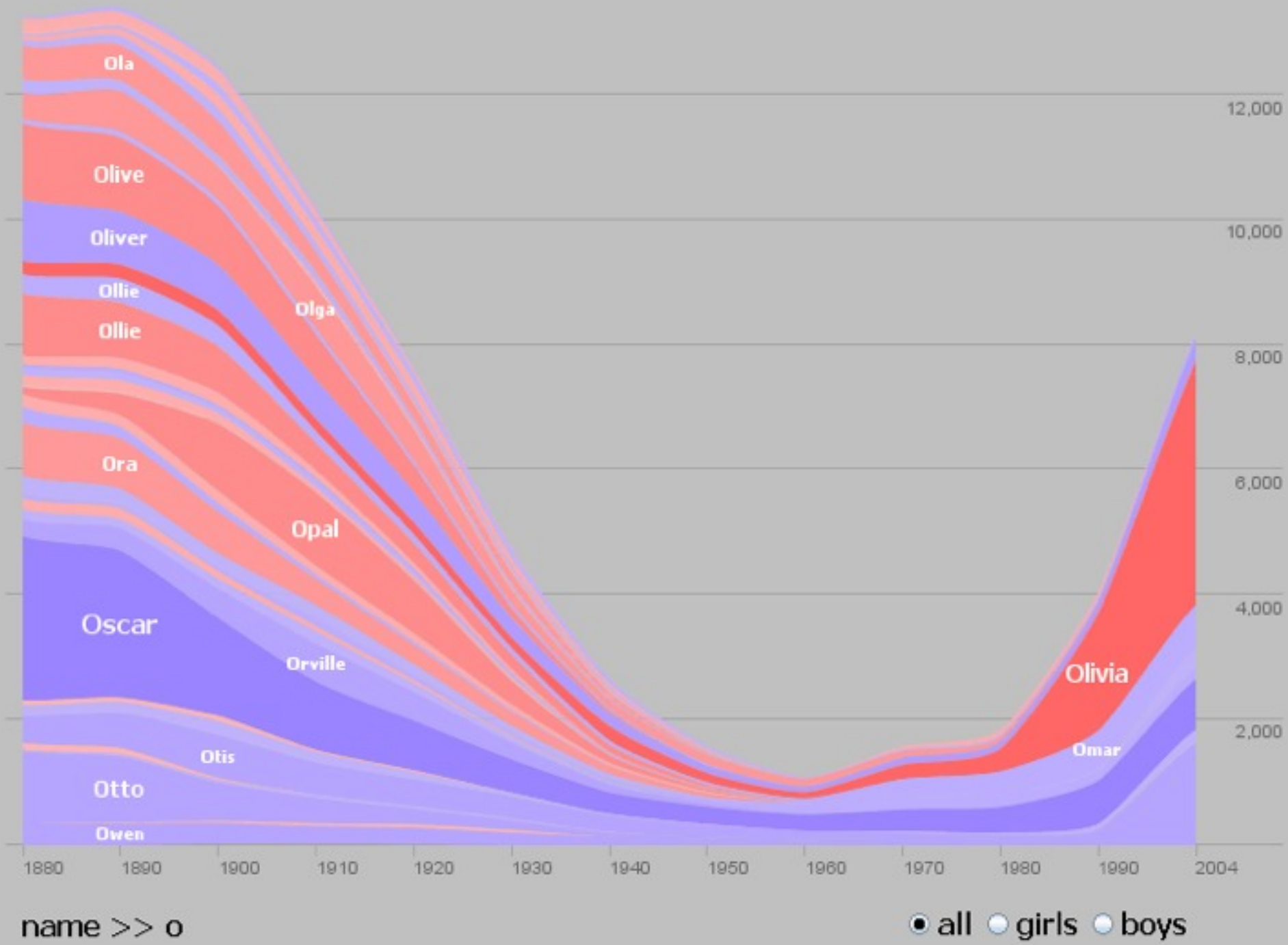
Groups spent more time in front of the visualization than individuals.

Friends encouraged each other to unearth relationships, probe community boundaries, and challenge reported information.

Social play resulted in informal analysis, often driven by story-telling of group histories.

The Baby Name Voyager





Social Data Analysis

Visual sensemaking is a **social** process as well as a cognitive process.

Analysis of data coupled with **social interpretation and deliberation.**

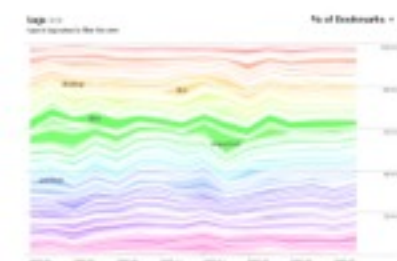
How can user interfaces catalyze and support **collaborative visual analysis?**

sense.us

A Web Application for Collaborative Visualization of Demographic Data

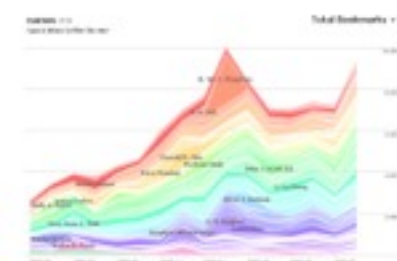
with **Fernanda Viégas** and **Martin Wattenberg**

sense.us

Log in to add comments! IBM e-mail pass [login](#) [help](#)

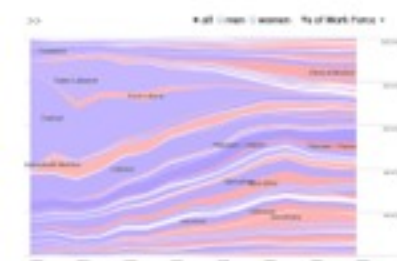
Dogear Tags

Dogear Tag Usage, May 2005 to August 2006
source: IBM Dogear
10 comments



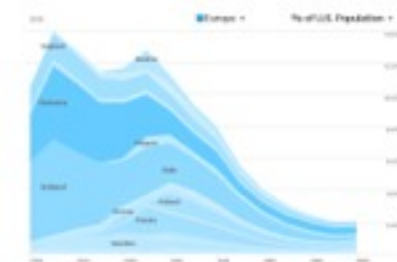
Dogear People

Dogear Bookmarking by Person, May 2005 to August 2006
source: IBM Dogear
1 comment



Job Voyager

Reported Occupations of U.S. Labor Force, 1850-2000
source: <http://ipums.org>
139 comments



Birthplace Voyager

Reported Birthplace of U.S. Residents, 1850-2000
source: <http://ipums.org>
10 comments

sense.us - social data visualization

sense.us is a prototype system for collaborative visualization.

- See the data. See what people have to say about it.
- Dive into the data and share your explorations.

The site requires **Java 1.5+** and either **Firefox** or **Internet Explorer**.
Use your **IBM W3/BluePages e-mail** and **password** to login.
Use at least **1024x768** resolution for the best experience.

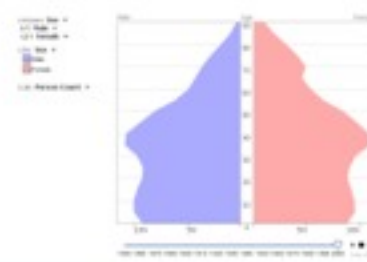
Check out the **user's guide** and **privacy policy** before getting started.

Having problems using Firefox with Java 1.4? Some users using Firefox and Java 1.4 have found that comments aren't loading properly. If you run into this problem, consider upgrading to Java 1.5 (**Windows, Linux**) or using Internet Explorer (on Windows systems). Sorry for any inconvenience!



U.S. Census State Map

State Map of 2000-2005 Census Data
source: U.S. Census Bureau
16 comments



Population Pyramid

U.S. Population Demographics, 1850-2000
source: <http://ipums.org>
7 comments

[CHI 07]

Supporting Collaboration

Sharing within visualizations and across the web

<http://sense.us/jobs#scale=1&gender=All&query=mili>

Reported Occupations of U.S. Labor Force, 1850-2000 (source: <http://ipums.org>)



comments (5) [New Comment](#) | [View All \(143\)](#)

▼ **Is this military info right?** (5)

I would have expected a different pattern for the military, but then again maybe this is just the military industrial complex growing and growing.

by **Martin Sharp** on Fri Jul 21, 2006 10:15 AM

here are labels where I would have expected big jumps.

by **Martin Sharp** on Fri Jul 21, 2006 10:16 AM

well, there was also the cold war right after ww2, which might be part of the reason why there's such a huge jump after the 40s. It is also interesting that there is such a drop between the 70s and the 80s.

by **Julia Hernandez** on Fri Jul 21, 2006 11:01 AM

I guess a lot of it has turned to robots, and the industrial complex, as martin suggested, though it would be interesting to see the comparison of the fall in military personal next to the rise in DOD funding for robots and industry.

by **Jesse O'Brien** on Fri Jul 21, 2006 11:51 AM

I think the jumps have more to do with the economy at large rather than any particular military conflict. Lots of money in conflict has already been spent before the conflict starts.

by **Fred Klein** on Wed Aug 2, 2006 10:24 AM

[reply](#)

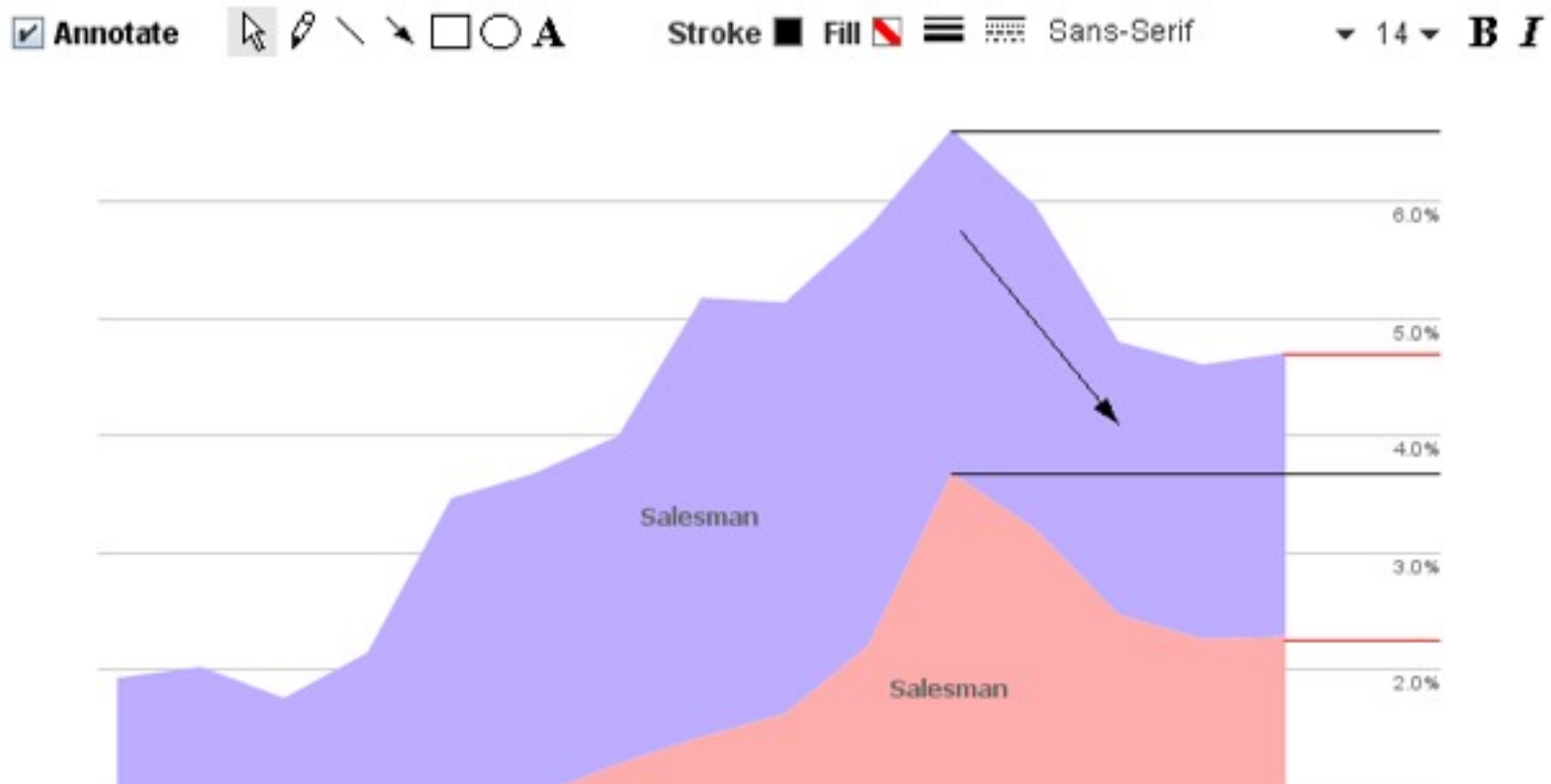
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Supporting Collaboration

Sharing within visualizations and across the web

Pointing at interesting trends, outliers

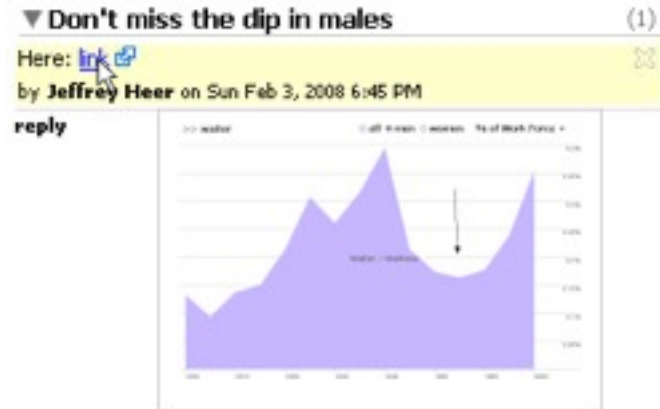
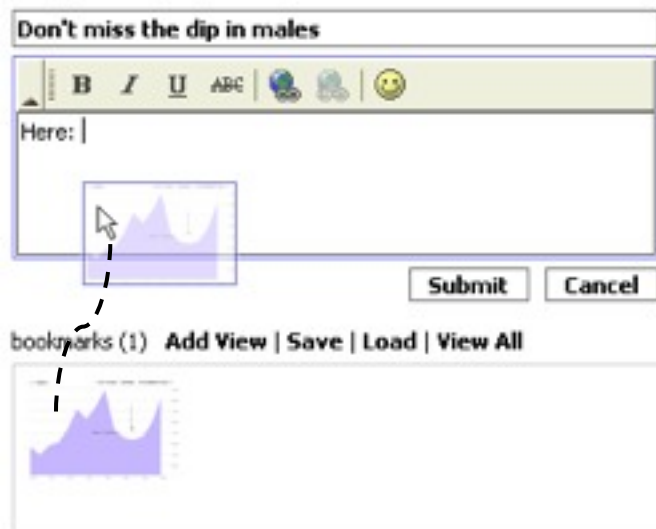


Supporting Collaboration

Sharing within visualizations and across the web

Pointing at interesting trends, outliers

Collecting and linking related views



Supporting Collaboration

Sharing within visualizations and across the web

Pointing at interesting trends, outliers

Collecting and linking related views

Awareness of social activity



Ushers?

Is this like the movie theatre kind of usher?

by **Martin Sharp** on Fri Jul 21, 2006 10:24 AM



Drop in household workers

This trend is almost the opposite of the "clerical worker" and "secretary" categories

by **Julia Hernandez** on Fri Jul 21, 2006 10:50 AM



Disappearing professors???

Note how a bunch of different kinds of professors "disappear" in the year 2000. Is this just a change in the way the census aggregates data?

by **Julia Hernandez** on Fri Jul 21, 2006 11:07 AM

Supporting Collaboration

Sharing within visualizations and across the web

Pointing at interesting trends, outliers

Collecting and linking related views

Awareness of social activity

Embedding in external media (blogs, wikis, webpages)

Supporting Collaboration

Sharing within visualizations and across the web

Pointing at interesting trends, outliers

Collecting and linking related views

Awareness of social activity

Embedding in external media (blogs, wikis, webpages)

Don't disrupt individual exploration

User Study Design

30 participant laboratory study

25 minute, unstructured sessions with job voyager

3-week live deployment on IBM intranet

Employees logged in using intranet accounts

Data analyzed

12.5 hours of qualitative observation

258 comments (41 pilot, 85 ibm, 60 ucb, 72 live)

Usage logs of user sessions

Voyagers and Voyeurs

Complementary faces of analysis

Voyager – focus on visualized data

Active engagement with the data

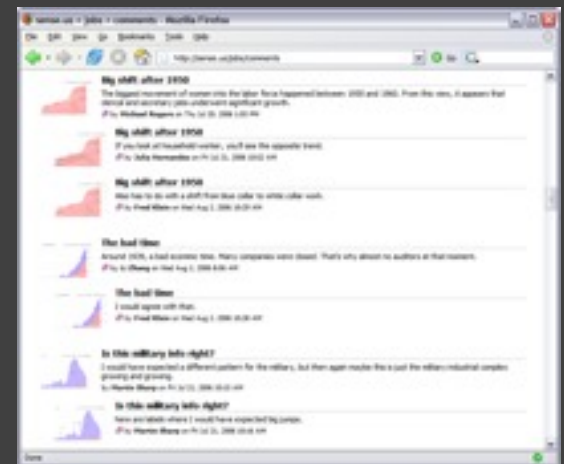
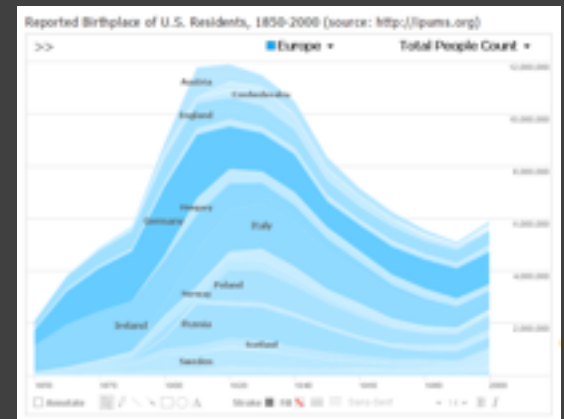
Serendipitous comment discovery

Voyeur – focus on comment listings

Investigate others' explorations

Find people and topics of interest

Catalyze new explorations



Social Data Analysis

Health

1877

Life expectancy in years

80

70

60

50

40

30

Uganda

Mozambique

Sierra Leone

1877

1810

1709

GDP per capita in US

Income

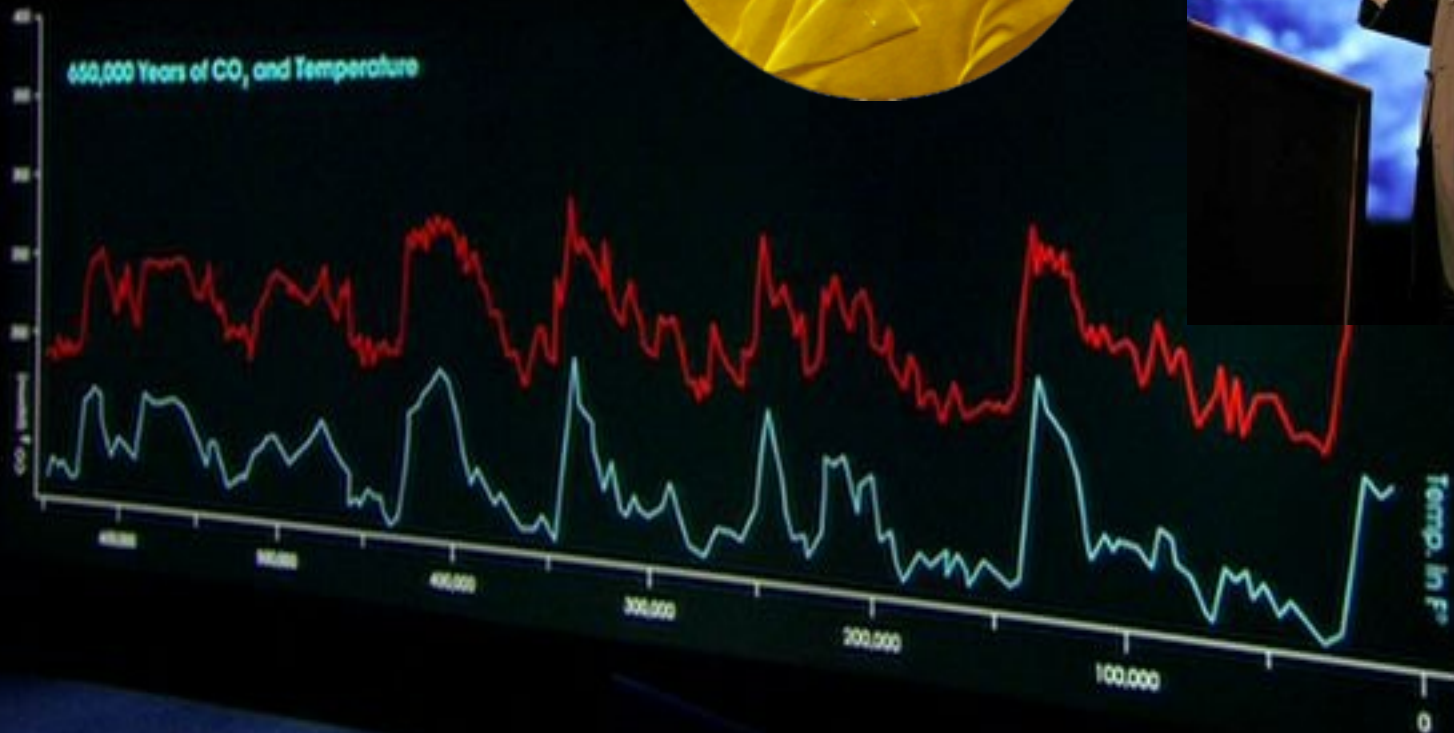
500

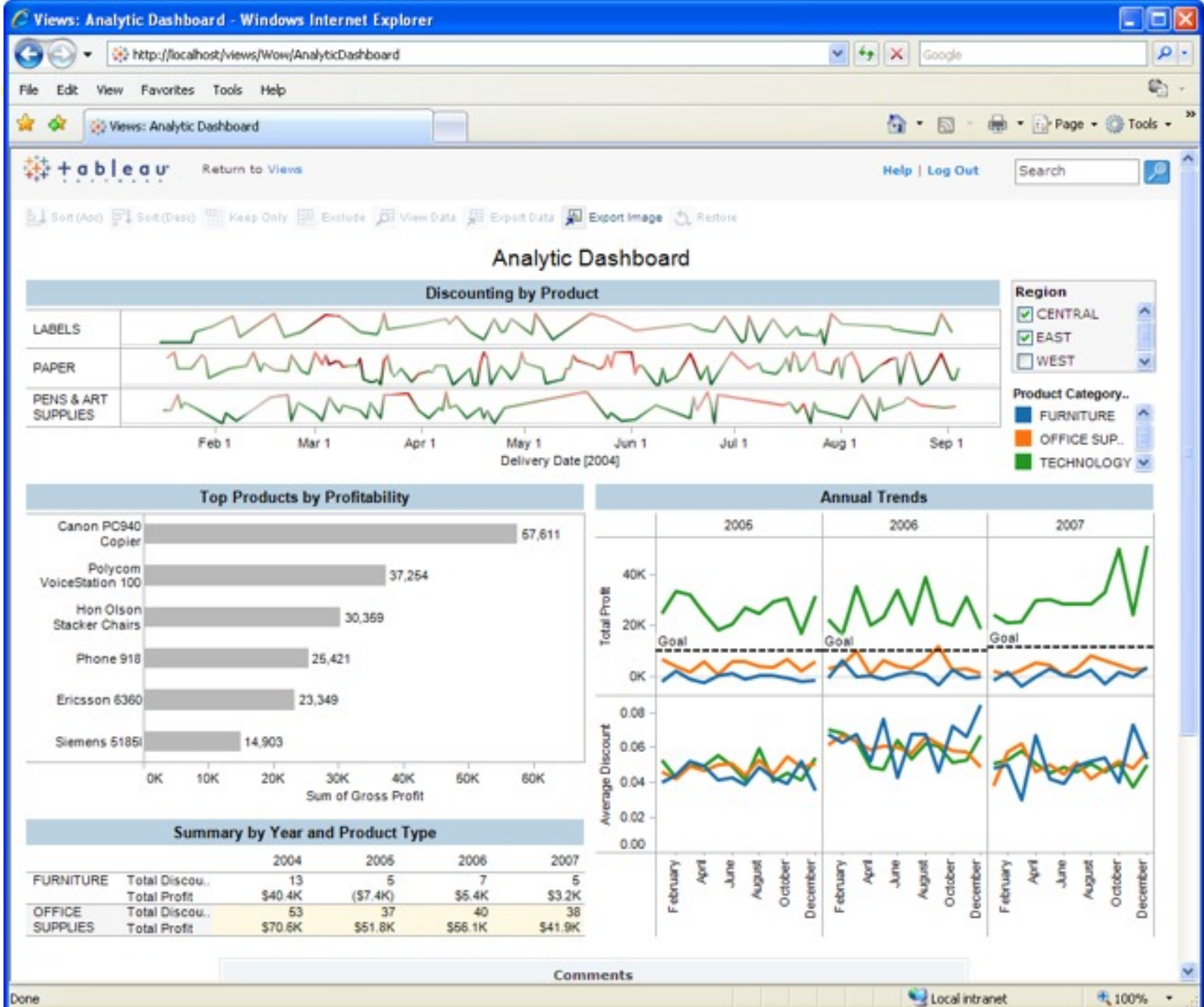
1000

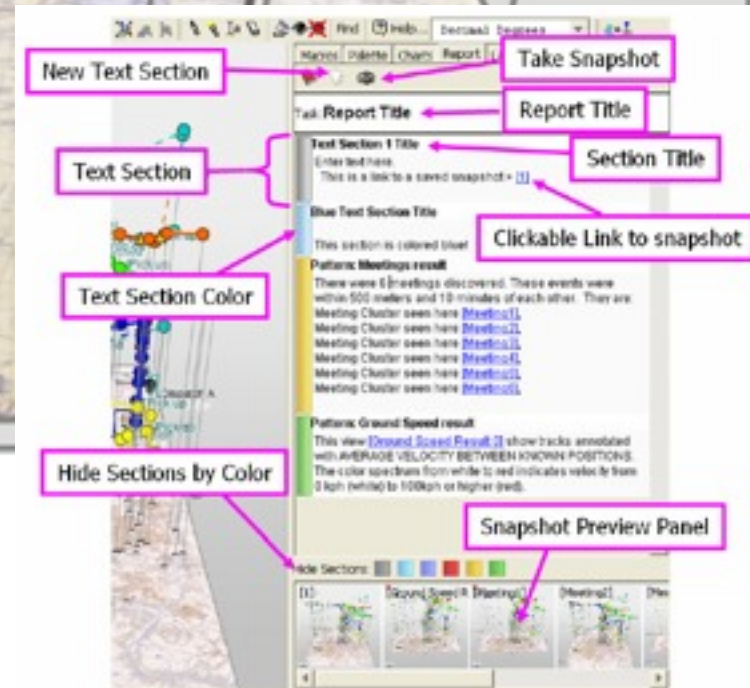
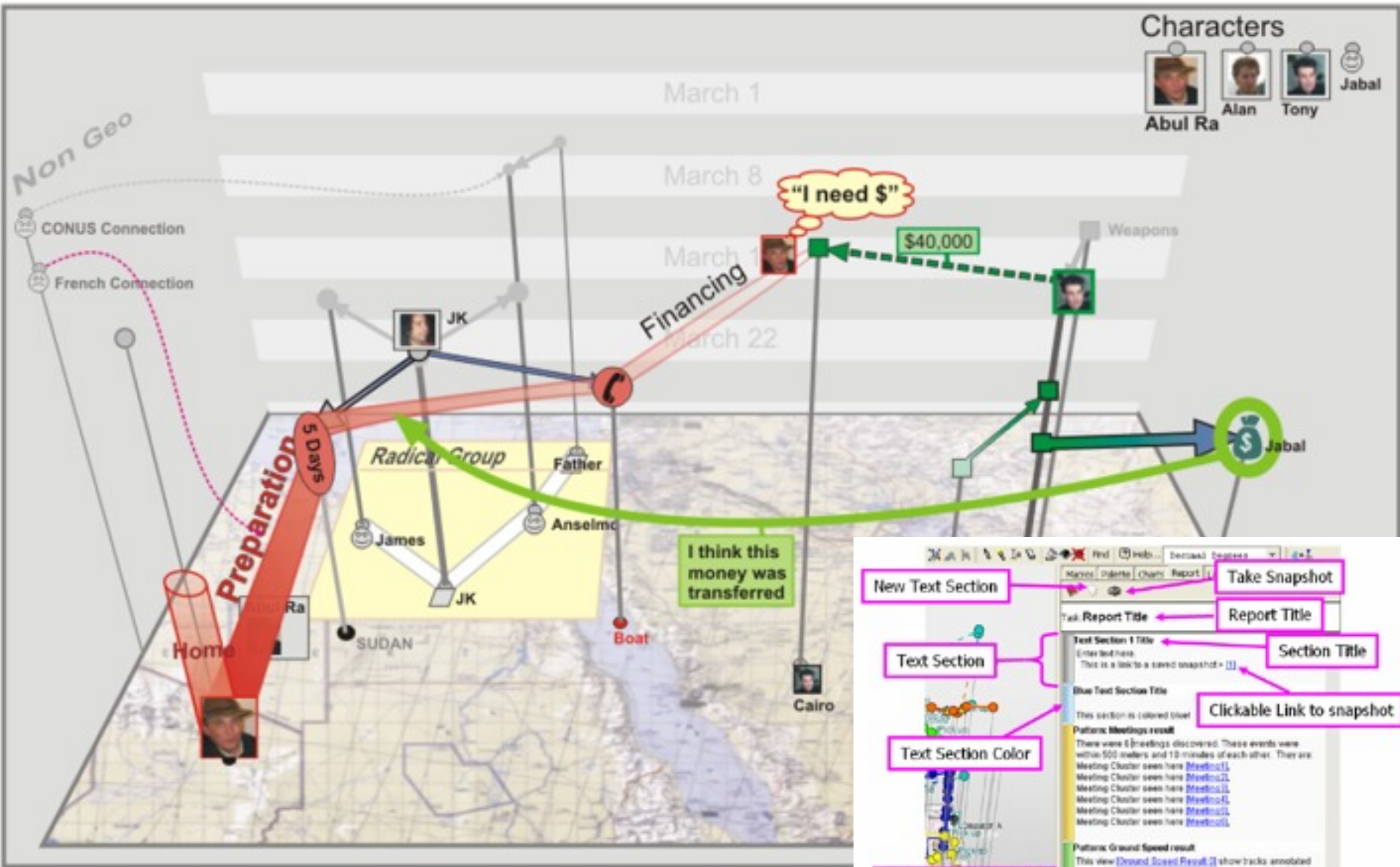
2000

5000

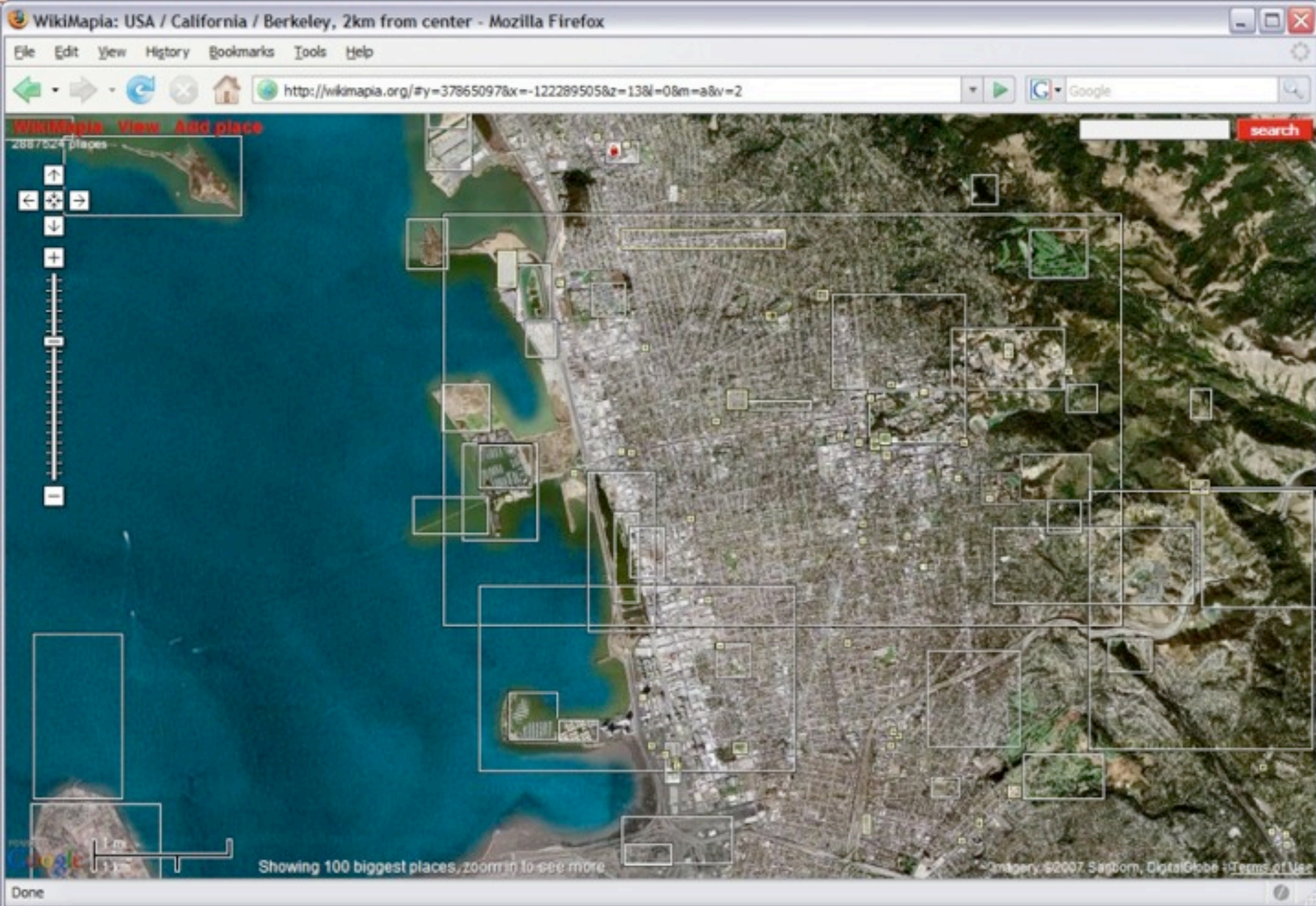
10000







GeoTime Stories



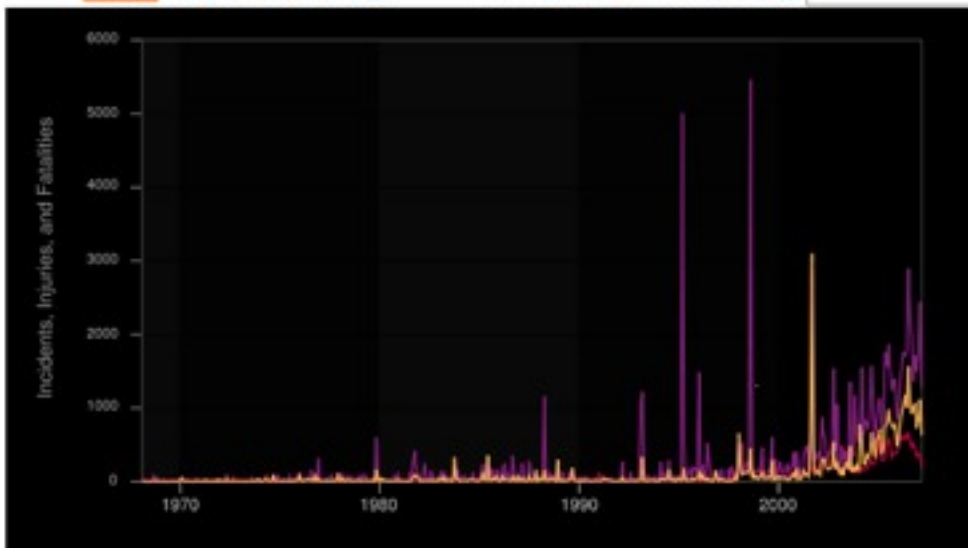
Wikimapia.org

The Status of George Bush's War on Terrorism



By [seema](#) on Feb 22, 2007
Viewed 8927 times

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[Map](#)
[Absolute](#)
[Relative](#)
[All](#)
[31y](#)
[21y](#)
[4y](#)

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Sources: MIPT Terrorism Knowledge Base (<http://www.terrorismknowledgebase.org>)

Incidents, injuries, and deaths from terrorism have increased during the new millenium. This may be because of the broader definition of what characterizes a terrorist act, or it may actually be a constant increase in such acts. —[seema](#)

Comments (12)



Anonymous says

Go BuSH!

posted 11 months ago



Tyler says

What a completely disingenuous graph, and comments to follow. You have absolutely no reason to think the line would stay flat without Bush.

You probably thought graphs like these (and your site more widely) would help people overcome preconceived notions by showing hard data.

Instead, you're just amplifying people's preconceived notions -- adding legitimacy

Share this Graph



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Rate It



3 ratings



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Legend



[Global Terrorist Incidents, 1968-2007](#)



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Tags

no tags yet

Community Tags

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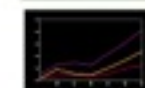
Correlations

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89% [Injuries](#) and [Fatalities](#)

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Created By: [Dmitry](#)

Views: 2474



[Global Terrorism Incidents and Iraq Body Count](#)

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[Reported Maximum vs. The Status of George Bush's War on Terrorism](#)

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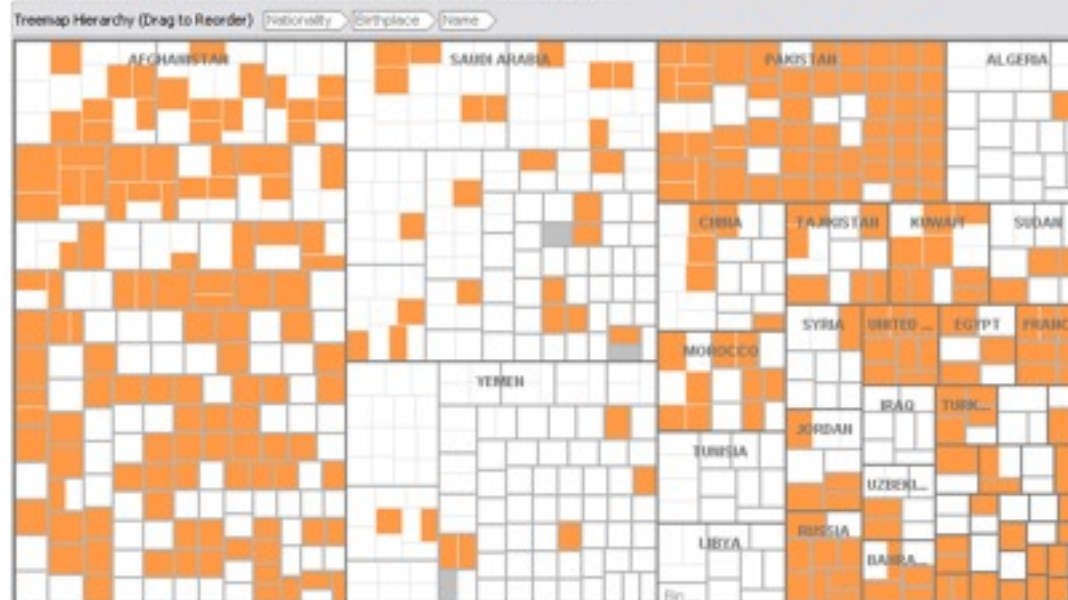
[Reported Maximum vs. The Status of George Bush's War on Terrorism](#)



Visualizations : Guantanamo Bay Detainees, release status & age

Can't see the visualization? Download the latest Java plugin [here](#). On Macs: best viewed in Safari.

Created by: [Martin Wattenberg](#) Created on: Saturday February 24, 12:06 PM



Search>>

0.0 0.2 +

Color Released (1=Yes, 0=No)

Size Age (approximate)

Data file: [Guantanamo Bay Detainees](#) Data source: [Washington Post \(via user Mark\)](#)

This data set has 1 positive rating



Comments (4)



[Martin Wattenberg](#) says:

In this view, orange means released, white means not released. Gray means committed suicide.

Posted Saturday February 24, 12:07 PM

[see view for this comment](#)



[Martin Wattenberg](#) says:

I'd be curious to hear ideas on why various countries have the release proportions that they do.

Posted Saturday February 24, 12:13 PM

[see view for this comment](#)



[Mark](#) says:

This visualization has 1 positive rating

You can add this visualization to a topic hub! [Learn more.](#)

Want to keep track of this visualization? Add it to your watchlist!

[Learn more!](#)

[About the Treemap](#)

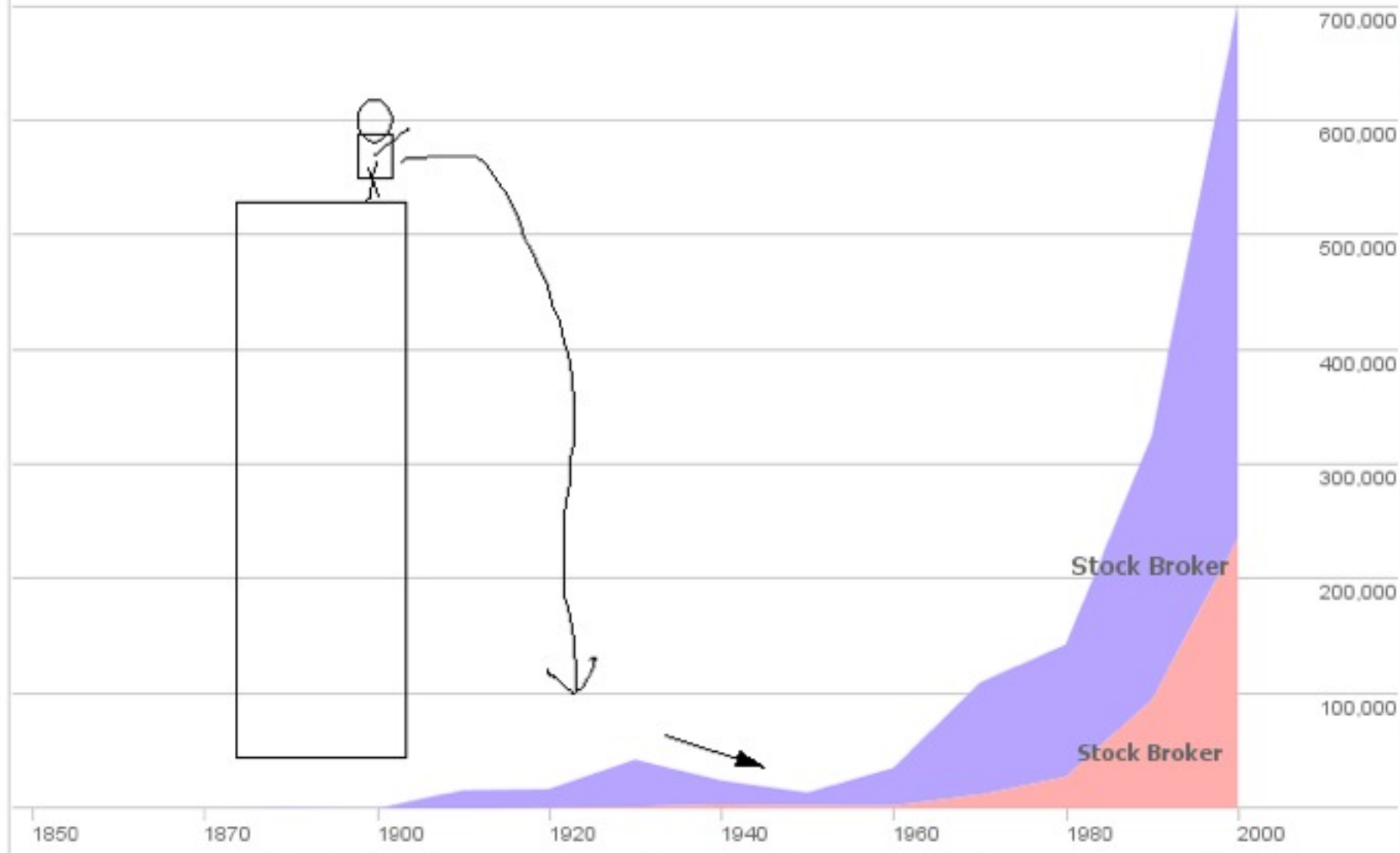
Many-Eyes

Discussion

Great depression "killed" a lot of brokers

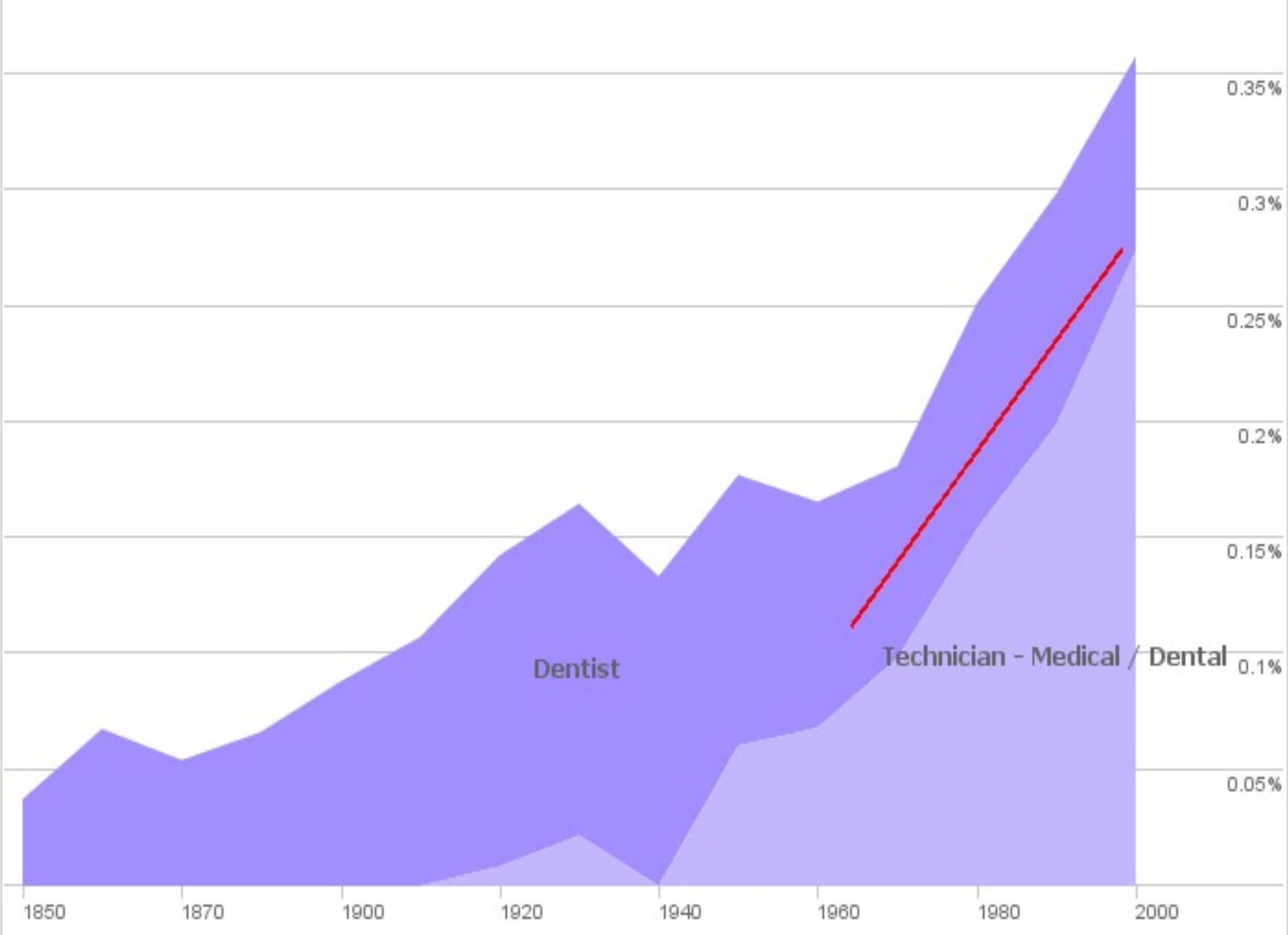
>> Stock Broker

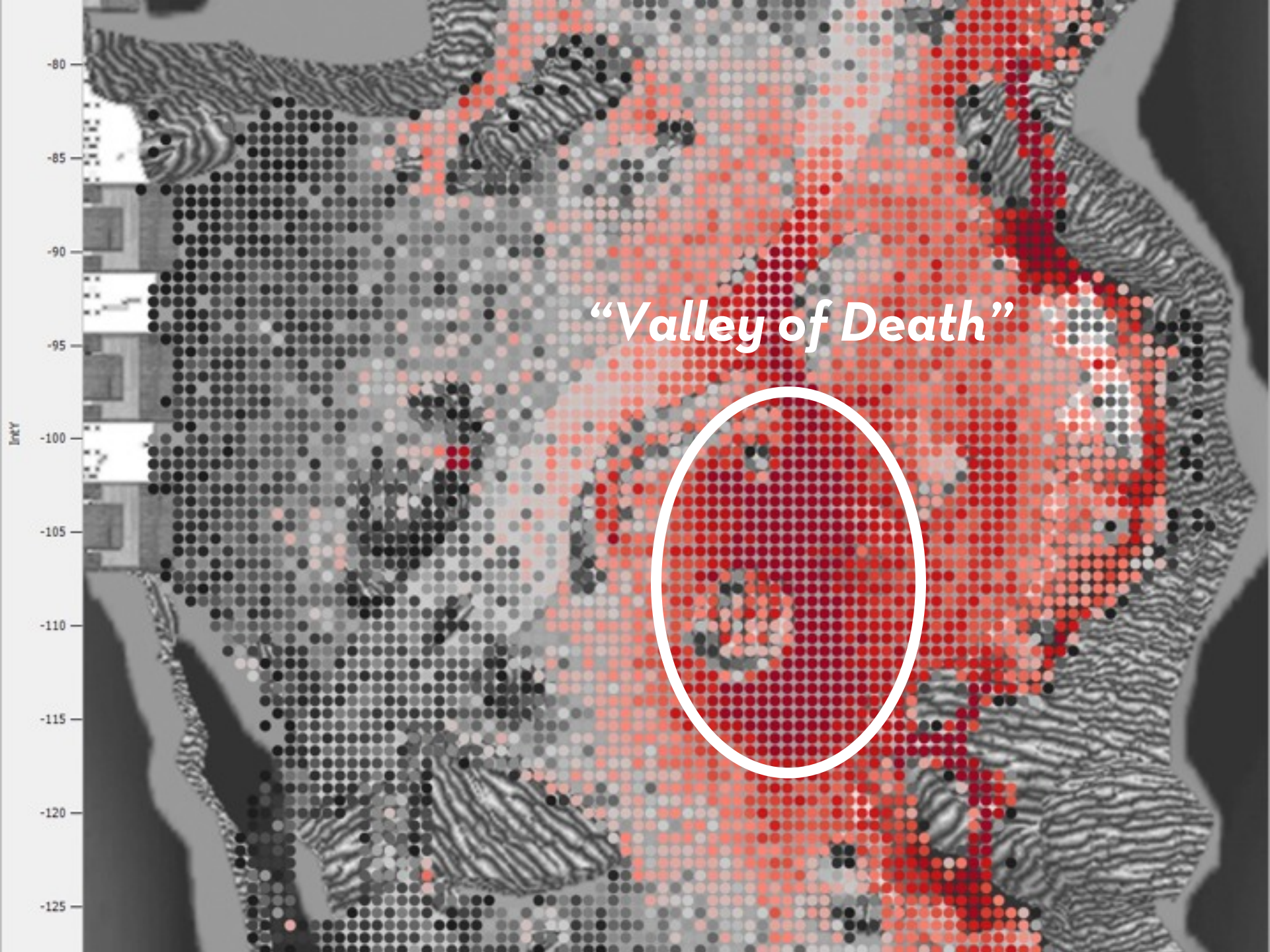
● all ● men ● women Total People Count ▼



>> dent

all men women % of Work Force ▼







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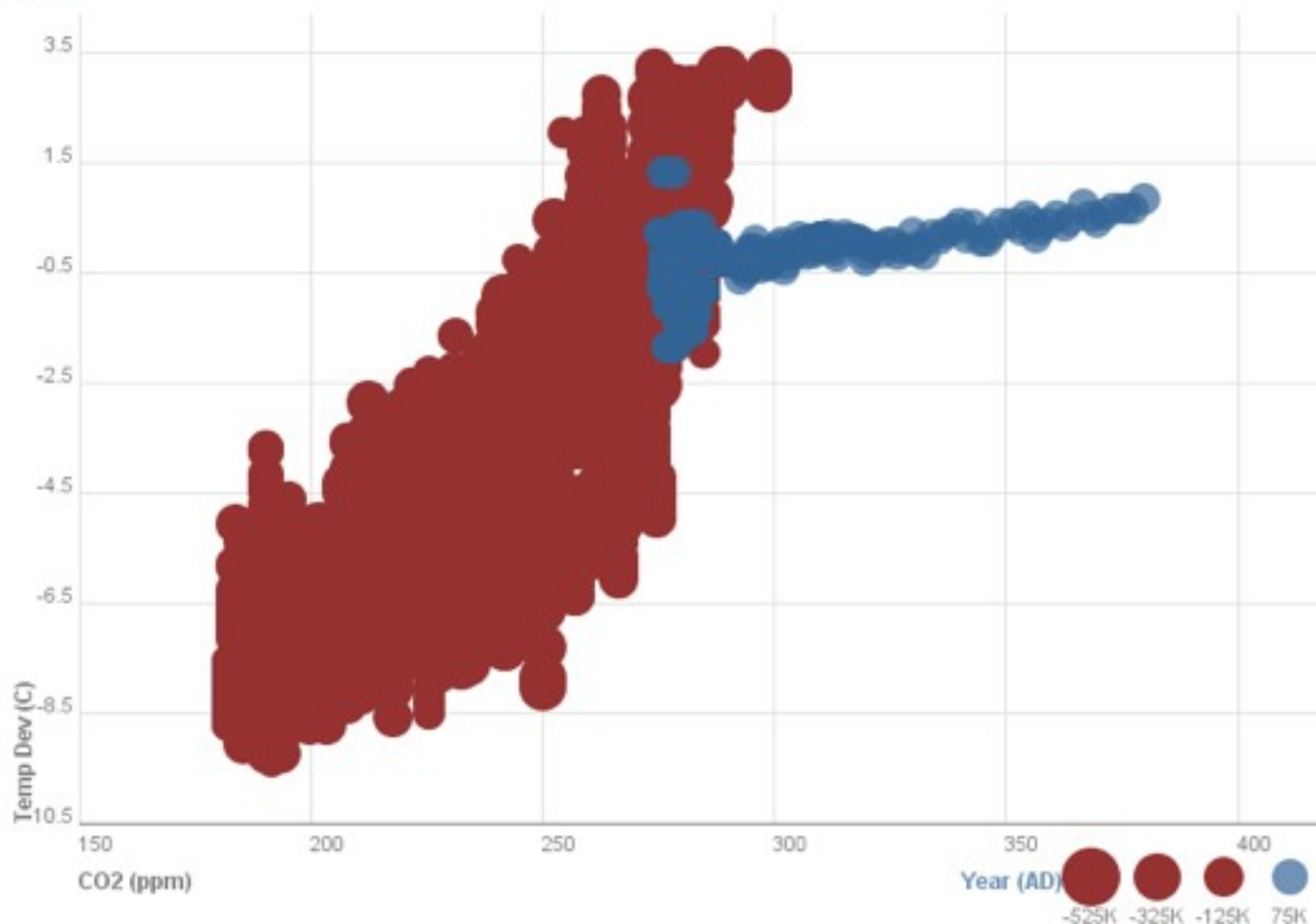
survey text US web world

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Visualizations: Flawed Data - Temp Over Time and CO2 Levels : This view shows the correlation between...

Creator: Bruce

Tags:



X Axis CO2 (ppm)

Y Axis Temp Dev (C)

Dot Size Year (AD)

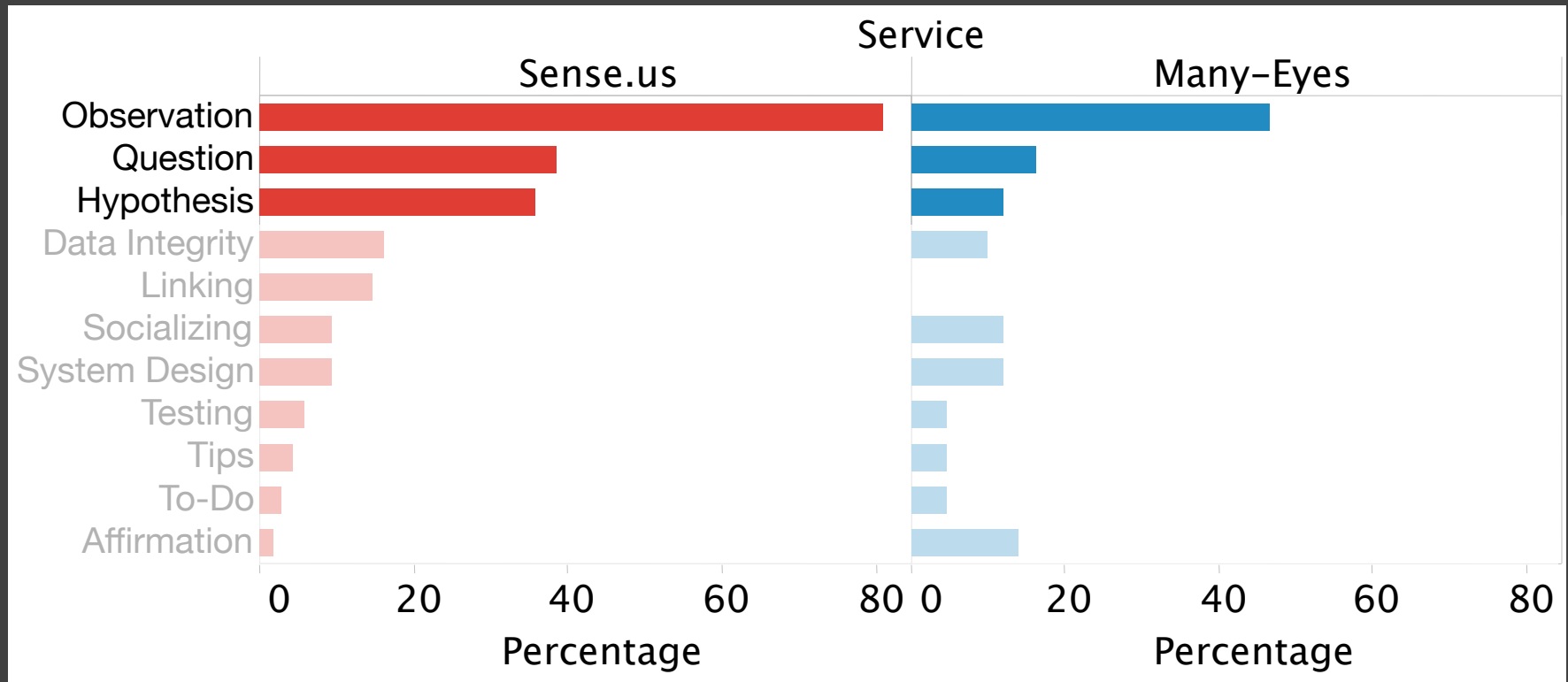
years cluster. What does this mean though that such high CO2 levels are preceding significant changes in temperature? Something, much worse is yet to come?

Posted Monday January 29 2007, 09:02 AM
see more for this content

experienced numerous times in the 4+ billion year history of the planet.

Posted Friday February 09 2007, 03:40 PM
see more for this content

Content Analysis of Comments



Feature prevalence from content analysis (min Cohen's $\kappa = .74$)
High co-occurrence of Observation, Question, and Hypothesis

Sharing in External Media

dogear Social Bookmarking for IBM

Cambridge, MA

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sense.us

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all bookmarks matching "sense.us"

1 - 10 of 66 1 2 3 4 5 OLDEST» «NEWER OLDER»

sense.us visualization
COPY | 23 Jan 2007 |

sense.us > dogear_tags dogear_tags visualization
COPY | 08 Sep 2006 | and 6 others
visualization by sense.us of dogear_tags

sense.us > social data visualization collaboration visualization
COPY | 08 Sep 2006 | and 38 others
sense.us - social data visualization
sense.us is a prototype system for collaborative visualization. - See the data. See what people have to say about it. - Dive into the data and share your explorations.

Asian-born as % of U.S. population: sense.us visualization demographics sense.us visualization
COPY | 01 Sep 2006 |
Places of birth, over time, for Asian-born respondents in U.S. census.

Art trumps science in dogear? dogear sense.us tagging visualization
COPY | 07 Sep 2006 |
From the sense.us visualization site... May be an artifact, but there are a surprisingly large number of art-related tags on dogear!

sense.us > dogear_people dogear ifvizi socialsoftware visualization
COPY | 06 Sep 2006 | and 4 others

Aak, Texans sense.us texas visualization
COPY | 07 Sep 2006 |
The Texans are taking over... texas!

sense.us > dogear_tags : sametime dogear many-eyes viz
COPY | 06 Sep 2006 | and 1 other

sense.us > birthplace :region=Asia asia many-eyes viz
COPY | 06 Sep 2006 |

African immigration africa sense.us visualization
COPY | 06 Sep 2006 |
A dramatic rise in African immigration to the U.S.

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all bookmarks matching "sense.us"

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African immigration africa sense.us visualization
COPY | 06 Sep 2006 |
A dramatic rise in African immigration to the U.S.

School & Poverty demographics sense.us visualization
COPY | 07 Sep 2006 |
College is clearly a cause of poverty, at least in the short term! sense.us

sense.us > dogear_tags atom rss tagging
COPY | 08 Sep 2006 |
atom is gaining on rss in dogear!!

Visualization of people on dogear dogear sense.us visualization
COPY | 06 Sep 2006 |
See who has been posting the most to dogear... you can even compare people side by side!

sense.us > dogear_tags : ict | sametime? ict many-eyes sametime viz
COPY | 06 Sep 2006 |

"personal" usage of dogear decreasing? dogear sense.us tags visualization
COPY | 07 Sep 2006 |
It seems like a decreasing percentage of dogear items are marked "personal." What does this mean?

Children and household size Children sense.us visualization
COPY | 07 Sep 2006 |
There's an unexpected inverse relationship between # children under five and total household size. I wonder what's going on?
children

The one shrinking state of the union sense.us us visualization
COPY | 07 Sep 2006 |
What is the one U.S. whose population is decreasing?
us map

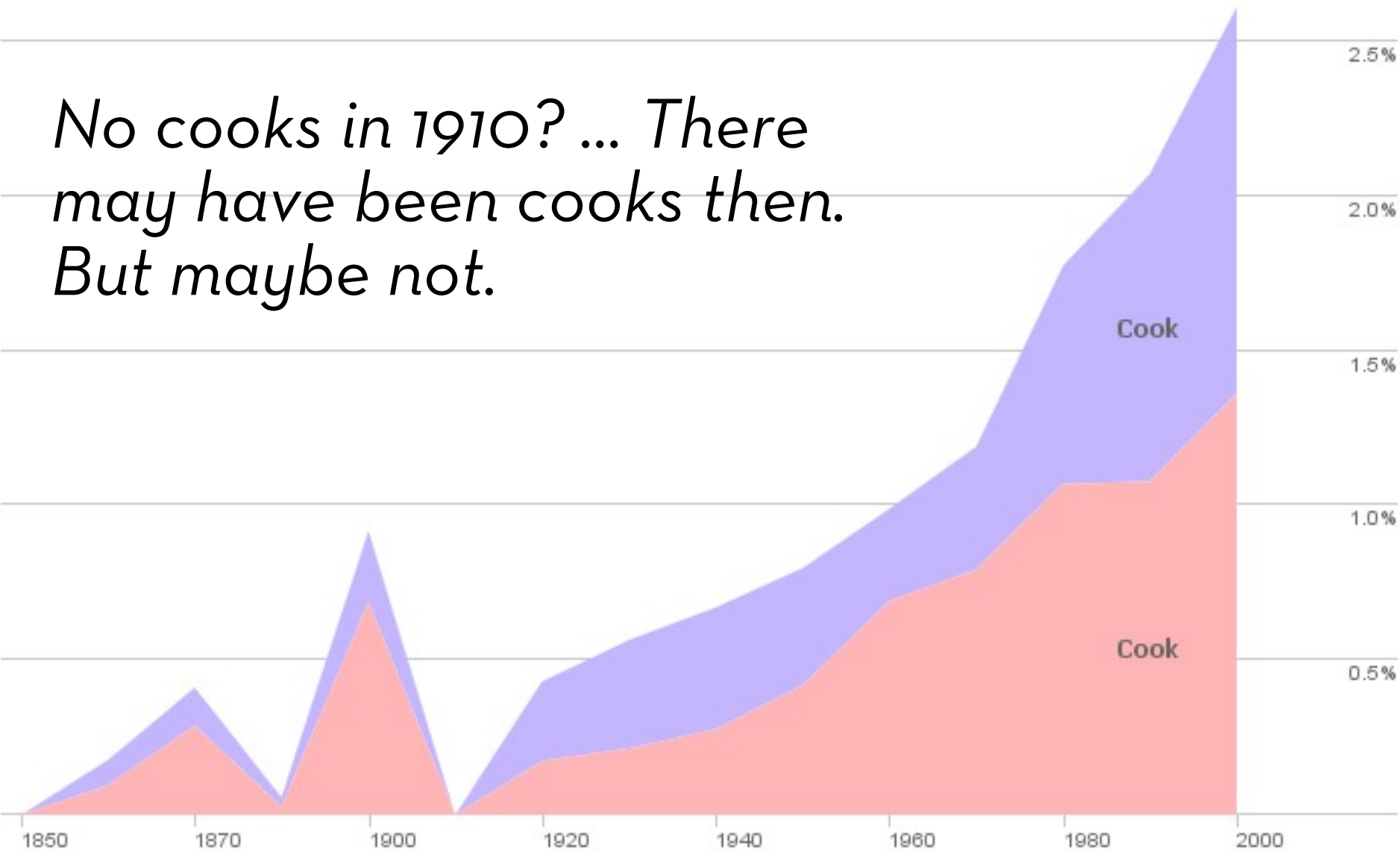
Florida was obvious, but the others? demographics sense.us visualization
COPY | 07 Sep 2006 |
Florida has a high proportion of senior citizens, sure. But some of the other extremes on the map are surprising.
senior citizen map

Data Quality

>> Cook

● all ○ men ○ women % of Work Force ▼

*No cooks in 1910? ... There
may have been cooks then.
But maybe not.*



Annotate



Stroke



Sans-Serif

14 ▼

B *I*

>> post

● all ○ men ○ women % of Work Force ▼

*The great postmaster
scourge of 1910?
Or just a bug
in the data?*

Postmaster

Postmaster

1850 1870 1900 1920 1940 1960 1980 2000

Annotate

Stroke Fill

Sans-Serif

14 B I

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Visualization
Software by **IBM**

Independents by Religious Tradition

Created by The New York Times

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Faith

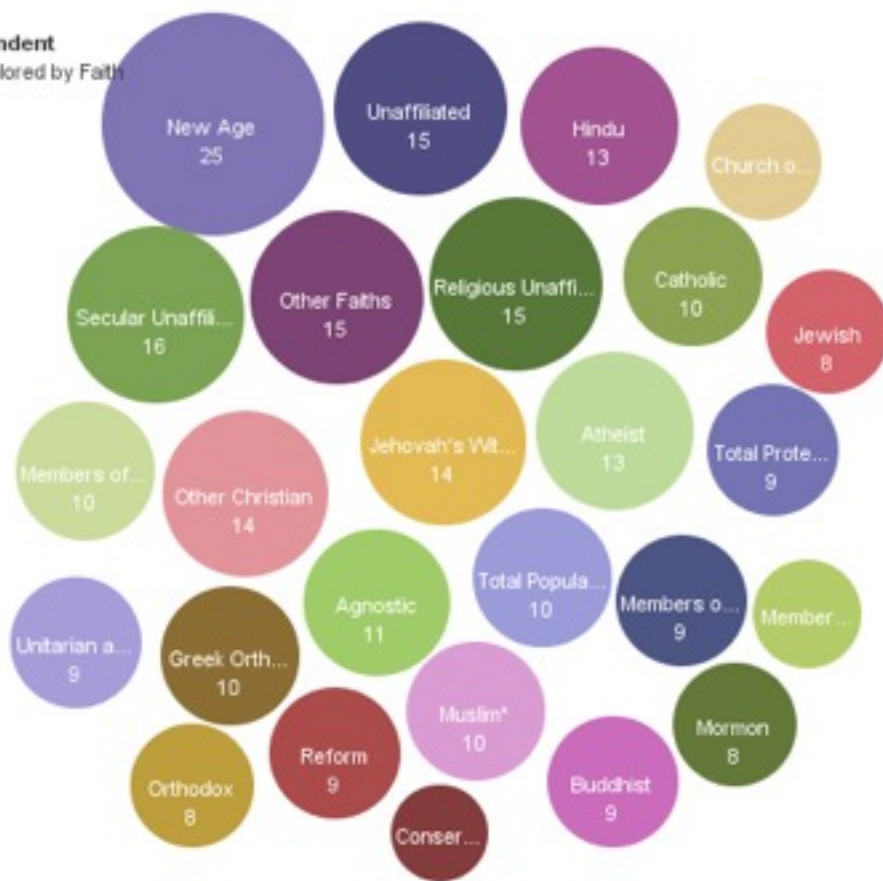
Click to select,
Ctrl-Click: multiple
Shift-Click: range

- ☐ Total Population
- ☐ Total Protestants
- ☐ Members of Evang. Prot. C
- ☐ Members of Mainline Prot. C
- ☐ Members of Hist. Black Prot
- ☐ Catholic
- ☐ Mormon
- ☐ Church of Jesus Christ of L
- ☐ Jehovah's Witness
- ☐ Orthodox
- ☐ Greek Orthodox
- ☐ Other Christian
- ☐ Jewish
- ☐ Reform
- ☐ Conservative
- ☐ Muslim*
- ☐ Buddhist
- ☐ Hindu
- ☐ Other Faiths
- ☐ Unitarian and Other Liberal

Search>>

Independent

Disks colored by Faith

To highlight or find totals
click or ctrl-click.

Bubble Size Independent

Color Faith

WORLD U.S. N.Y. REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION ARTS STYLE TRAVEL **JOB** REAL ESTATE AUTOS

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Data Sets

Topics

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Visualization Software by **IBM**

Independents by Religious Tradition > Um, I believe Church of Jesus...

Created by The New York Times

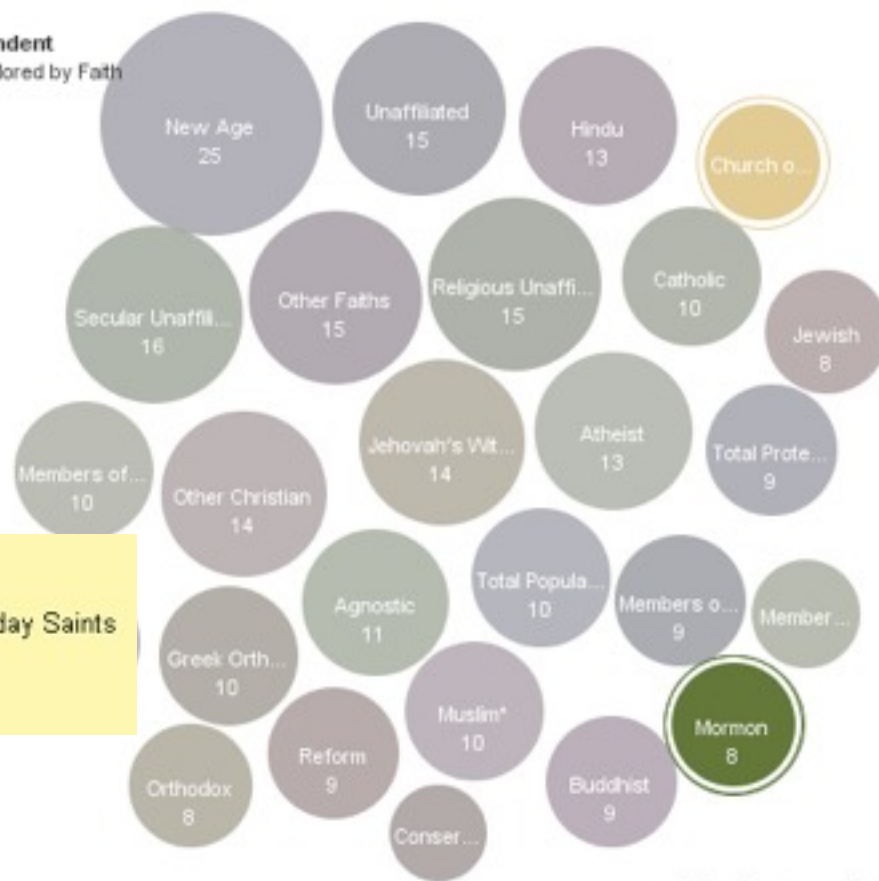
[Browse All Visualizations >](#)

Faith

Click to select,
Ctrl-Click: multiple
Shift-Click: range

- ☐ Total Population
- ☐ Total Protestants
- ☐ Members of Evang. Prot. C
- ☐ Members of Mainline Prot. C
- ☐ Members of Hist. Black Prot
- ☐ Catholic
- ☐ Mormon
- ☐ Church of Jesus Christ of L
- ☐ Jehovah's Witness
- ☐ Orthodox
- ☐ Greek Catholic

Independent
Disks colored by Faith



Anonymous says:

Um, I believe Church of Jesus Christ of Latter-day Saints
and Mormon are the same?

- ☐ Buddhist
- ☐ Hindu
- ☐ Other Faiths
- ☐ Unitarian and Other Liberal

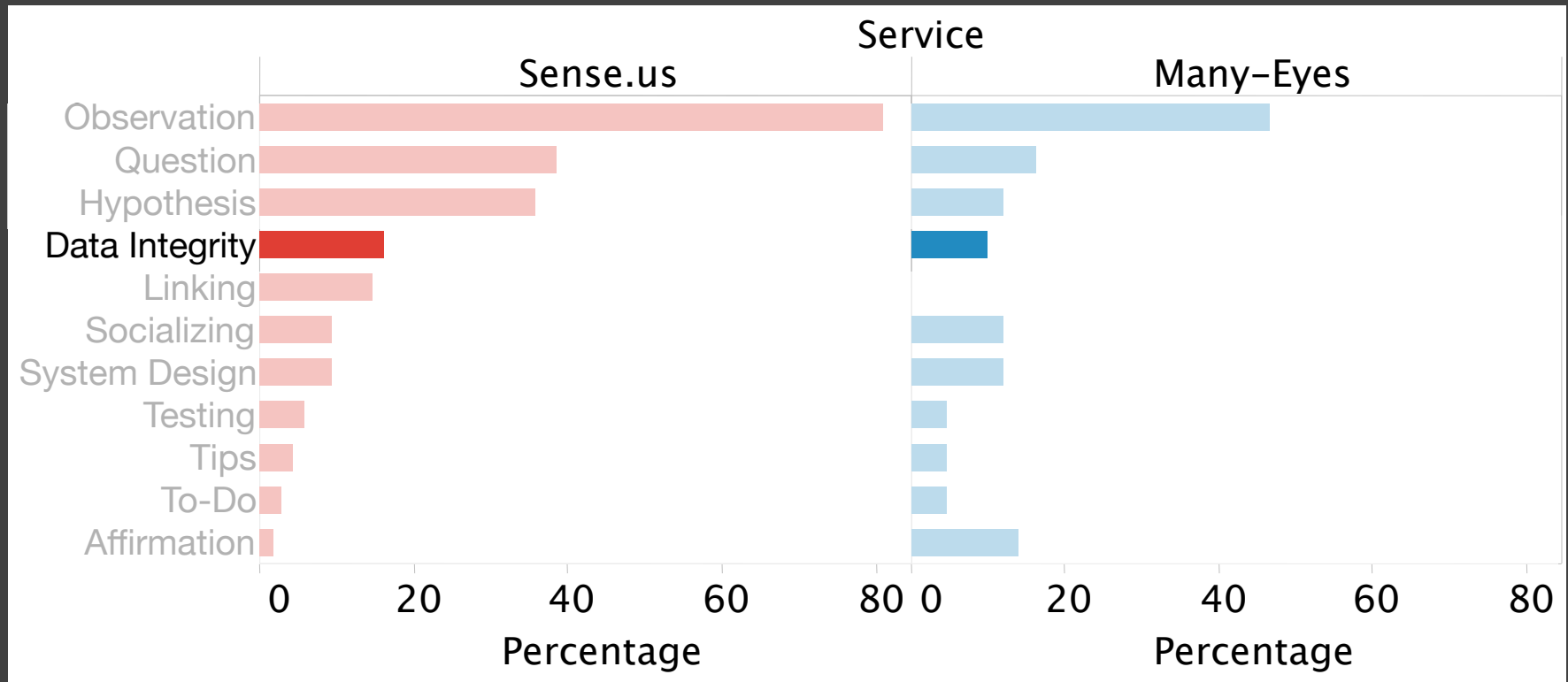
Search>>

Highlighted: 1 item and 2 categories
total: 15 = 5%

Bubble Size Independent

Color Faith

Content Analysis of Comments

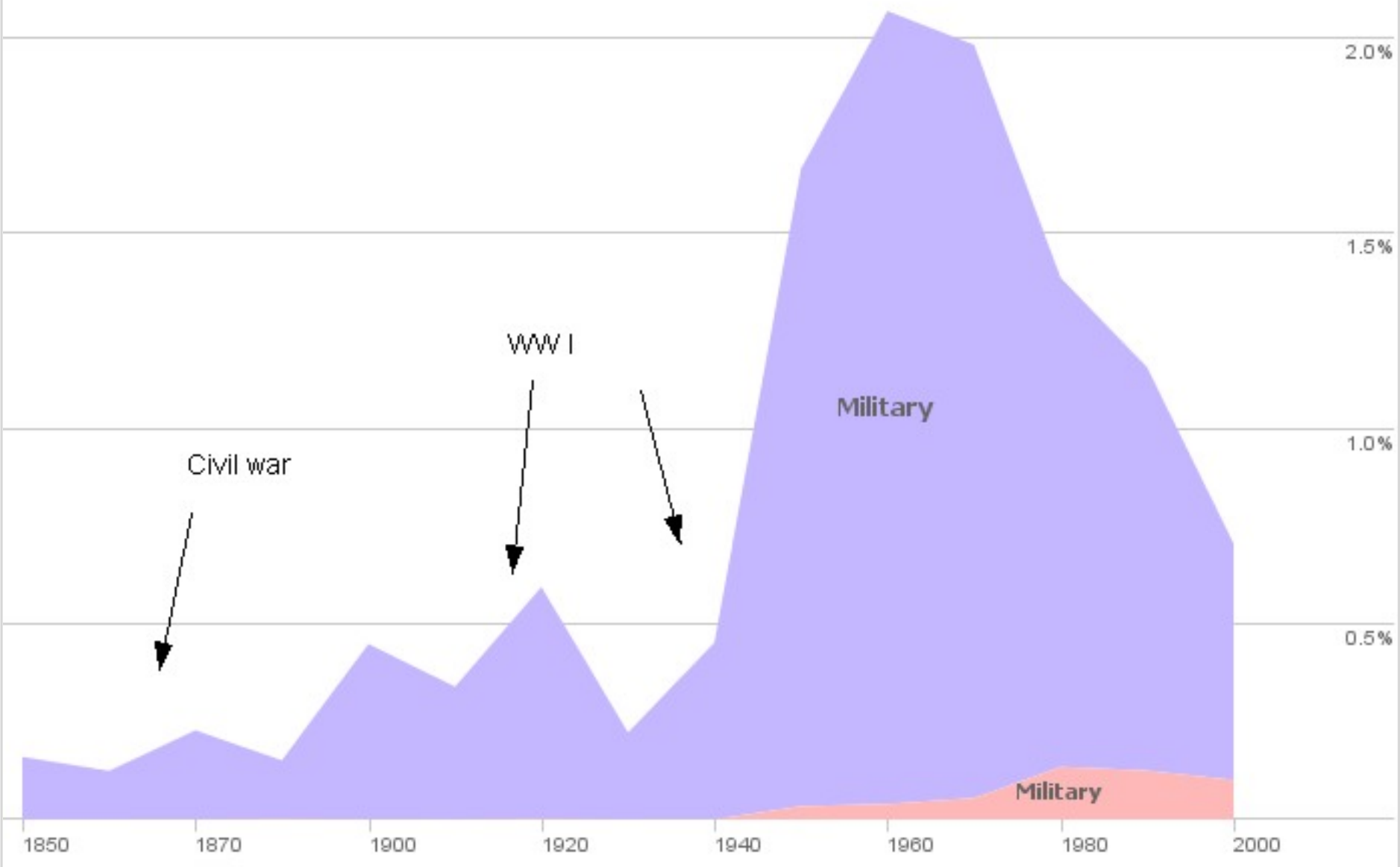


16% of sense.us comments and **10%** of Many-Eyes comments reference *data integrity* issues.

Data Integration in Context

>> mili

● all ● men ● women % of Work Force ▼



Heroin vs. Cocaine vs. MDMA (Ecstasy) vs. Crystal Meth.



By [quest](#) on Dec 19, 2006
Viewed 20481 times

Graph

Table

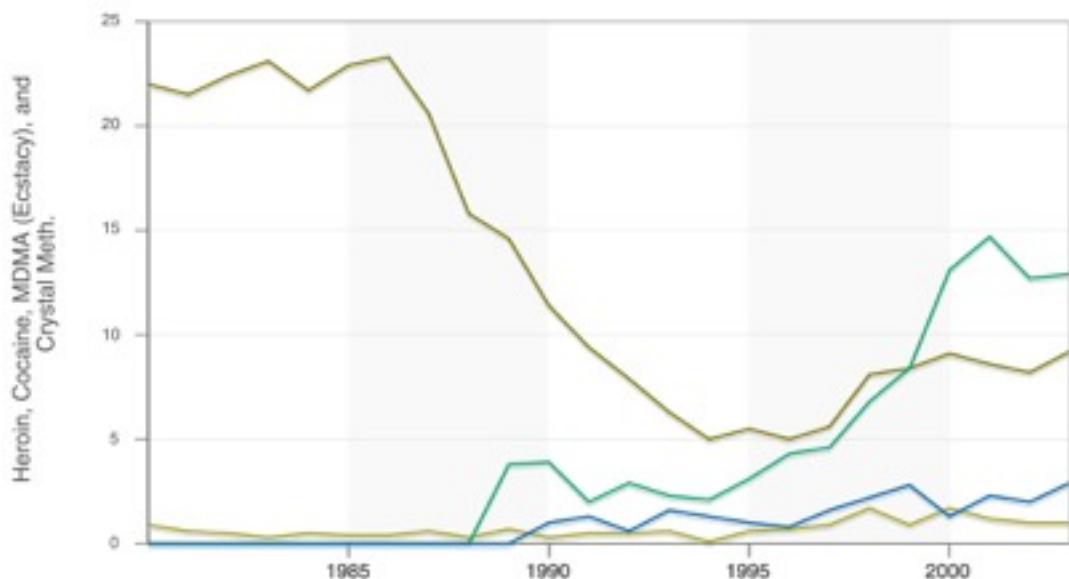
Map

Absolute **Relative**

All 23y 17y 8y



More Options



Bling



Compare

Sources: University of Michigan

Comments (1 - 20 of 32)



<script src='http:' />jonny12</script> says
jonny15
posted about 1 year ago



Anonymous says
Where's the pot?

Share this Graph



Send an Email



Post to Blog

Digg

submit

Rate It



3 ratings

Swivel Business

Have you tried [Swivel Business](#)?

Legend



[College Student Drug Use](#)



[MDMA \(Ecstasy\)](#)



[Cocaine](#)



[Heroin](#)



[Crystal Meth.](#)

More >

Tags

no tags yet

Community Tags

[Add tags](#)

no tags yet

Correlations

[See all](#)



81% [MDMA \(Ecstasy\)](#) and [Crystal Meth.](#)

Related Graphs

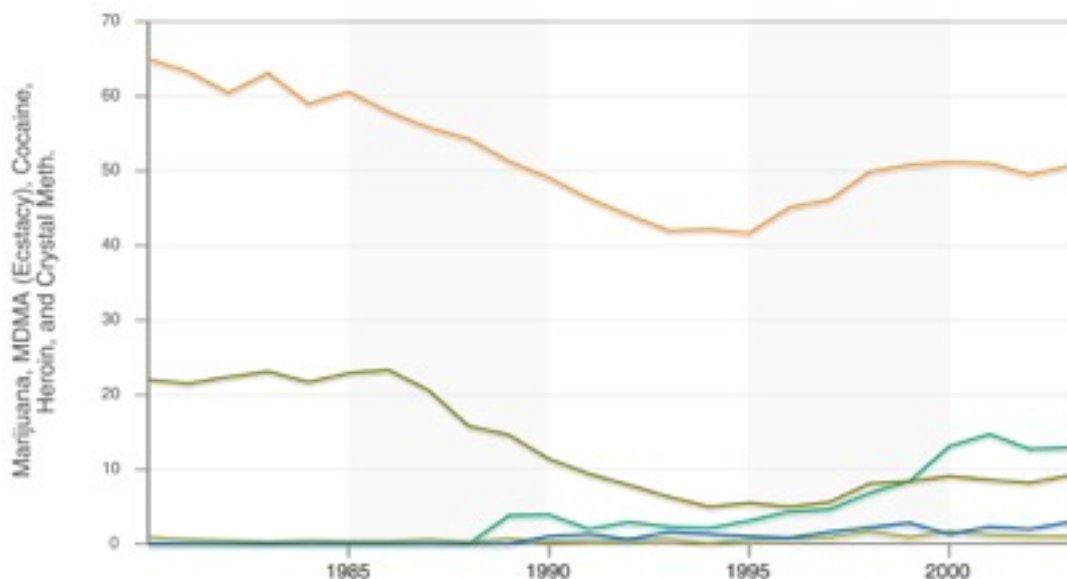


[Heroin vs. Cocaine vs. MDMA \(Ecstasy\) vs. Crystal Meth. vs. Heroin vs. Cocaine vs. MDMA \(Ecstasy\) vs. Crystal Meth. vs. Cocaine, NASDAQ Adjusted Close, and Dow Jones Industrial Average Adjusted Close](#)

Marijuana vs. Heroin vs. Cocaine vs. MDMA (Ecstasy) vs. Crystal Meth.

By [quest](#) on Mar 12, 2007
Viewed 25401 times

Graph Table Map Absolute Relative All 23y 17y 8y **>** More Options



Bling Compare

Sources: University of Michigan

Comments (17)



[visnu](#) says
pot pot pot pot
weed weed weed weed
posted about 1 year ago



MARTY says

Share this Graph

Send an Email

Post to Blog

Digg

Rate It

0 ratings

Swivel Business

Have you tried [Swivel Business](#)?

Legend

[College Student Drug Use](#)

- [Marijuana](#)
- [MDMA \(Ecstasy\)](#)
- [Cocaine](#)
- [Heroin](#)
- [Crystal Meth.](#)

[More >](#)

Tags

no tags yet

Community Tags

[Add tags](#)

no tags yet

Correlations

[See all](#)

93% [Marijuana](#) and [Cocaine](#)

Related Graphs



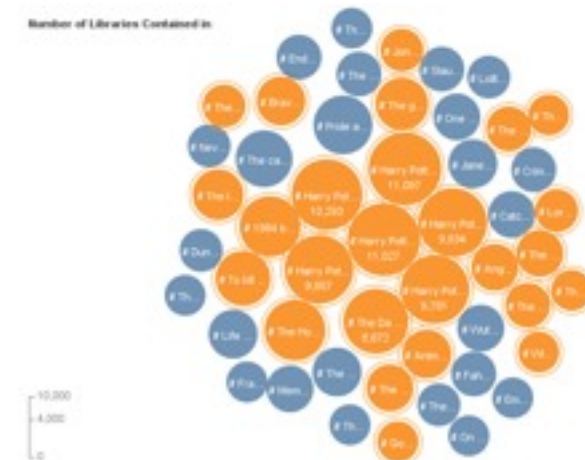
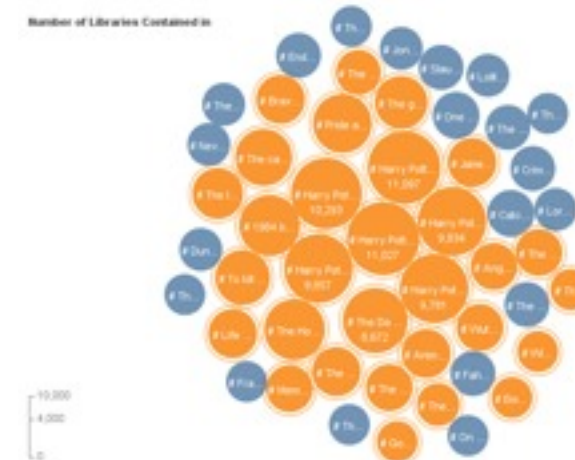
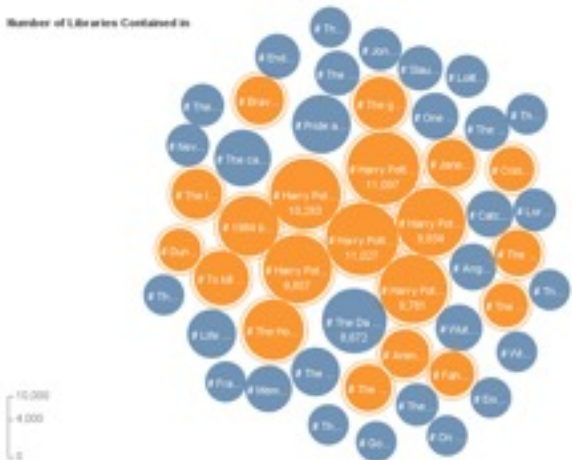
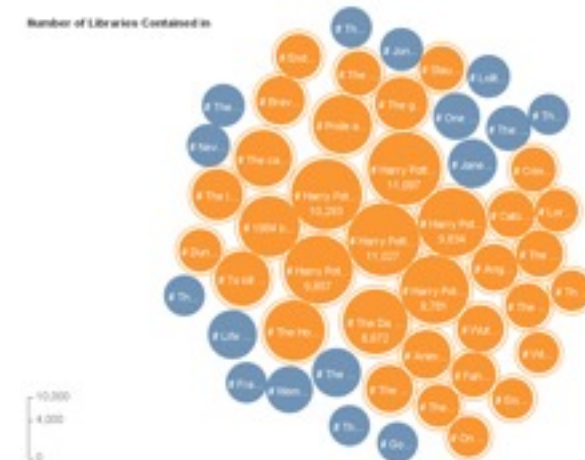
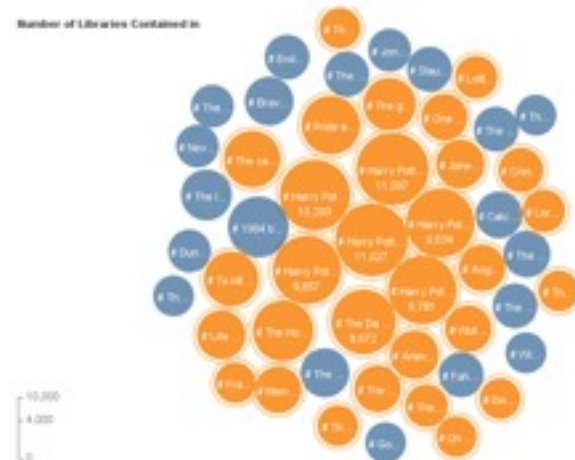
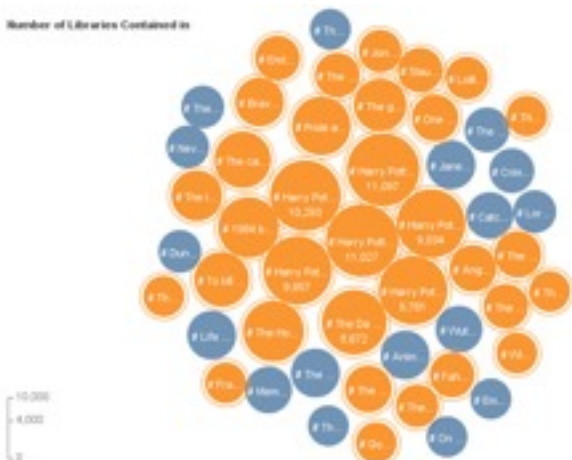
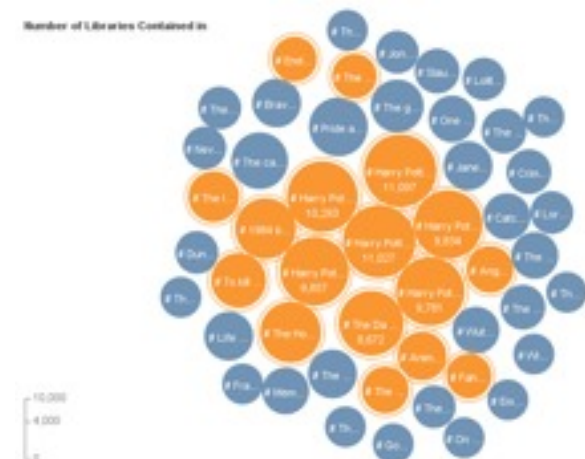
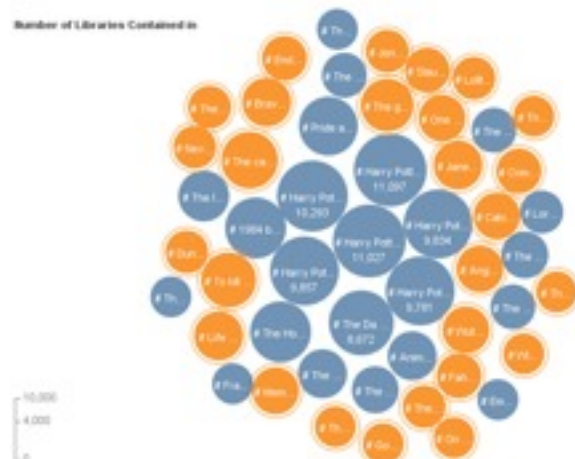
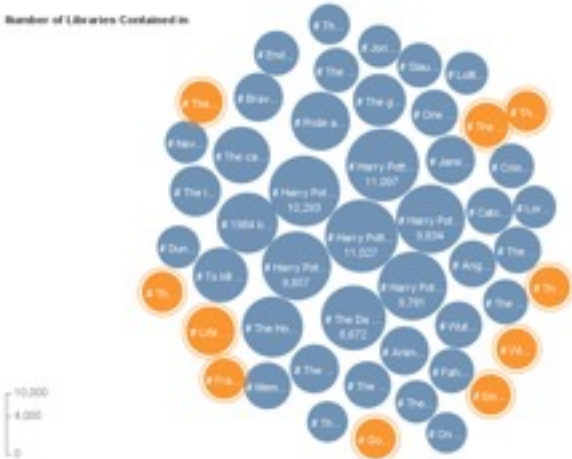
[Heroin vs. Cocaine vs. MDMA \(Ecstasy\) vs. Crystal Meth. vs. Heroin vs. Cocaine vs. MDMA \(Ecstasy\) vs. Crystal Meth. vs. Cocaine, NASDAQ Adjusted Close, and Dow](#)

Creator: Alison
Tags:

Tags:

[illegible]

Search>>



What factors enable
viable collaborations?

How might we design
systems to facilitate
social data analysis?

Administrivia

Final Project

Poster Presentations

Session is Thu Mar 13 5-8pm in CSE Atrium
Bring **Poster + Laptop/Device** for demos
Arrive early to setup!

Post Webpage on GitHub Pages

List team members, title, abstract, link to paper
Include summary image for project!

Final Project Reports

Due Thu Mar 20, by 7am, posted to GitHub
4-6 pages in ACM or IEEE TVCG format

Design Considerations for Collaborative Analysis

Modules of Contribution

Data Management

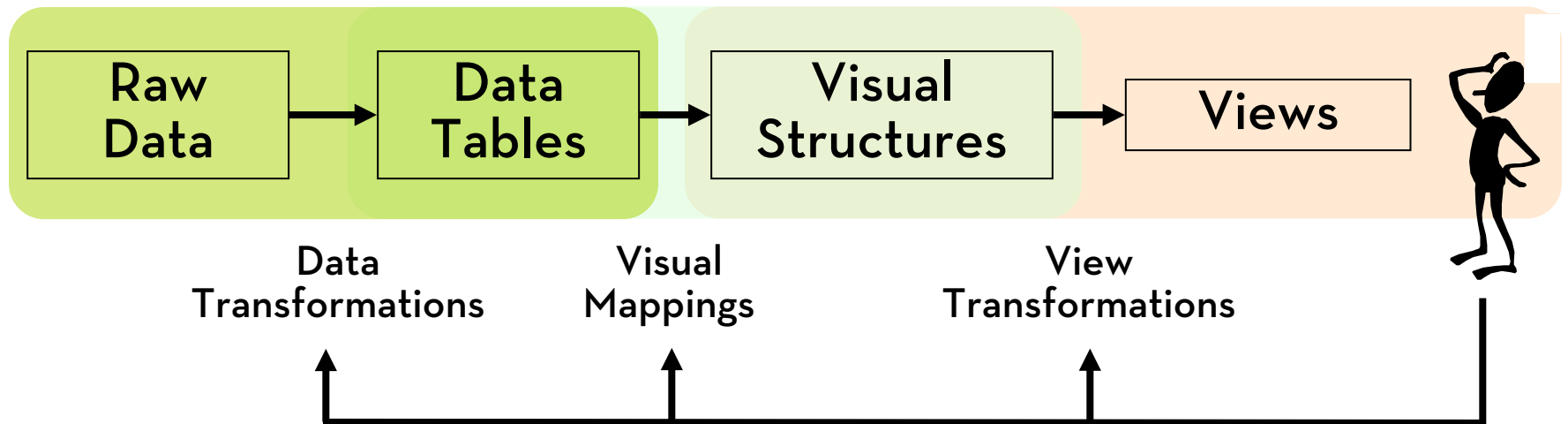
- Contribute Data
- Clean Data
- Categorize Data
- Moderate Data
- Create Metadata

Visualization

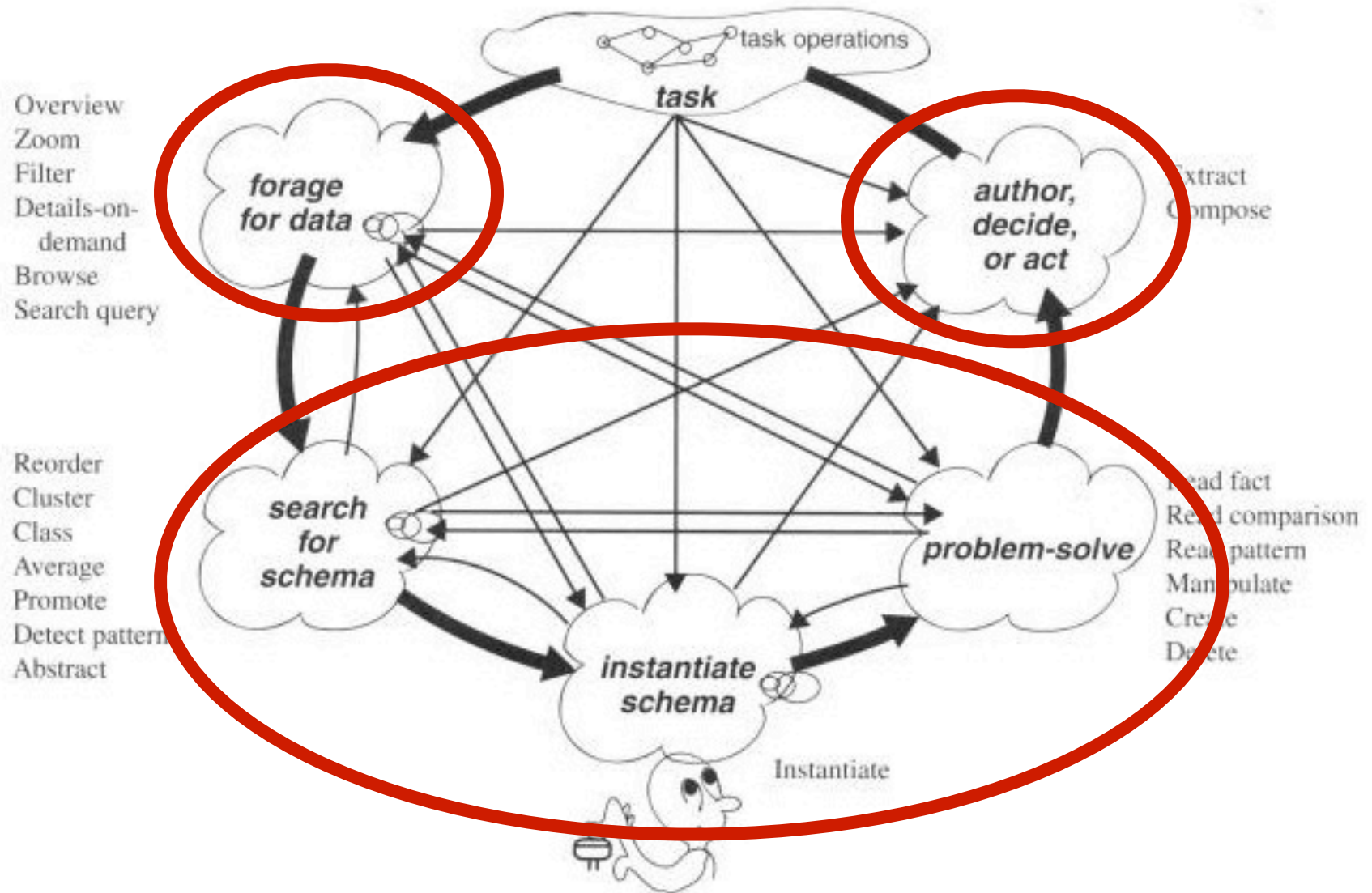
- Select Data Sources
- Apply Visual Encoding
- Author Software

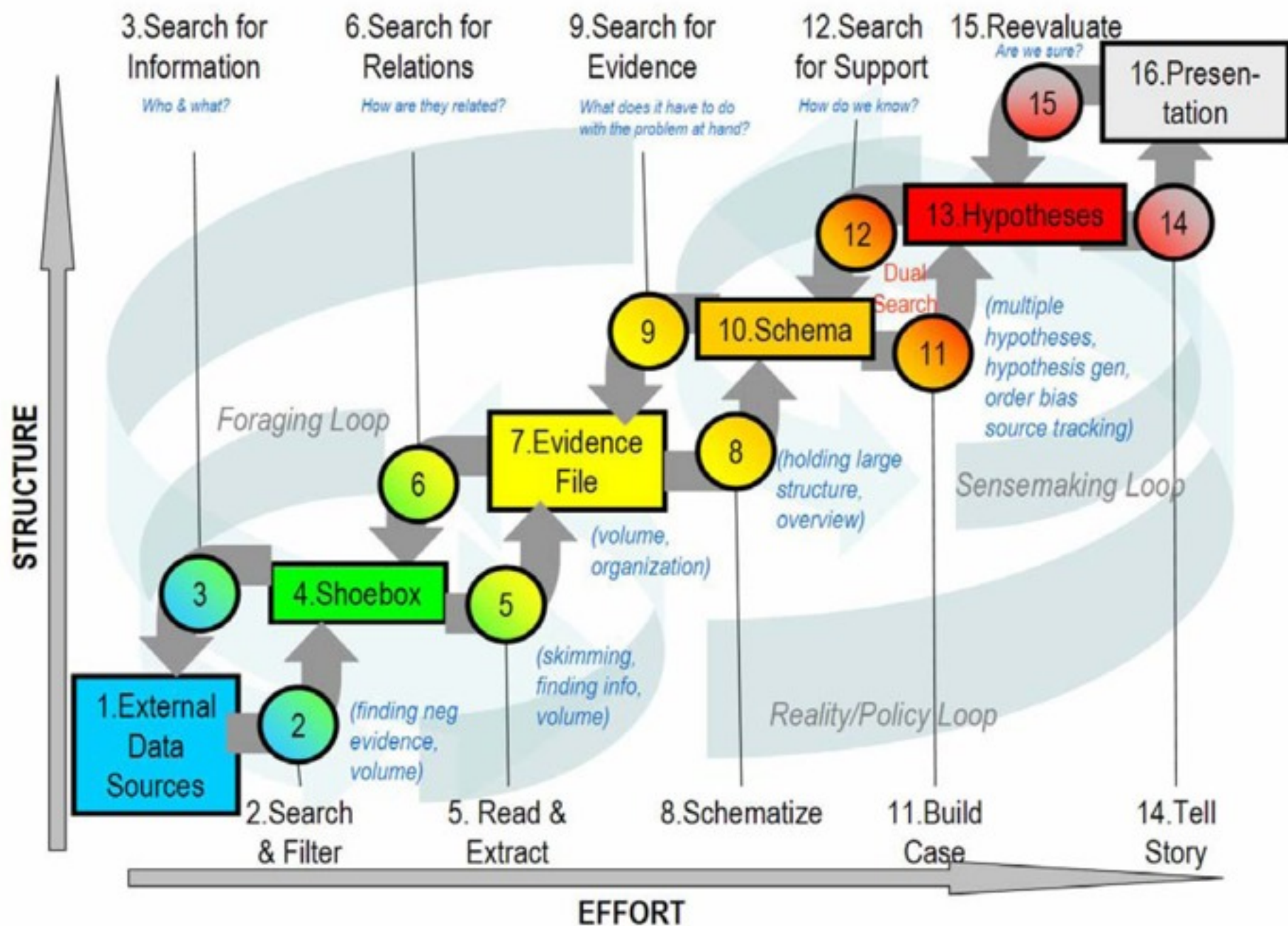
Visual Analytics

- Observations
- Hypotheses
- Evidence (+/-)
- Summarize
- Report / Presentation



Sensemaking





Design Considerations [VAST 07, IVS 08]

Division, allocation, and integration of work

Common ground and awareness

Reference and deixis (pointing)

Identity, trust, and reputation

Group formation and management

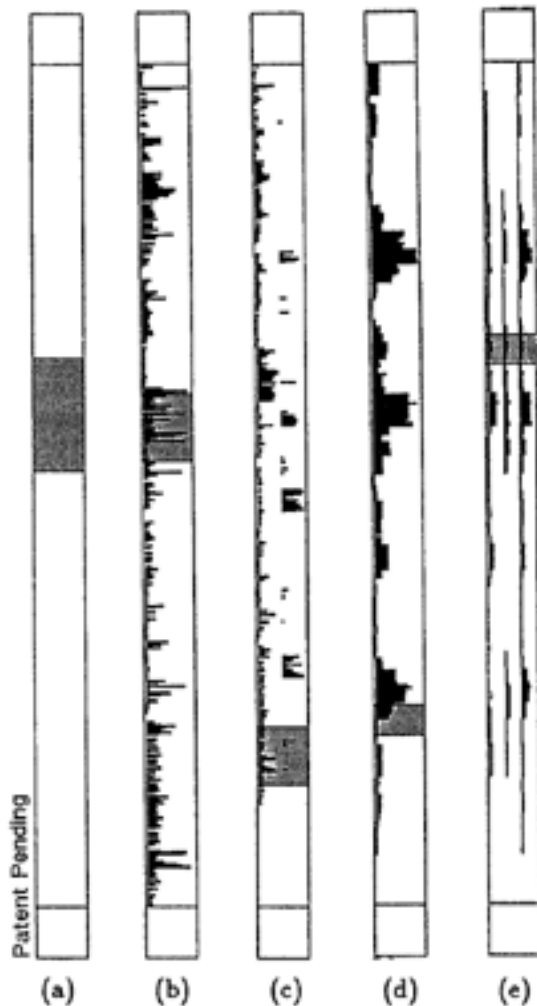
Incentives and engagement

Presentation and decision-making

Social Data Analysis

How can users' **activity traces** be used to improve awareness in collaborative analysis?

Social Navigation



Read & Edit Wear, Hill et al 1992

del.icio.us / jheer /

your bookmarks | your network | subscriptions | links for you | post

All your items (189)

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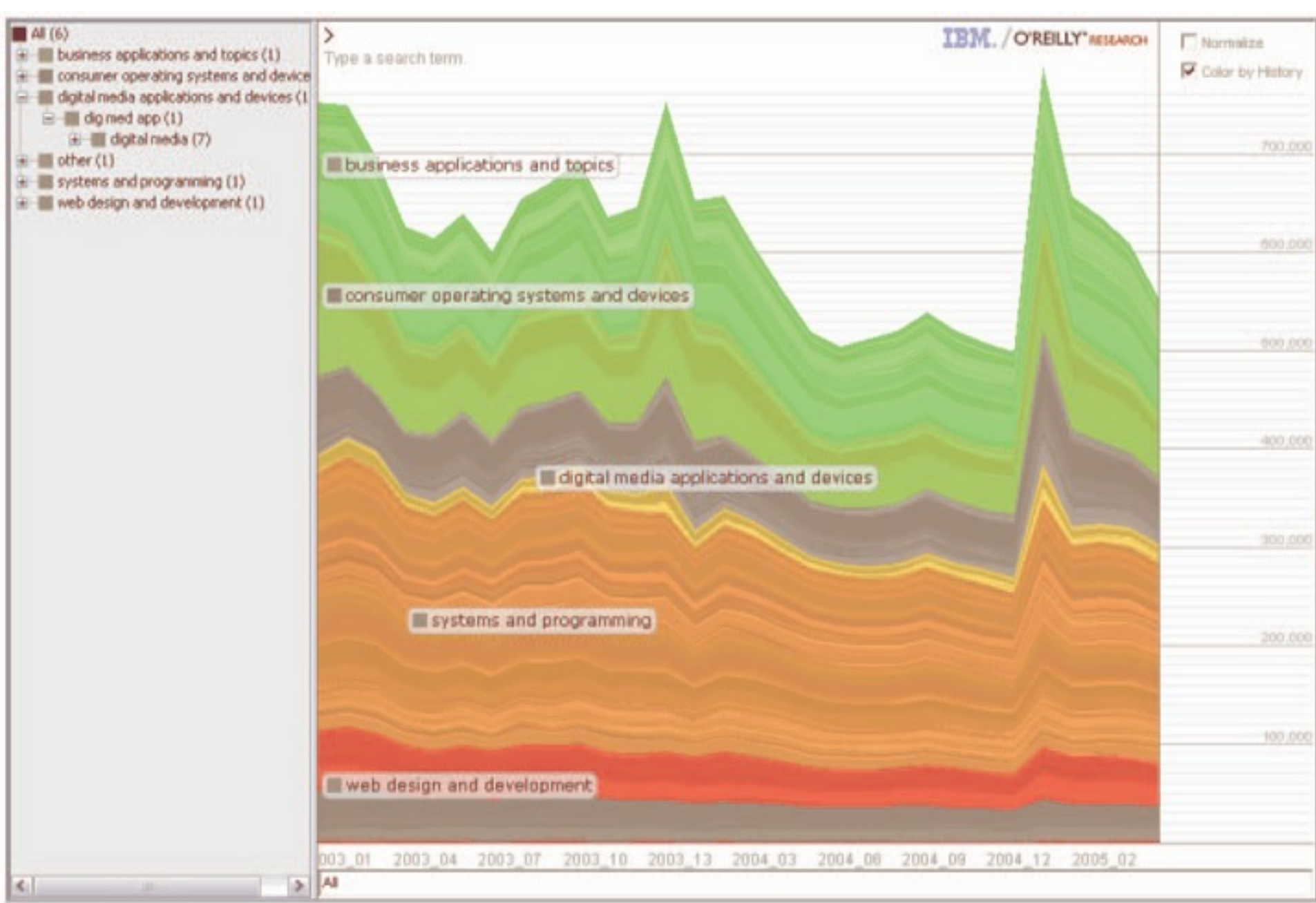
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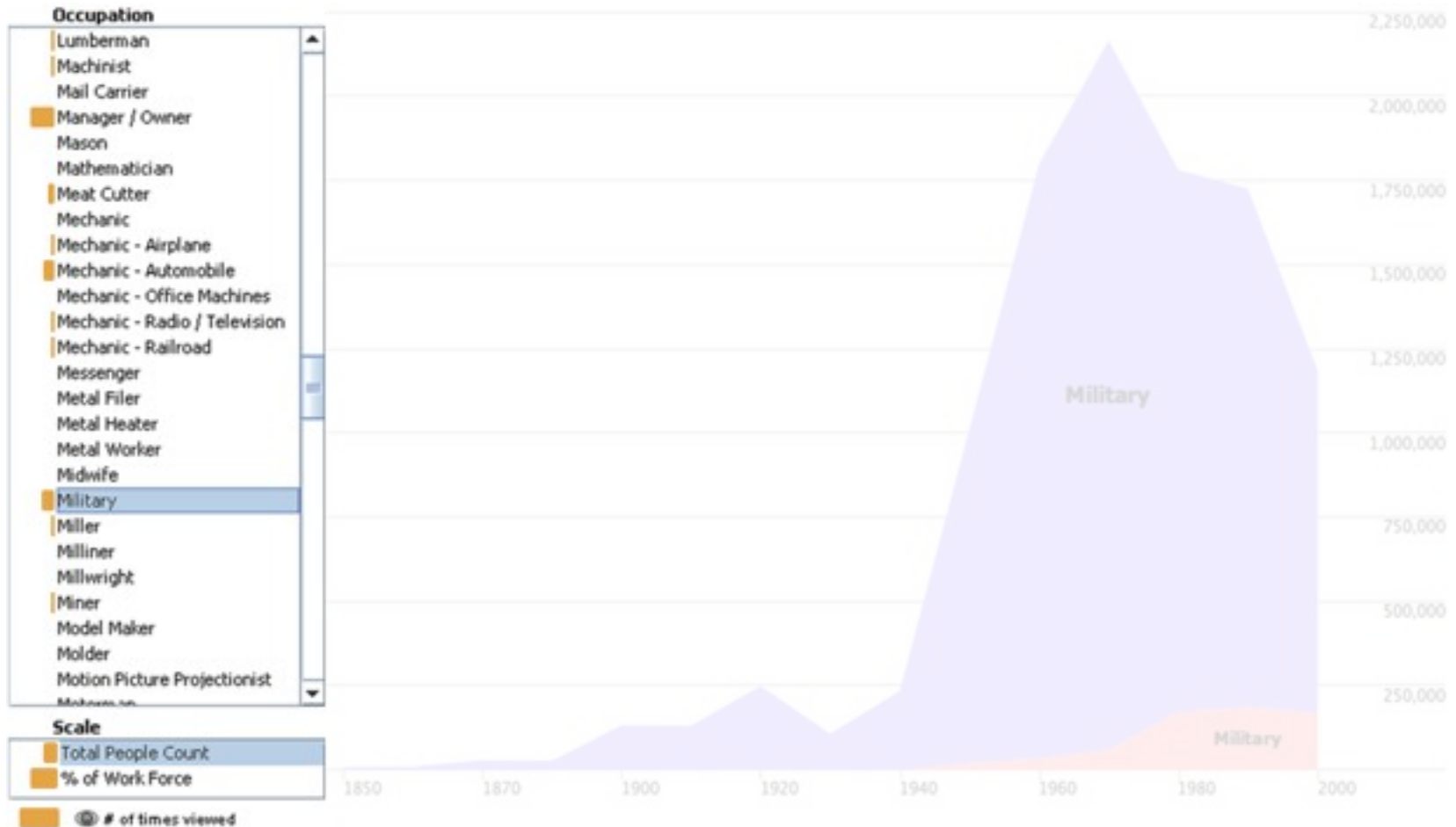
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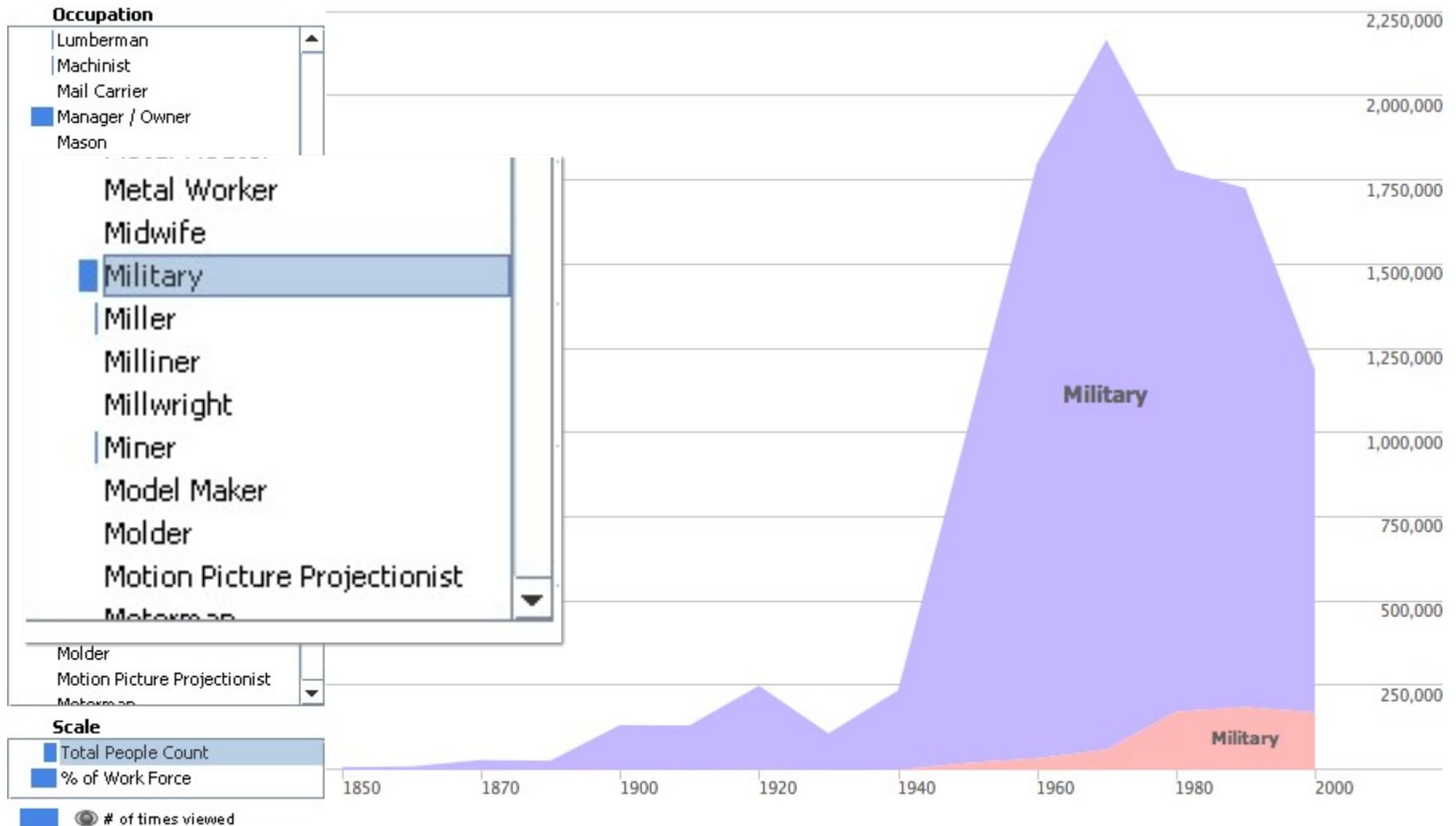
Wattenberg & Kriss - Color by history: gray regions have already been visited

Scented Widgets [InfoVis 07]

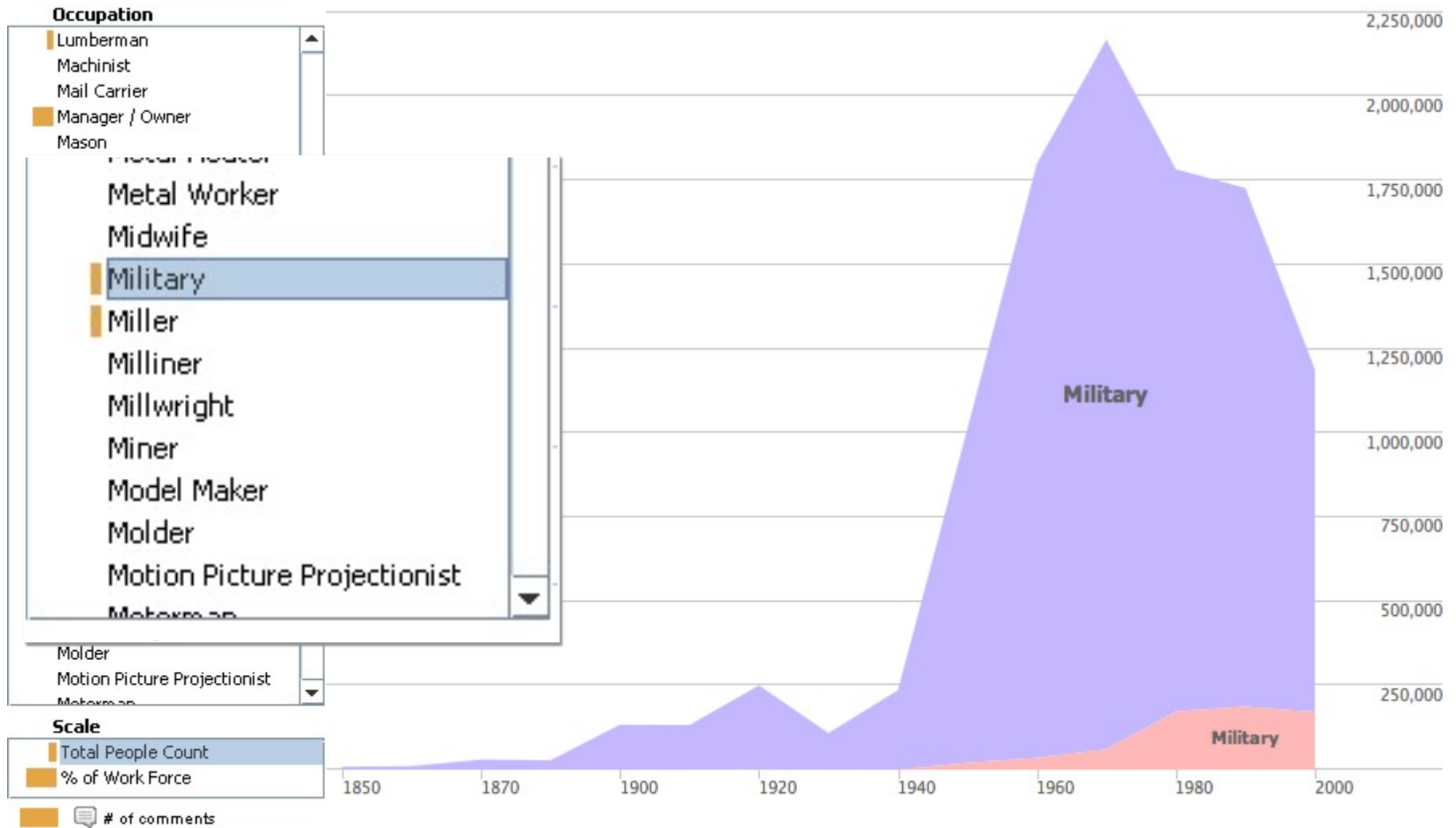


Visual navigation cues embedded in interface widgets

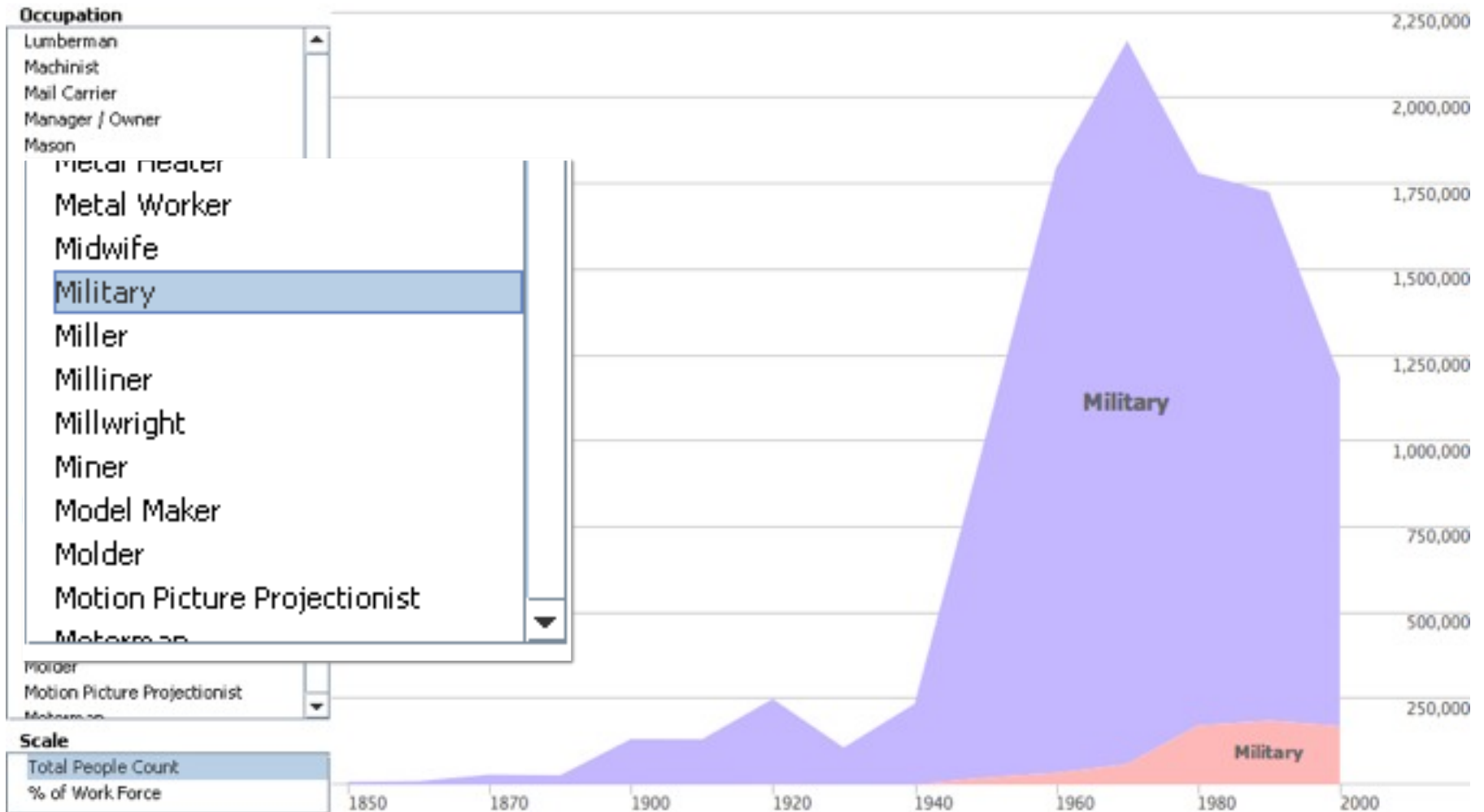
Visitation counts



Comment counts



No scent (baseline)



Do activity cues affect usage?

Hypotheses: With activity cues, subjects will

1. Exhibit more revisitation of popular views
2. Make more unique observations

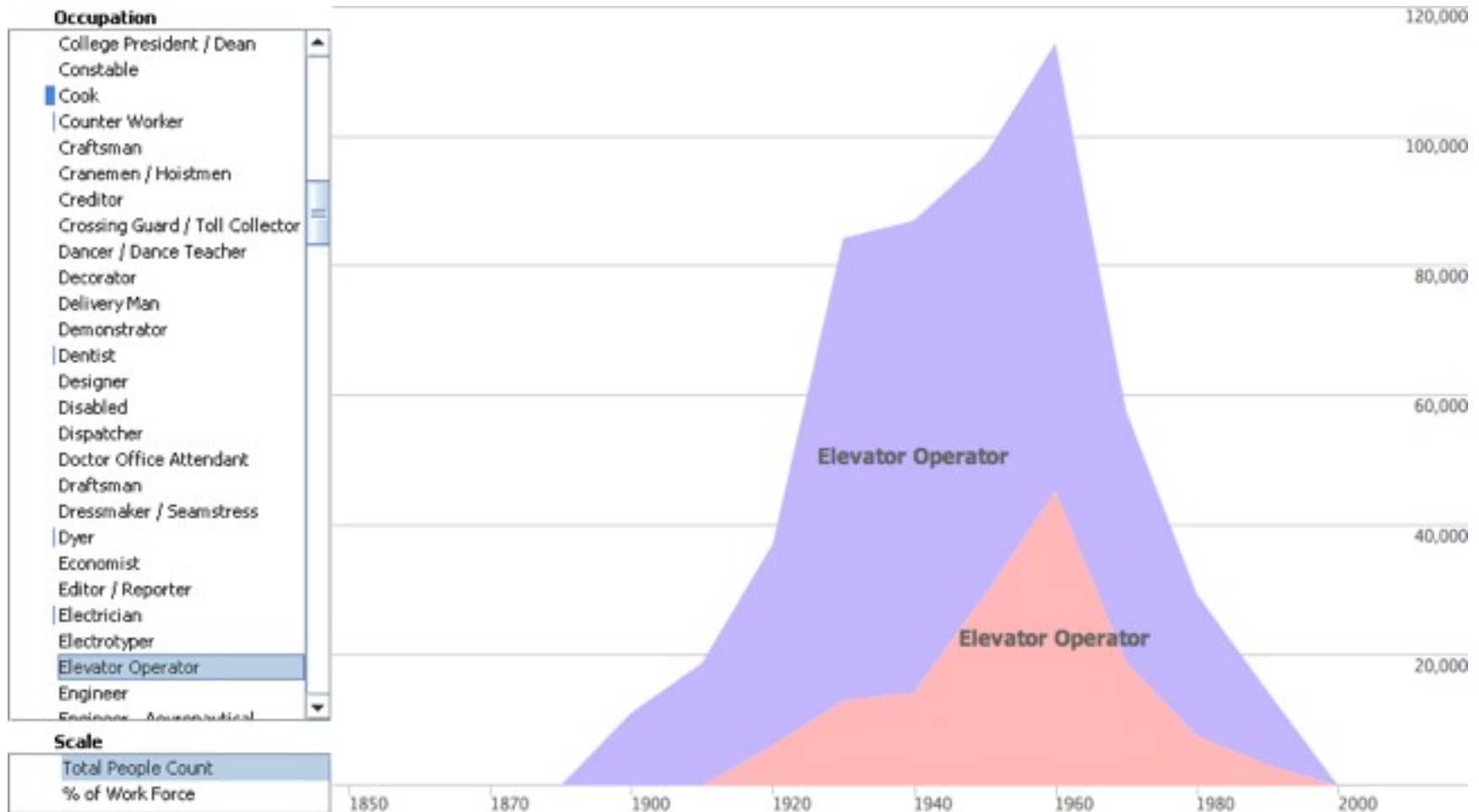
Controlled experiment with 28 subjects

Collect evidence for and against an assertion

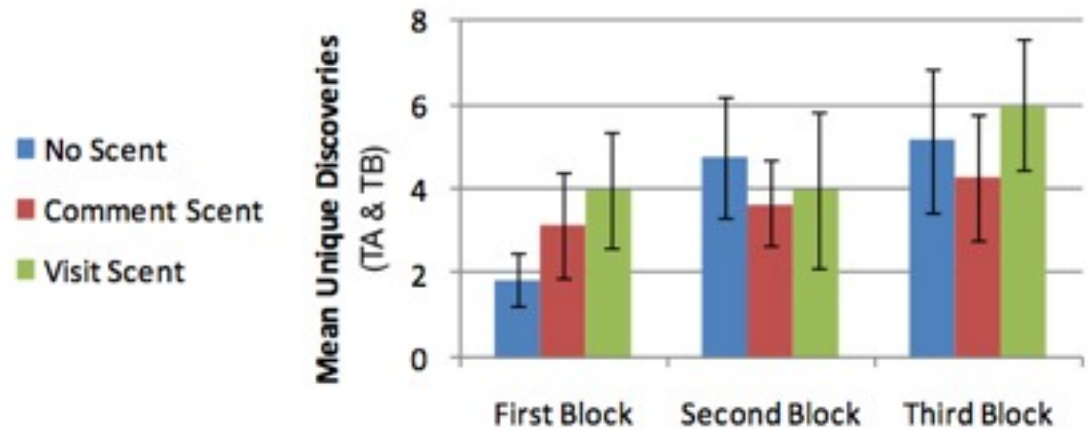
Varied scent cues (3) and foraging task (3)

Activity metrics collected from sense.us study

“Technology is costing jobs by making occupations obsolete.”



Results



Unique Discoveries

Visit scent had sig. higher rate of discoveries in first block. Less reliance on scent when subjects were familiar with data and visualization.

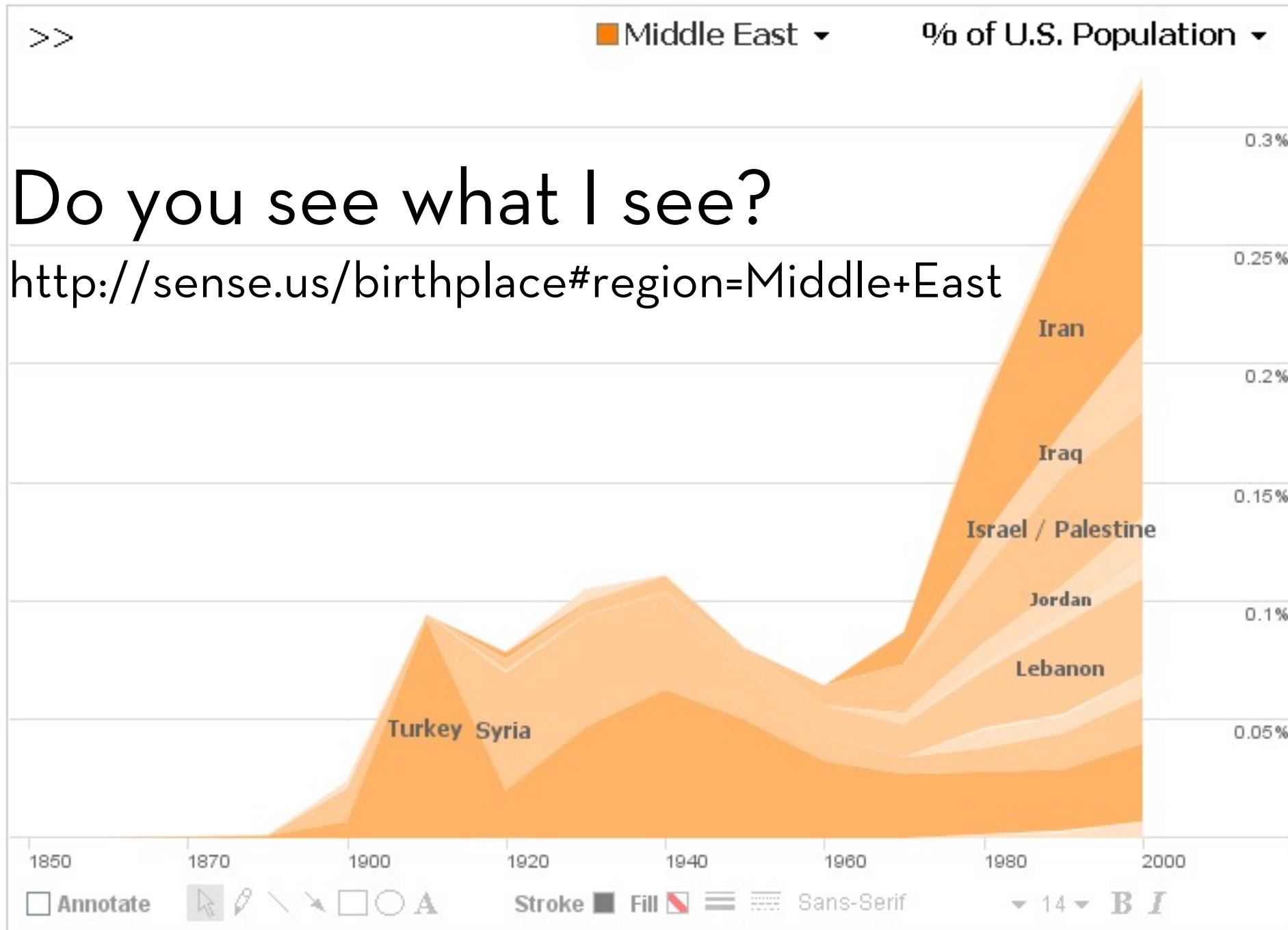
Revisitation

Visit and comment scent conditions correlate more highly with seed usage than no scent.

Social Data Analysis

How can users' **activity traces** be used to improve collaborative analysis?

How should **annotation techniques** be designed to provide nuanced pointing behaviors?



Common Ground

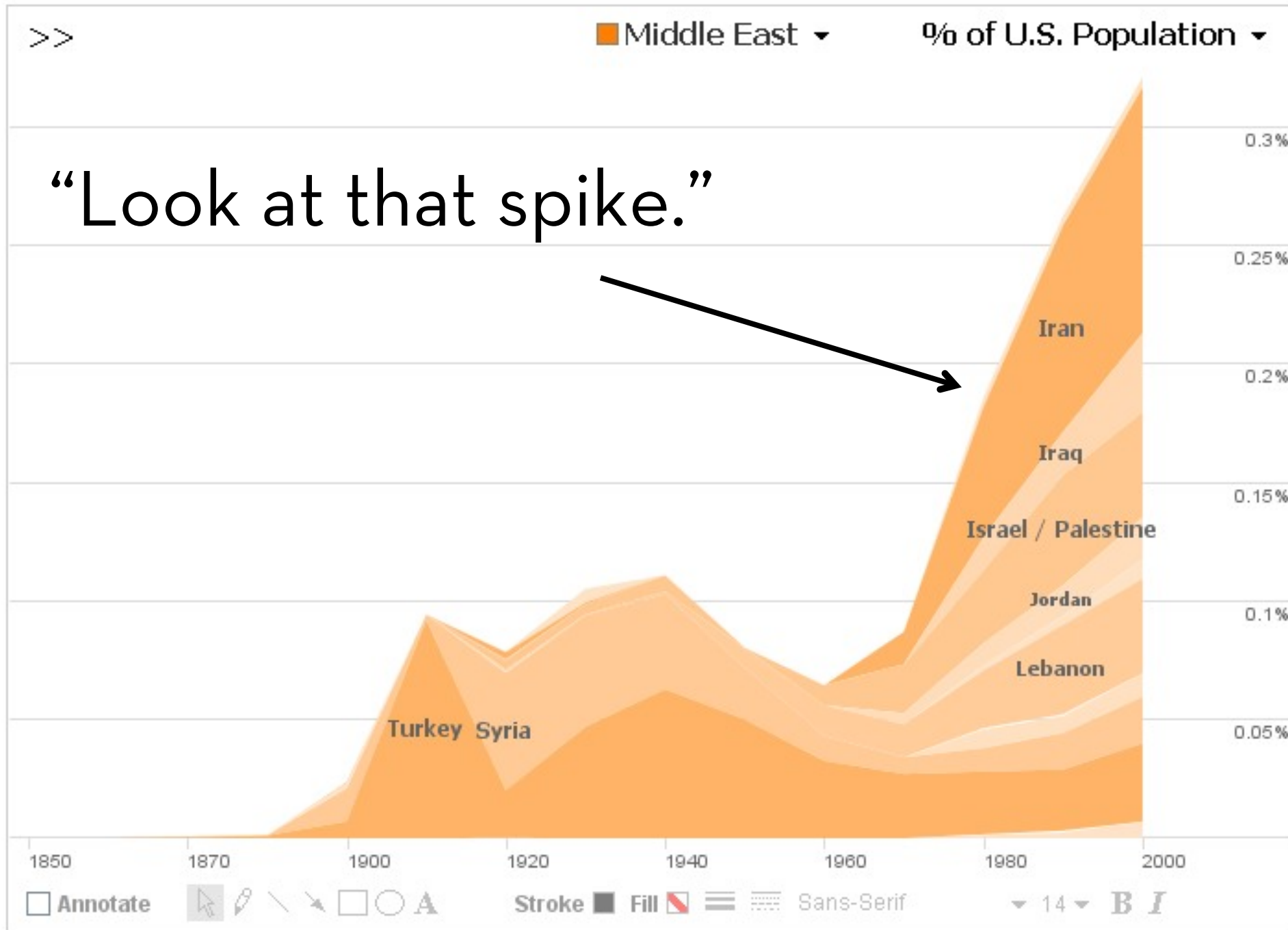
Common Ground: the shared understanding enabling conversation and collaborative action [Clark & Brennan '91]

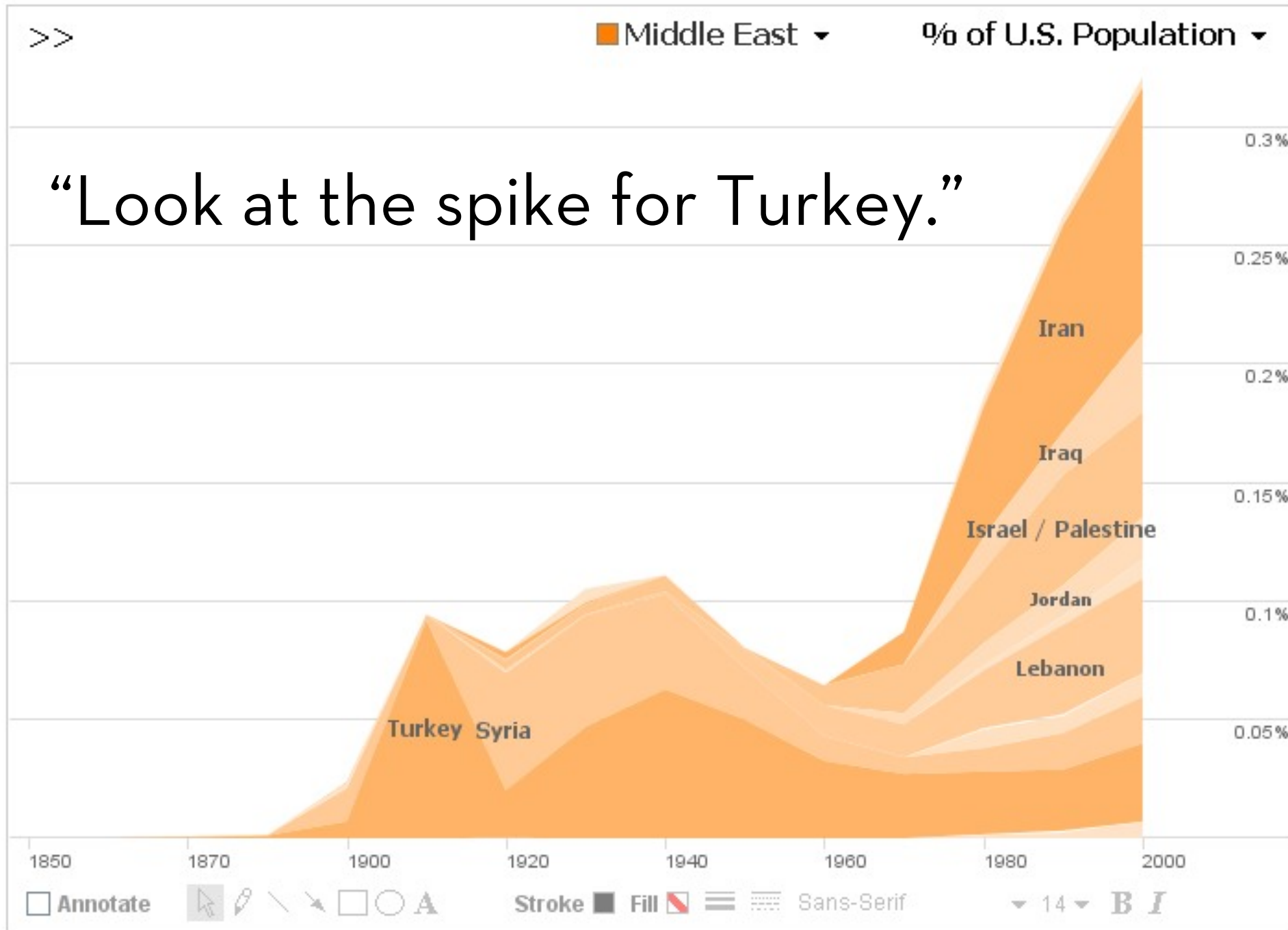
Do you see what I see? → View sharing (URLs)

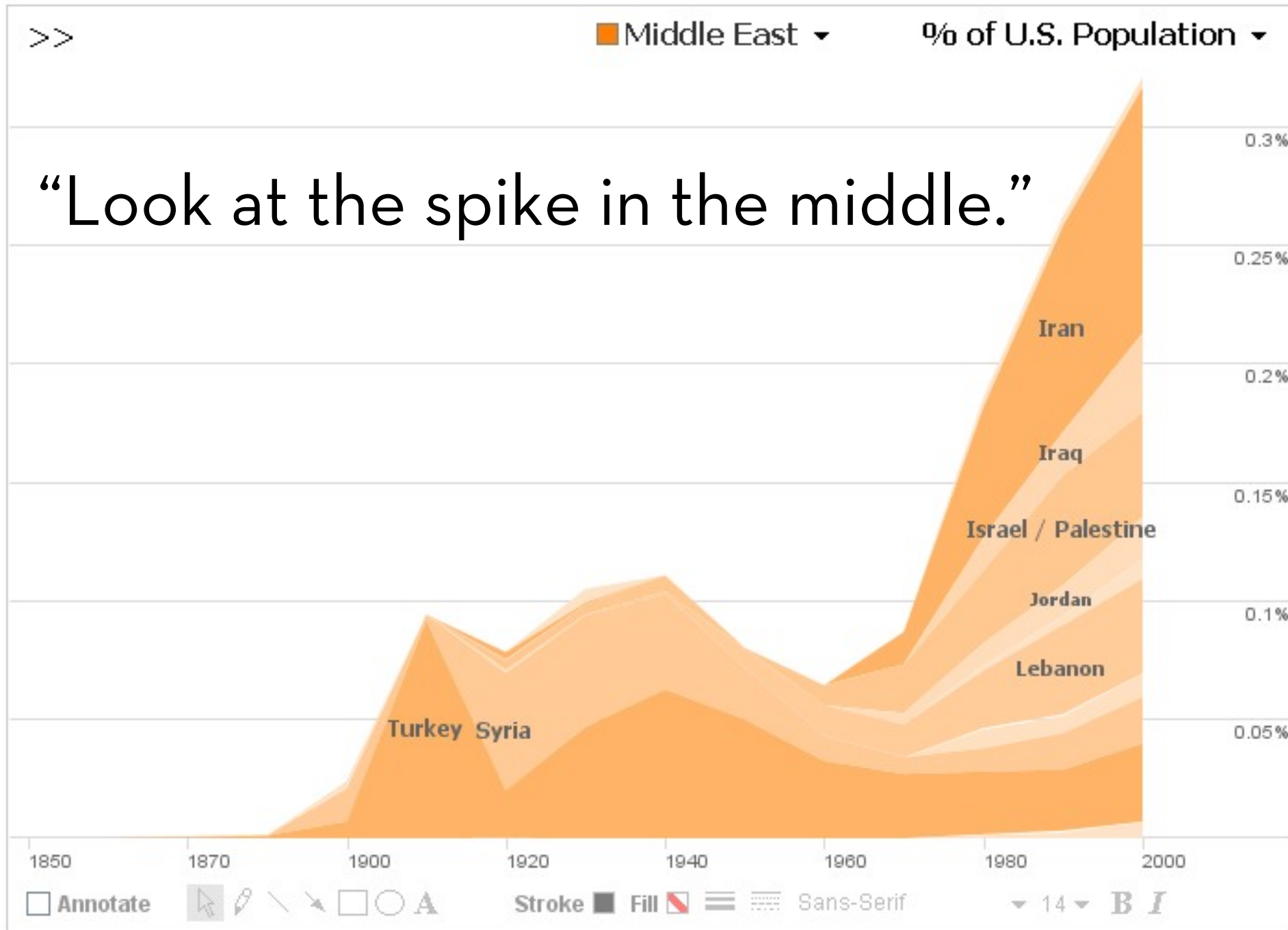
How do collaboration models affect grounding?
Linked discussions vs. embedded comments vs. ...

Principle of Least Collaborative Effort: participants exert *just enough* effort to successfully communicate.

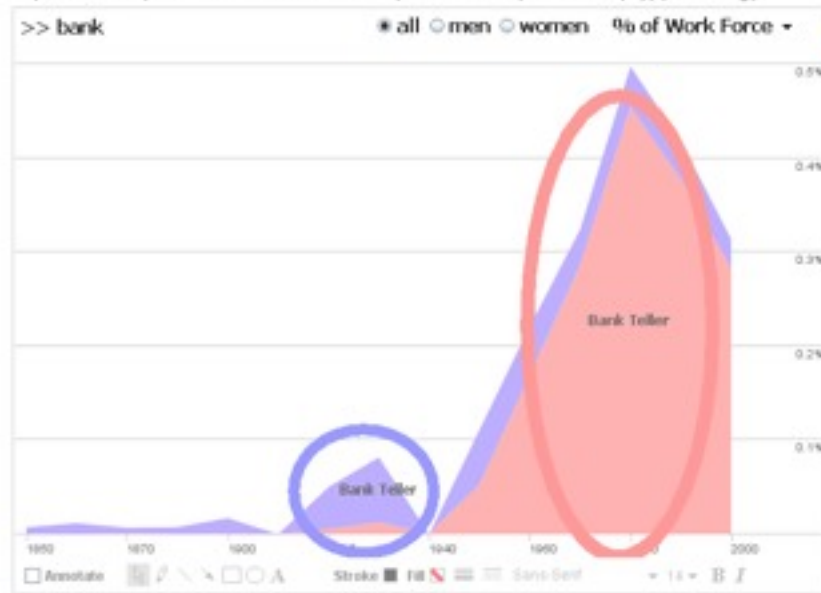
[Clark & Wilkes-Gibbs '86]







Reported Occupations of U.S. Labor Force, 1850-2000 (source: <http://ipums.org>)

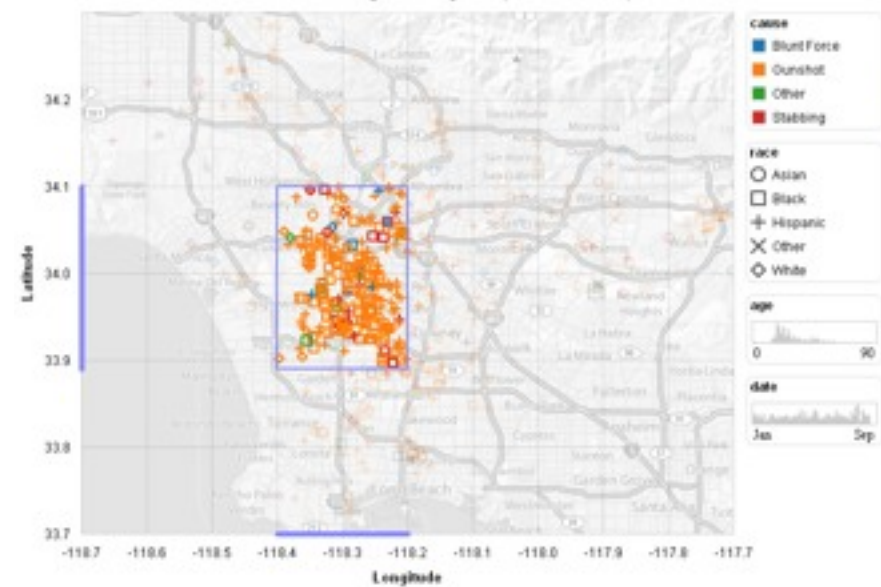


Reported Occupations of U.S. Labor Force, 1850-2000 (source: <http://ipums.org>)

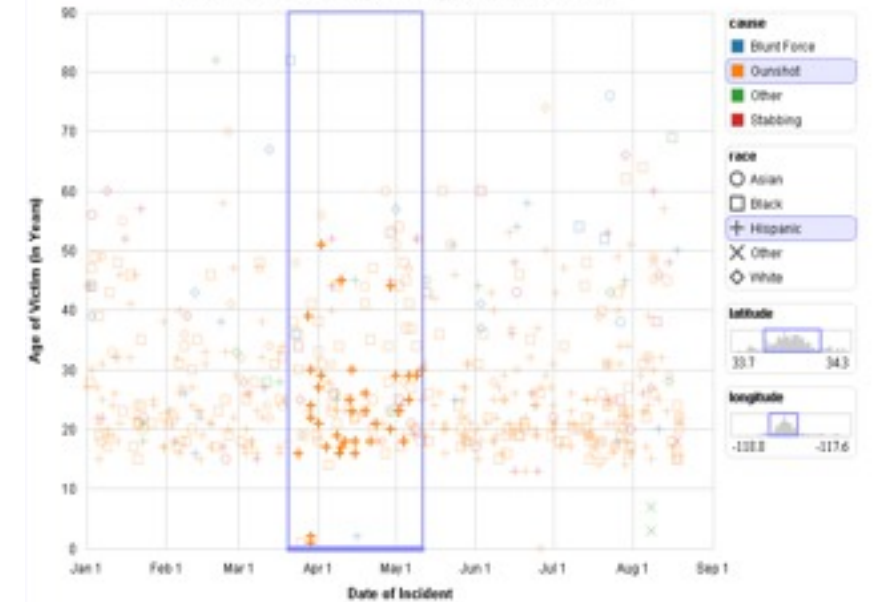


Free-form

Homicide Victim in Los Angeles County, 2007 (Source: LA Times)









Homicide Victims in Los Angeles County, 2007 (Source: LA Times)



Data-aware

Use of Annotations

Arrows		25.1%	
Text		24.6%	
Ovals		17.9%	
Pencil		16.2%	
Lines		14.5%	
Rectangles		1.7%	

39.0% of comments included annotations

Pointing to specific points, trends, or regions (88.6%)

Drawing to socialize or tell jokes (11.4%)

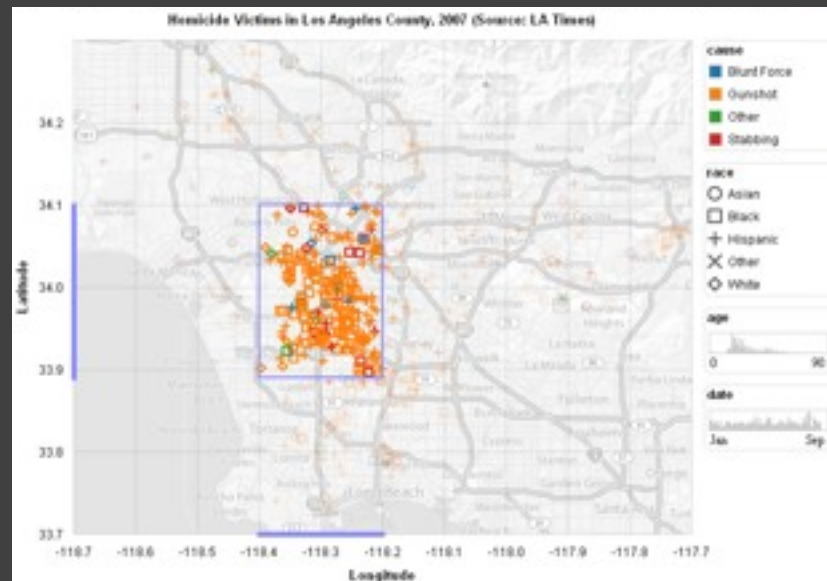
Variety of subject responses

‘Not always necessary’, but ‘surprisingly satisfying’

Some concern about professional look

Visual Queries

Model selections as **declarative queries** over interface elements or underlying data



$(-118.371 \leq lon \text{ AND } lon \leq -118.164) \text{ AND } (33.915 \leq lat \text{ AND } lat \leq 34.089)$

Visual Queries

Model selections as **declarative queries** over interface elements or underlying data

Applicable to **dynamic, time-varying data**

Retarget selection **across visual encodings**

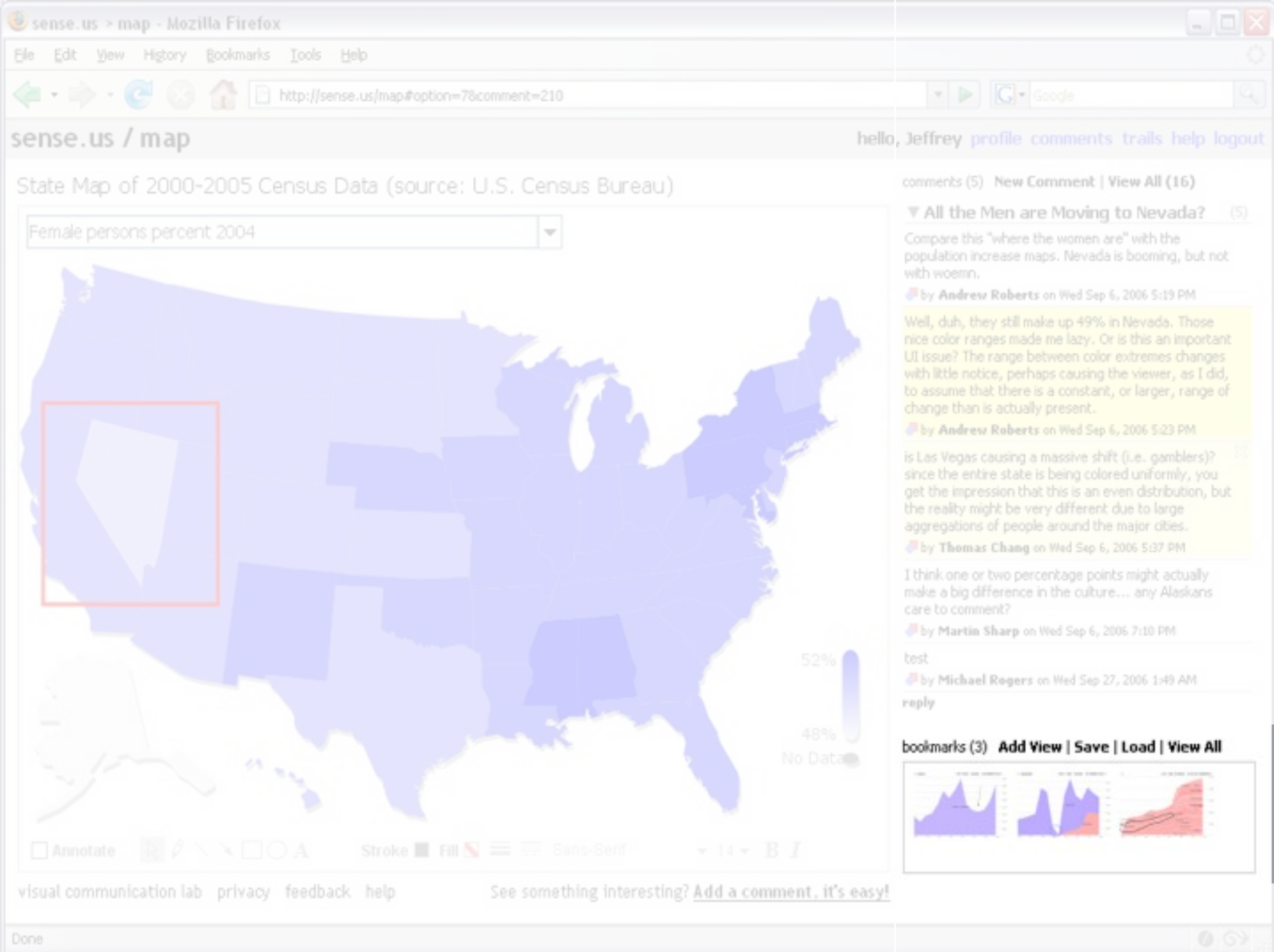
Support **social navigation and data mining**

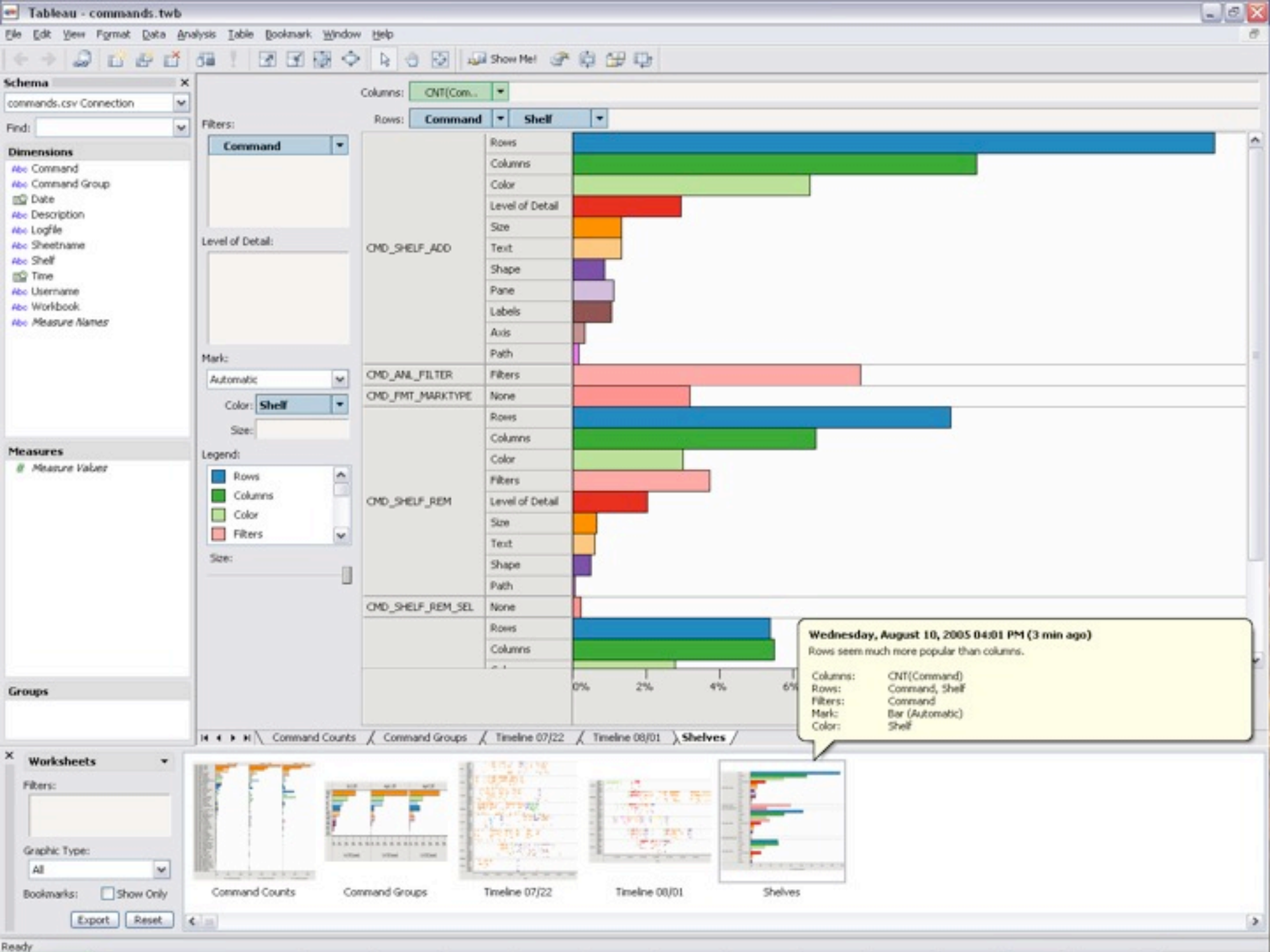
Social Data Analysis

How can users' **activity traces** be used to improve collaborative analysis?

How should **annotation techniques** be designed to provide nuanced pointing behaviors?

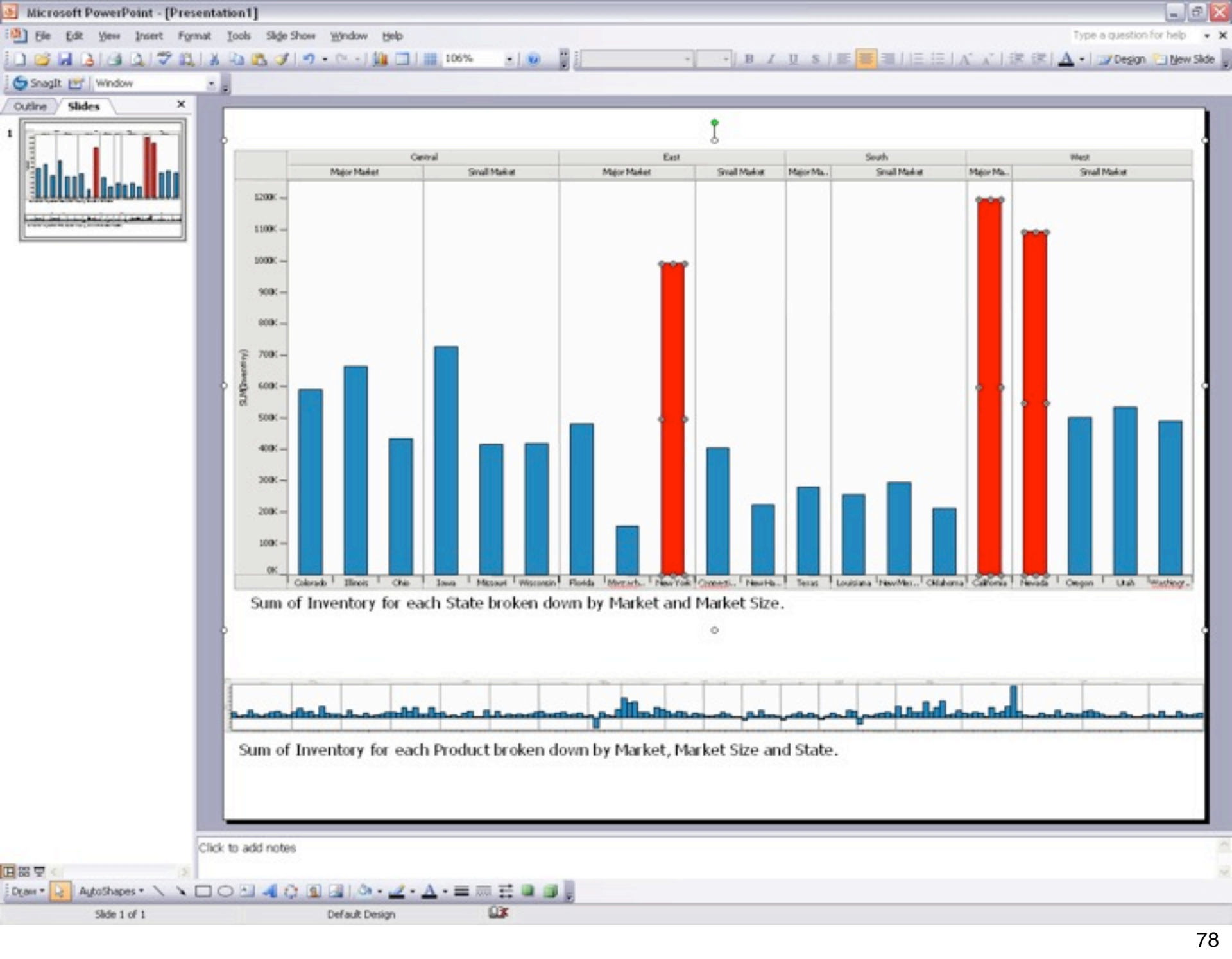
How can interface design better support **communication of analytic findings**?





Graphical Analysis Histories





Social Data Analysis

How can users' **activity traces** be used to improve collaborative analysis?

How should **annotation techniques** be designed to provide nuanced pointing behaviors?

How can interface design better support **presentation of analytic findings**?

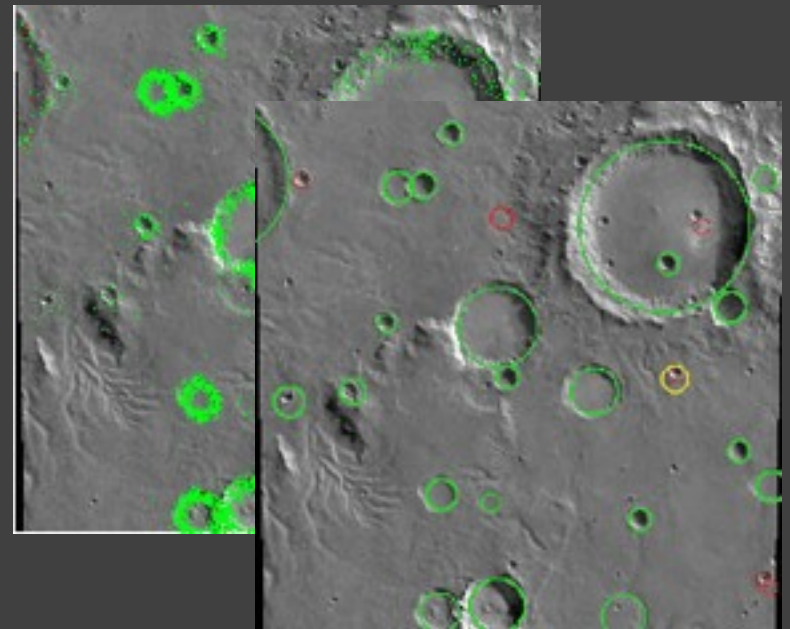
How can contributions be **better integrated**?

Structured Conversation

Reduce the cost of synthesizing contributions



Wikipedia: Shared Revisions



NASA ClickWorkers: Statistics

Integration: Evidence Matrices (Billman '06)

Cache XSB 2.2 Andersen E803-1908 GC 59740-1 - Mozilla Firefox

http://andersen.perc.vassar.com/XSB2/bedisplay.htm?id=244&sig=2C9748F7A6

Current World: **Experiment**
Current Matrix: **Analyst alpha**

[H] GC-IOWA	Evidence Ops	[H] Overram ?	[H] Friction ?	[H] Hartwig ?	Diagnosticity:
[1] Navy: no systemic pr...	HIGH	C 2	II 2	I 2	Diagnostic (+1, -2)
[1] Gunpowder is leaking...	HIGH	N/A 2	N/A 2	I 2	Non-Diagnostic
[1] Glycol is present in...	HIGH	I 2	C 2	II 2	Diagnostic (+1, -2)
[1] Iowa Commanding Off...	MEDIUM	N/A 2	II 2	N/A 2	Non-Diagnostic
[1] A recent similar inc...	HIGH	CC 2	N/A 2	II 2	Diagnostic (+1, -1)
[1] No direct evidence o...	LOW	N/A 2	C 2	II 2	Diagnostic (+1, -1)
[1] In 1943 friction had...	MEDIUM	CC 2	I 2	C 2	Diagnostic (+2, -1)
Belief:		20	28	28	
Support:		0.25	-2.0	-4.5	

Cache Xsb v2.2

Alpha's ACH matrix

Integration: Evidence Matrices (Billman '06)

Alpha's CACHE workspace



Beta's matrix



Ticker



Gamma's matrix

+



Chat tool

Sharing & coordination

Individual analysis



Search

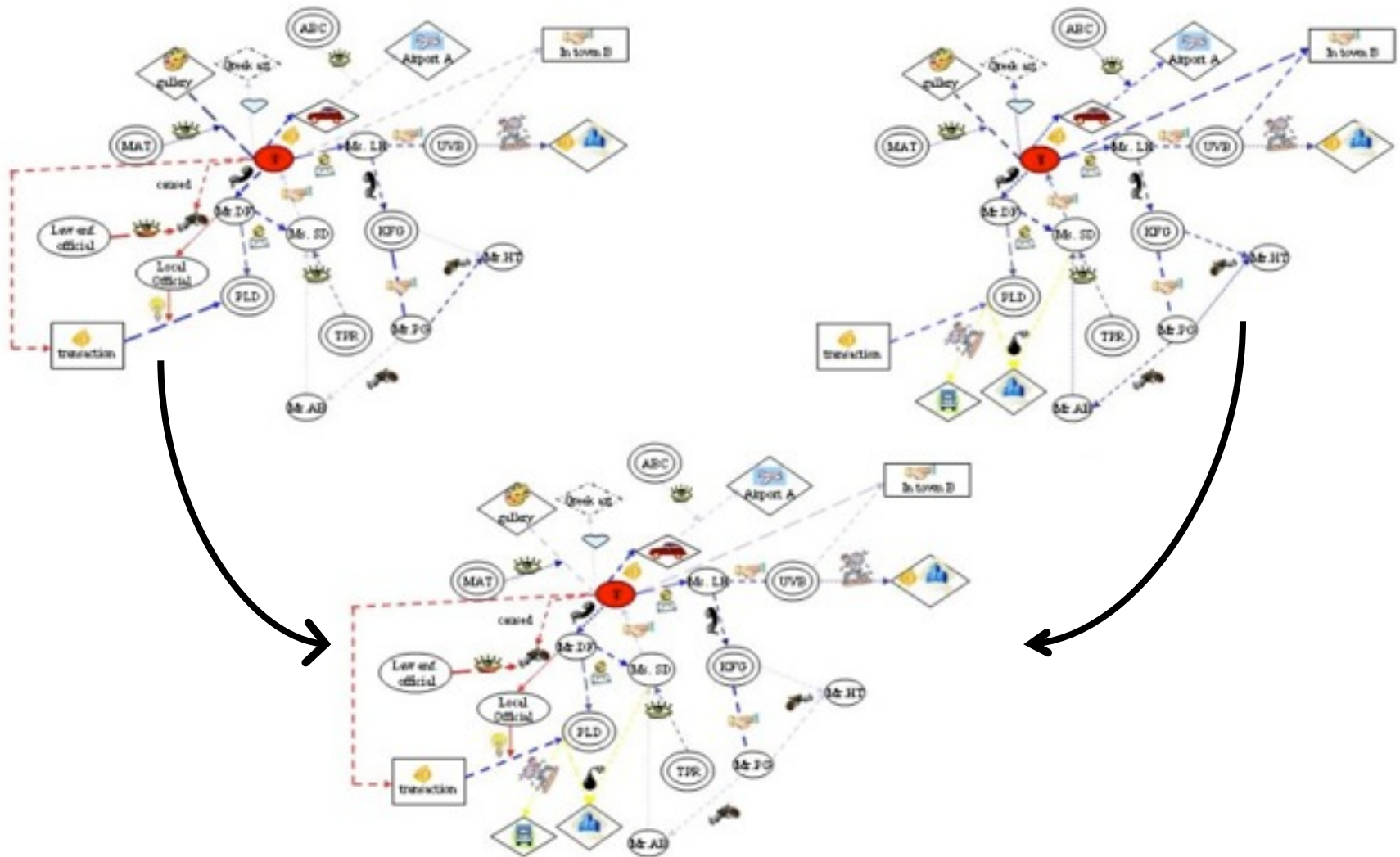


Alpha's ACH matrix



Read & Interpret

Merging Analysis Structures (Brennan et al '06)



Design Considerations [VAST 07, IVS 08]

Division, allocation, and integration of work

Common ground and awareness

Reference and deixis (pointing)

Identity, trust, and reputation

Group formation and management

Incentives and engagement

Presentation and decision-making

Ongoing Work

How to better structure analysis tasks?

Observe trends / patterns of interest

Generate hypotheses

Marshall evidence for/against a claim

Structured tasks improve outcomes [Willett 2011]

How to better encourage participation?

Narrative: storytelling to spur exploration

Financial incentives / crowdsourcing [Willett 2012]

Social Data Analysis

Visual sensemaking is a **social** process as well as a cognitive process.

Analysis of data coupled with **social interpretation and deliberation**.

How can user interfaces catalyze and support **collaborative visual analysis**?