A text-based model of foreign-affairs sentiment

Sean Gerrish and David Blei
Princeton University Computer Science

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These news articles tell a story.

Libyans wary of NAT

by DAVID BELL

PERTH'S Libyan community joined a slew of activists

a decade ago, is distressed by
y. Photo by Alex Bainbridge
ould harm the

SATURDAY • MARCH 16 • 1991

Fort Worth Star-Telegram

U.S. advances in Iraq

Soviet ties survive, Baker says

Arms control talks remain deadlocked

Victories reported by rebels

The Philadelphia Inquirer

PUBLIC LEDGER

An Independent Newspaper for All the People.

RUSSIA AT WAR WITH JA

2,000,000 Red Troops to Be Hurled Into Action in A

Virtually All Life Destroyed in Hiroshima, Tokio

Today

Halsey's Planes Renew Assault, Batter Honshu

Moscow
Hirohito
For Med

Sunday, August 30, 2006

Martians invade earth

Incredible as it may seem, it has been confirmed that a large martian invasion fleet has landed on earth tonight.

First vessels were sighted over Great Britain, Denmark and Norway already in the late evening from where, as further reports indicate, the fleet headed towards the North Pole and Santa Claus was taken hostage by the invaders.

Afterwards they split apart in order to approach most major cities around the earth. The streets filled as thousands fled their homes, many only wearing their pajamas...

Honolulu Star-Bulletin 1st EXTRA

8 PAGES—HONOLULU, TERRITORY OF HAWAII, U. S. A., SUNDAY, DECEMBER 7, 1941—8 PAGES — PRICE FIVE CENTS

WAR !

(Associated Press by Transpacific Telephone)

SAN FRANCISCO, Dec. 7.—President Roosevelt announced this morning that Japanese planes had attacked Manila and Pearl Harbor.

OAHU BOMBED BY JAPANESE PLANES

Quad-City Times LATEST UPDATE!

WAR

'So far, so good'

DESERT STORM

ntonio Express

STREET FINAL

EXCLUSIVE IN SAN ANTONIO

VOL. LXXVI—NO. 342—76TH YEAR SAN ANTONIO, TEXAS, MONDAY MORNING, DECEMBER 8, 1941—EIGHTEEN PAGES PRICE 5 CENTS—ESTABLISHED 1865

JAPS BUTCHER AMERICANS

VIVALDI Four S

EXCLUSIVE Judge rules jail i

DOG OF W TO NAME MINISTE IN AFRIC COUP PL

WILSON BEGINS TOUR FOR TREATY, SEES VICTORY IN THE SENATE FIGHT; REPUBLICANS FEAR PARTY SETBACK

SENATE TACTICS ASSAILED

Despite the savage cutbacks at home, Britain tops world league in foreign aid

UK DOLES OUT MORE AID THAN ANY OTHER COUNTRY

Hugs for Life

The big relationship drought is connected to emotional and physical health

by John Sanderson

Mural dedicated

World reaches out to Haiti

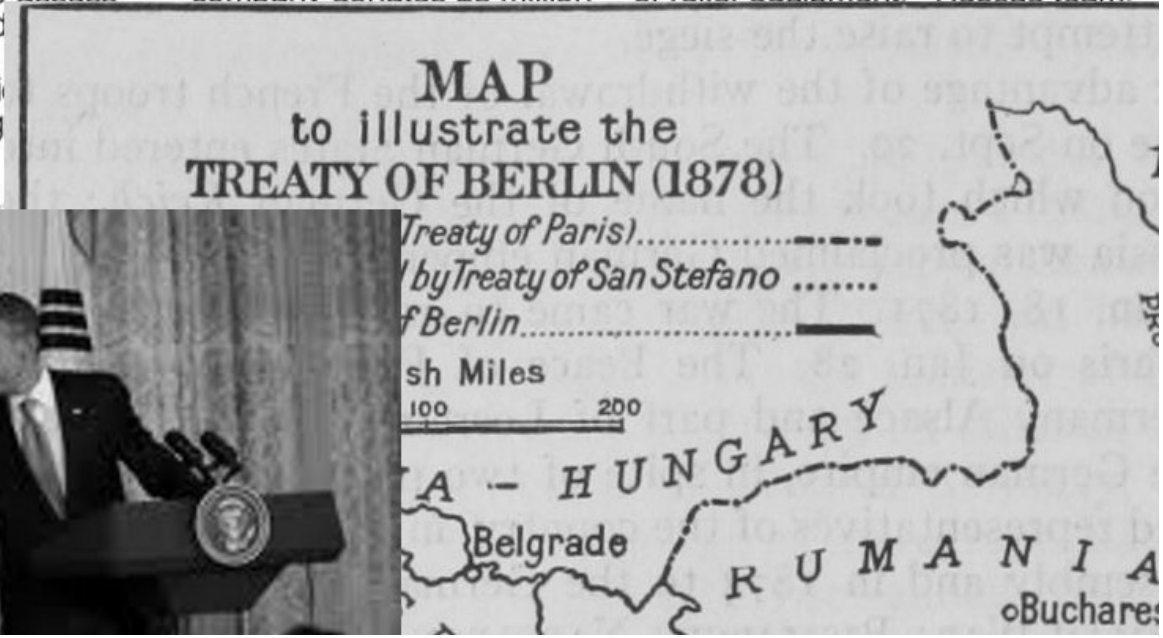
The U.N. is releasing $10 million from its emerge European Commission has approved $4.37 millio after Tuesday's earthquake. Here is a selection o

Canada: A military team to assess needed goods, sanitati packag

Irish telecommunications company donates $5 million

Spain: 100 tons of relief equipment

Netherlands: Rescue team



A spatial model of foreign relations sentiment

This work develops a model of the sentiment between countries over time.

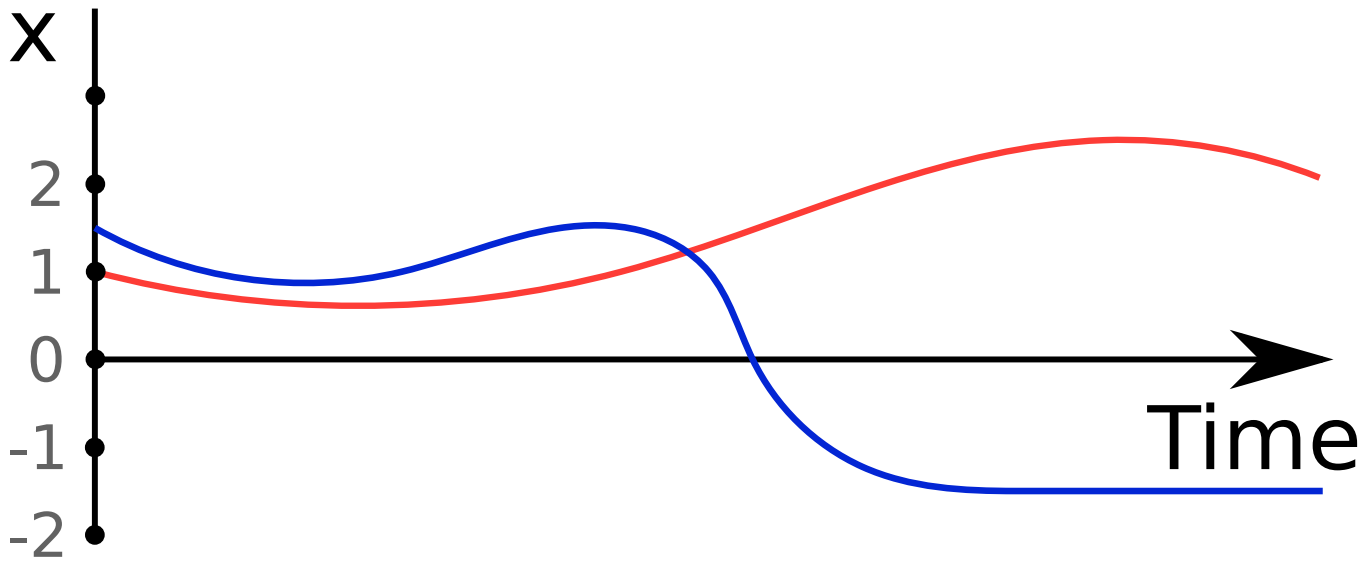
- It models dynamic relationships in an interpretable way
- It infers sentiment from printed media
- Sentiment is defined by Mechanical Turkers

A spatial model of foreign relations sentiment

To do this, our plan is to:

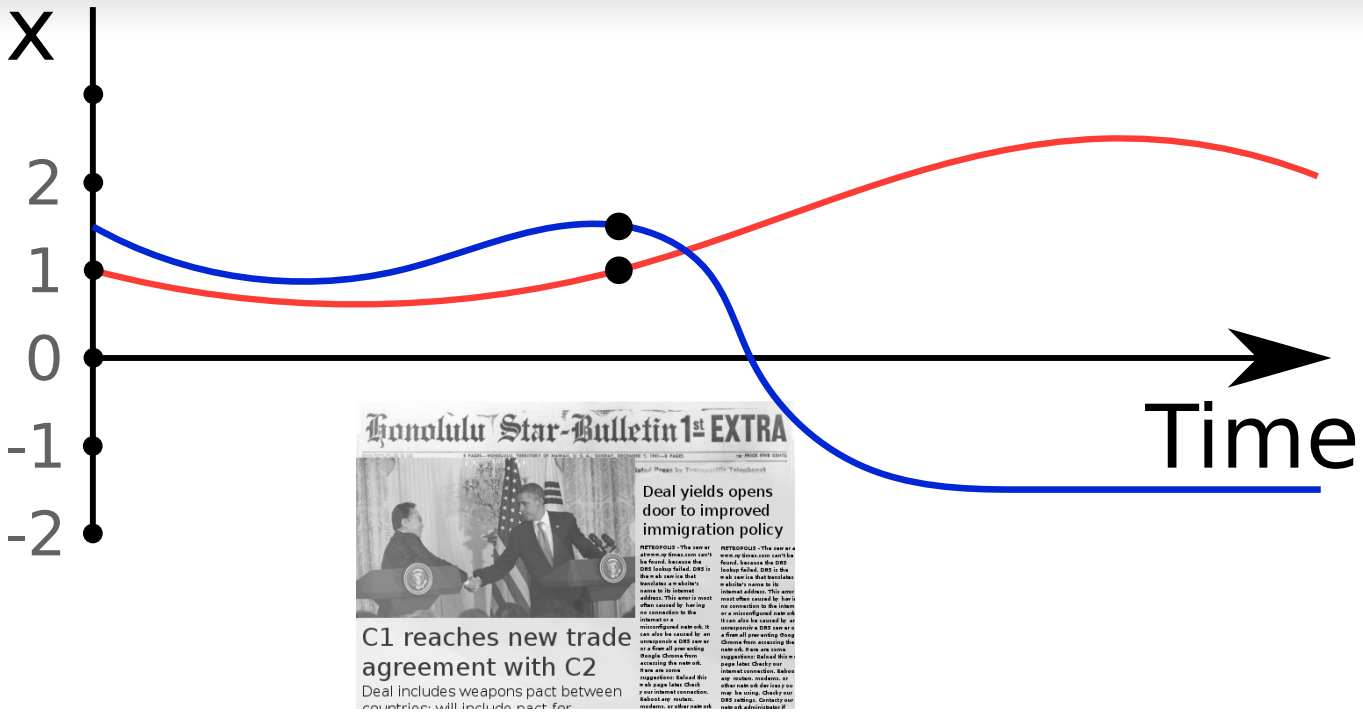
- Collect a bunch of newspaper articles
- Define a latent variable model to capture interesting structure in these articles
- Perform posterior inference to estimate the value of these random variables

Countries take latent positions $\bar{x}_{ct}$ over time



$$\bar{x}_{c,t} | \bar{x}_{c,t-1} \sim N(\bar{x}_{c,t-1}, \sigma_K^2)$$

The relationship between countries is observed in the news.



$$x_{c_1,d} \sim N(\bar{x}_{c_1,t}, \sigma_D^2)$$

$$x_{c_2,d} \sim N(\bar{x}_{c_2,t}, \sigma_D^2)$$

$$\text{Sentiment } s_d := x_{c_1,d}{}^T x_{c_2,d}$$

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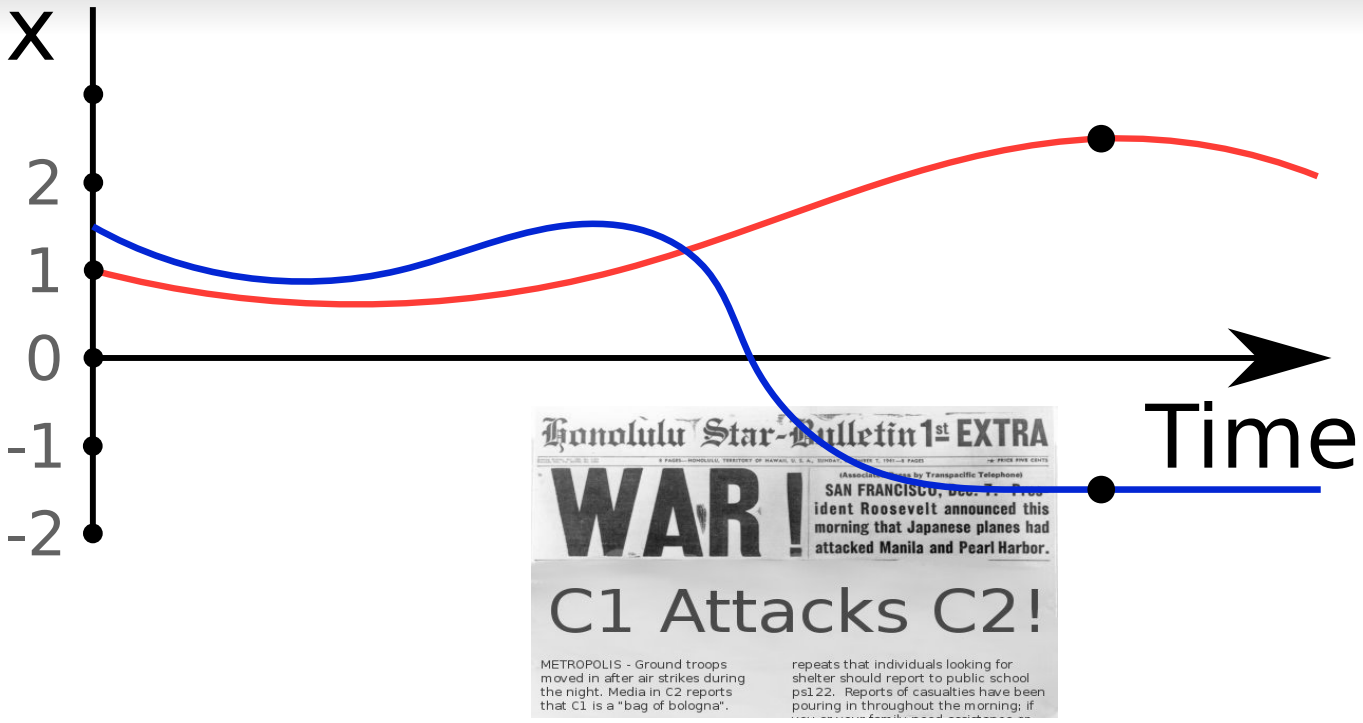

$$x_{c_1,d} \sim N(\bar{x}_{c_1,t}, \sigma_D^2)$$

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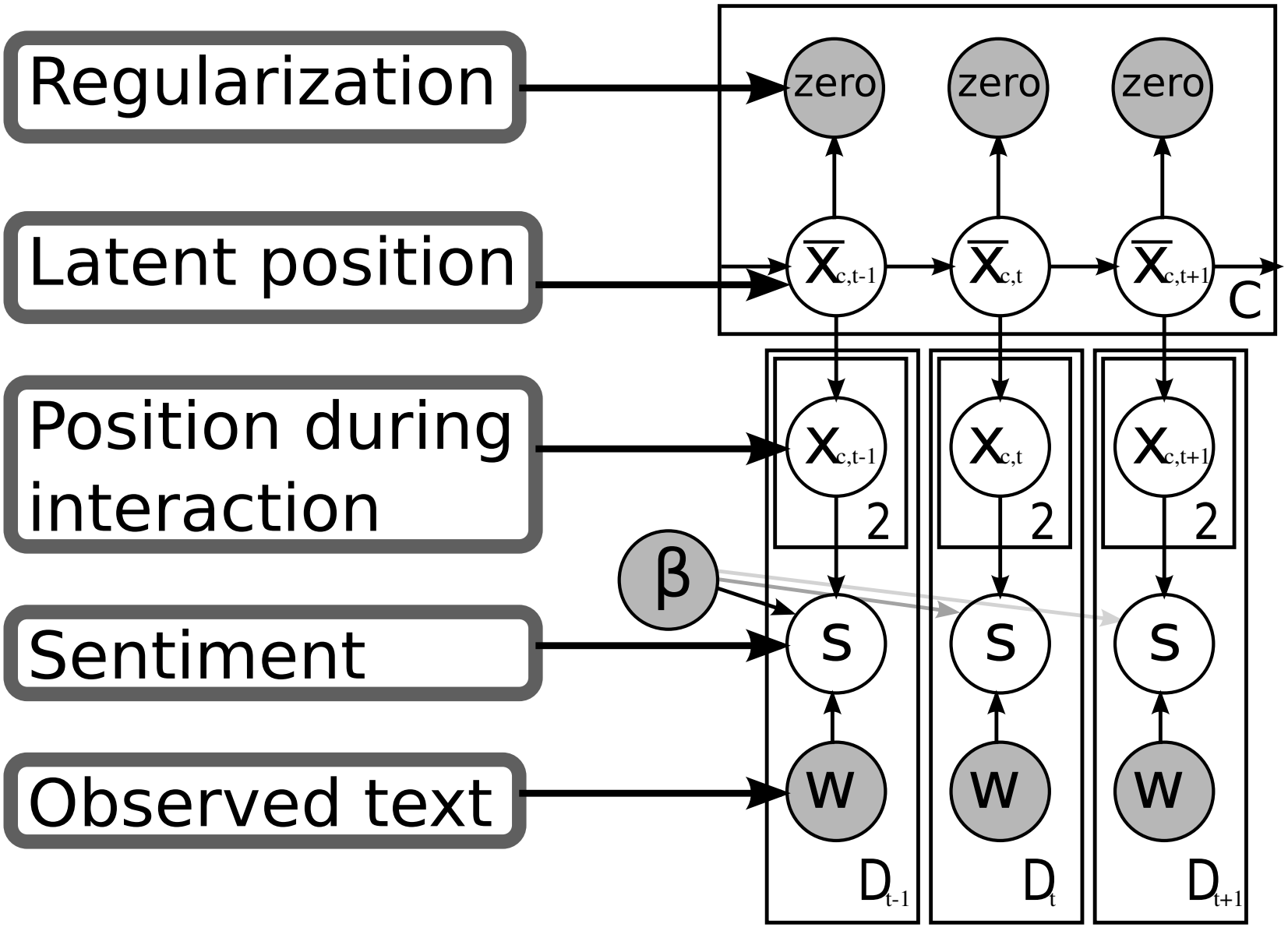
$$\text{Sentiment } s_d := x_{c_1,d}{}^T x_{c_2,d}$$

The relationship between countries over time



Labeling sentiment

1. We found all pairs of paragraphs from the New York Times which discussed exactly two countries
2. A random sample of 3607 paragraphs from *New York Times* articles from 1988 to 2008 were labeled by Amazon Mechanical Turk workers
3. Raters rated news articles on the scale $-5, -3, -1, 1, 3, 5$

Labeling sentiment: typical task

although **israel** and neighboring **jordan** agreed with fanfare in late july to end their technical state of war and have since behaved in public like old and dear friends they have yet to sign a peace treaty and have no official links.

What is the relationship between **israel** and **jordan** as suggested by the text above?

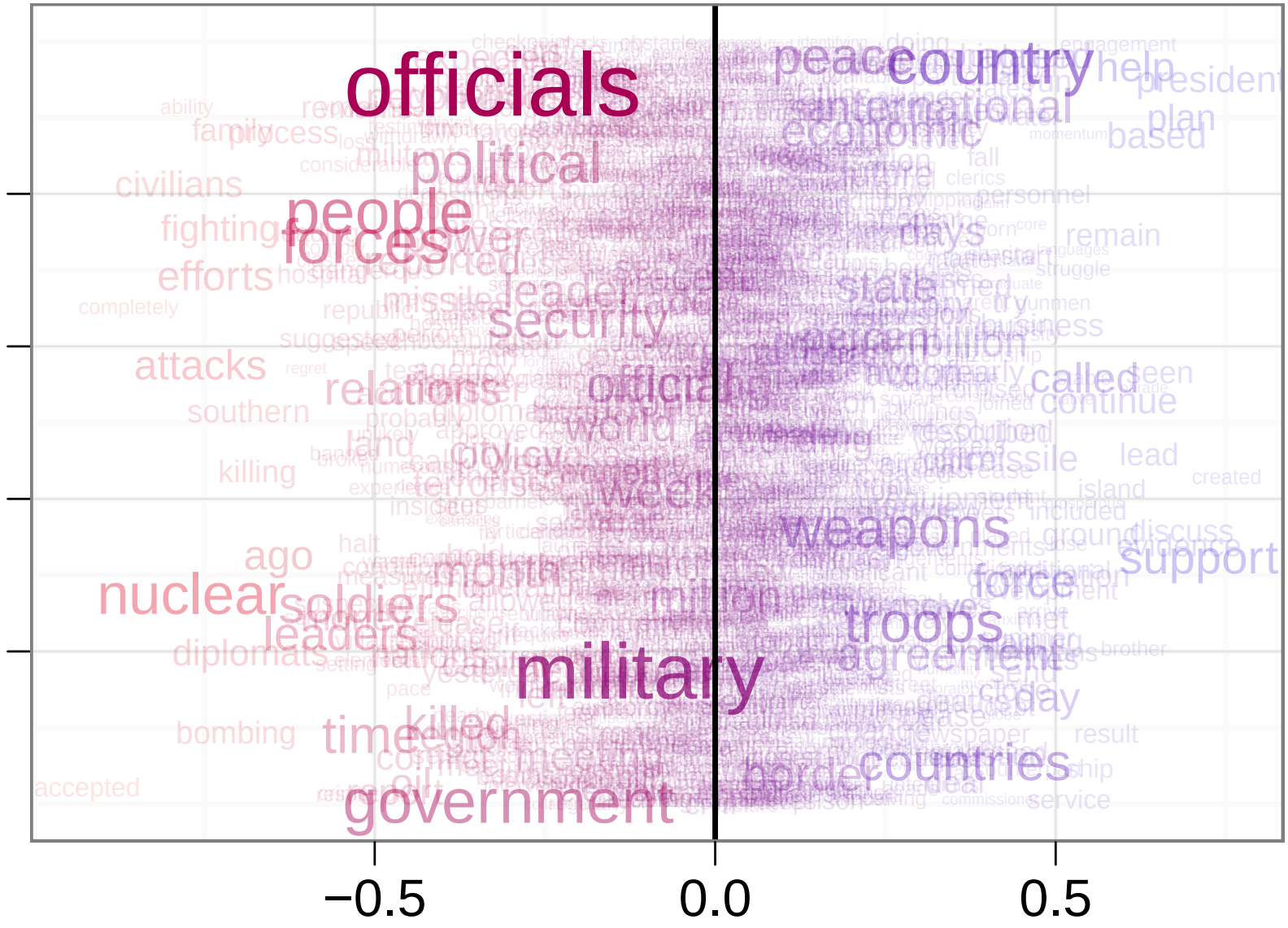
- **There was no obvious relationship between these countries, or they were not discussed.**
- **Very Positive++** These states have a very good relationship.
- **Positive+** These states have a very good relationship.
- **Slightly Positive** These states are on decent terms.
- **Slightly Negative** There is a little tension between these states (tariffs might exist, for example.)
- **Negative-** These states have a bad relationship (e.g. the states are using negative, threatening remarks.)
- **Very Negative--** These states are mortal enemies.

Sentiment and news articles: text regression

$$s_d = \mathbf{w}_d^T \boldsymbol{\beta} + \varepsilon$$

- $\mathbf{w}_d \in \mathbb{R}^V$ is the text of a news paragraph
- $s_d \in \mathbb{R}$ is the sentiment between two countries
- $\boldsymbol{\beta} \in \mathbb{R}^V$ is the "weight" of each word

Sentiment and news articles: text parameter β



Experiments

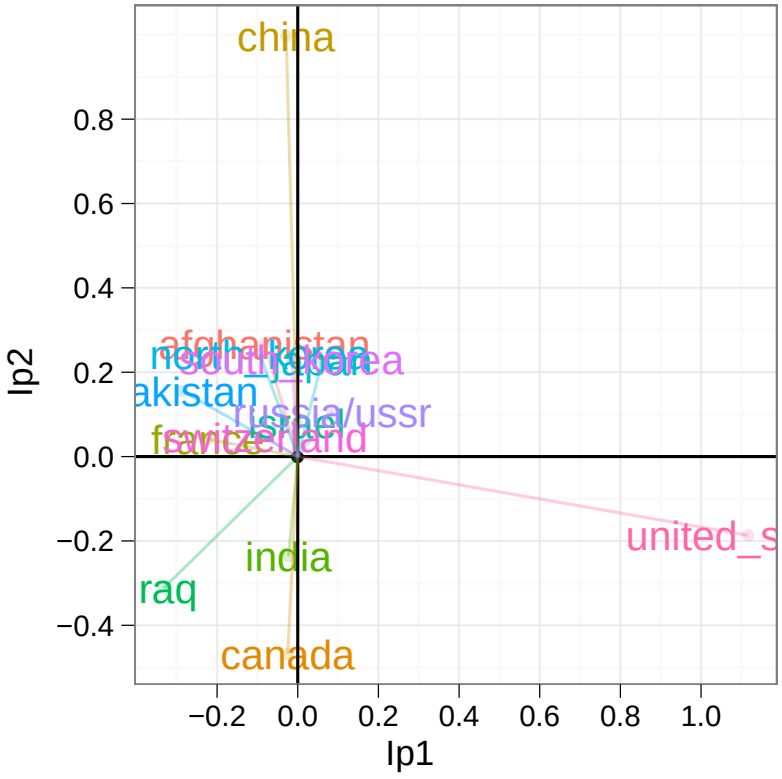
- Randomly select 3607 paragraphs discussing pairs of 245 countries and territories.
- Label each of these paragraphs' sentiment with two ratings from Amazon Mechanical Turk.
- Hold out 42 random pairs (244 paragraphs) for testing.
- Fit sentiment model parameters β on training paragraphs.
- Infer the spatial sentiment model with these parameters on all 257,472 paragraphs from 1988 to 2008.

Analysis with this model

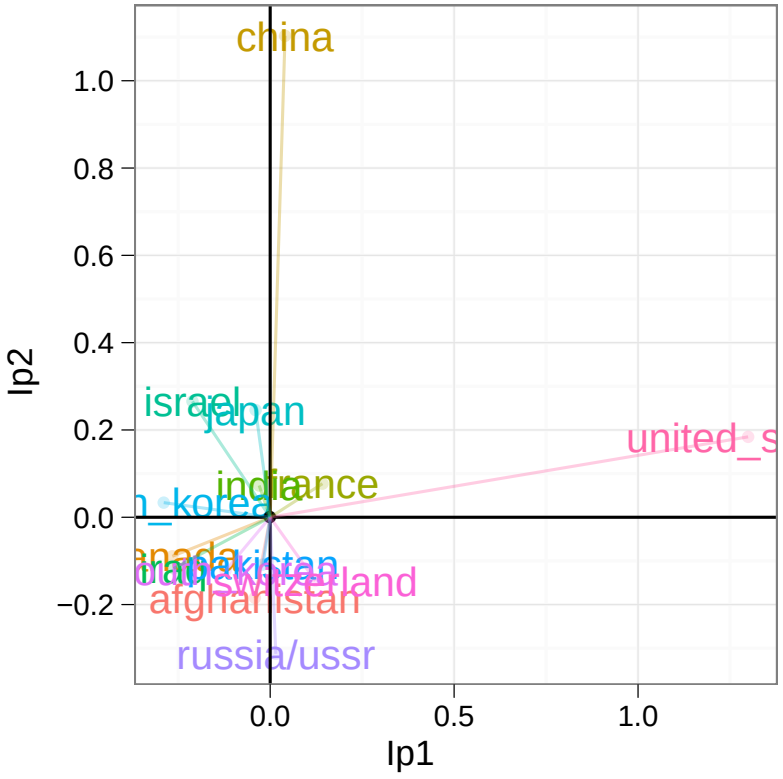
To perform analysis with this model:

1. Fit the posterior (we used MAP)
2. Inspect countries' means $\bar{x}_{c,\cdot}$
3. Inspect the relationship between countries' means $\bar{x}_{c_1,t}\bar{x}_{c_2,t}$

Results: selected countries' latent positions

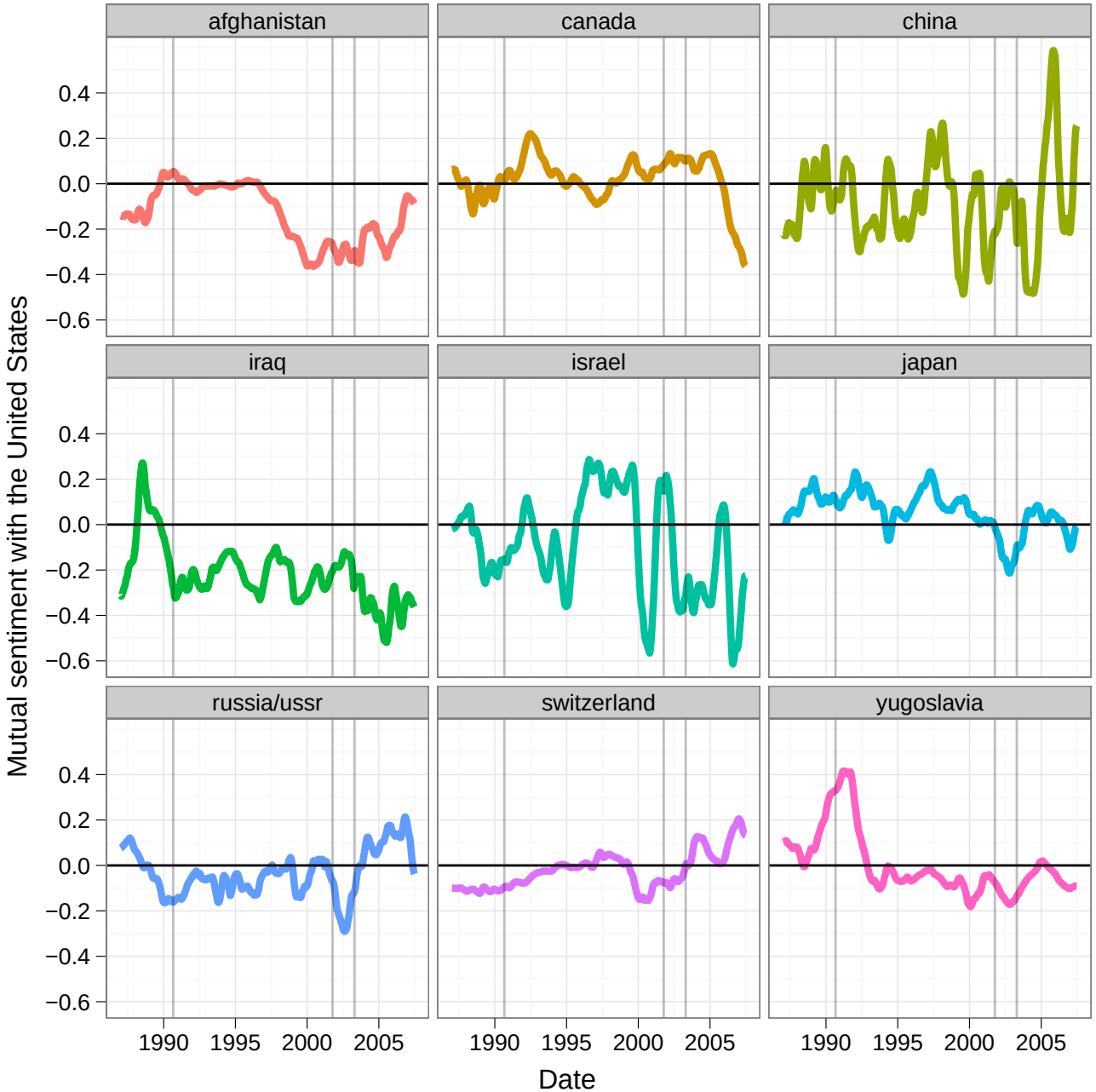


1987

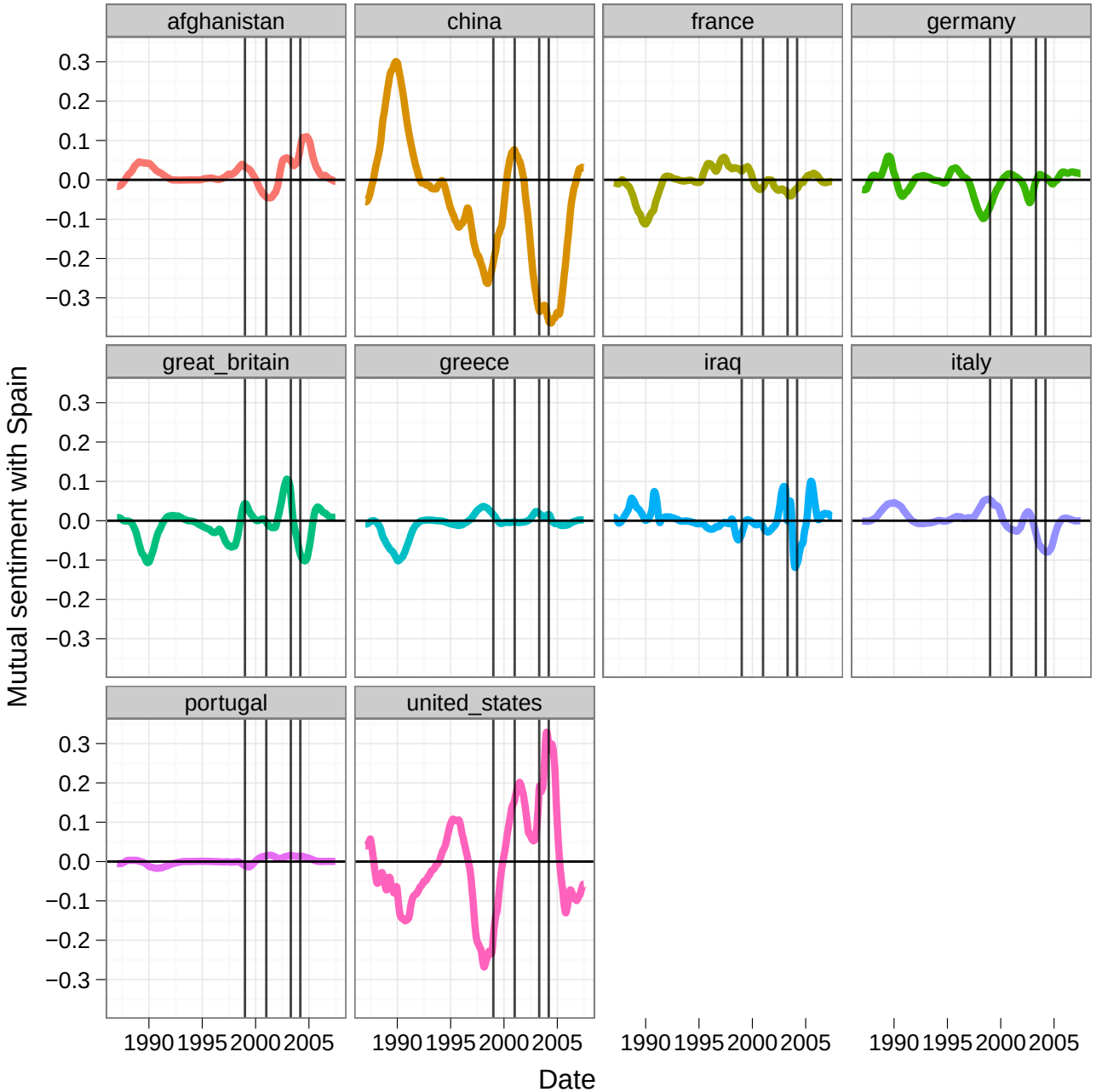


2007

Results: selected countries' mutual sentiment with the U.S.



Results: selected countries' mutual sentiment with Spain



Evaluation

The model does better than text regression and individual *Mechanical Turk* workers compared against one another.

Model	Mean Squared Error	Mean Absolute Error
Inter-rater agreement	1.77 (7.11)	1.037 (2.07)
Text regression	5.53	1.94
Reversion variance 0.1	2.36	1.09
Reversion variance 1	**2.32**	**1.07**
Reversion variance 10	2.32	1.08
Reversion variance 100	2.34	1.09
Reversion variance 1000	2.33	1.08

Current work and future directions

- Sentiment intercepts for each country
- Infer asymmetric relationships
- Application to other dyads
- Infer unsupervised relations
  - Sentiment is only one dimension
  - Similar to relational topic models [1]

Thank you

- Sean Gerrish (sgerrish@cs.princeton.edu)
- David Blei (blei@cs.princeton.edu)

Bibliography

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