

# Computational History

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Principles of Complex Systems, Vols. 1, 2, & 3D  
CSYS/MATH 300, 303, & 394, 2022-2023 | @pocsvox

Prof. Peter Sheridan Dodds | @peterdodds

Computational Story Lab | Vermont Complex Systems Center  
Santa Fe Institute | University of Vermont



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Lexical Ultrafame  
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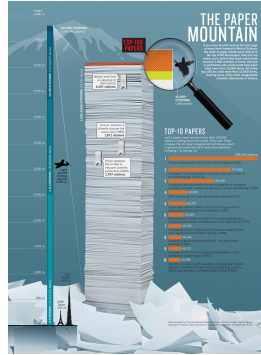
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## Fame by rank



Nature (2014): Most cited  
papers of all time

## Word frequency:

Brown Corpus (~ 10<sup>6</sup> words):

rank	word	% q	rank	word	% q
1.	the	6.8872	1945.	apply	0.0055
2.	of	3.5839	1946.	vital	0.0055
3.	and	2.8401	1947.	September	0.0055
4.	to	2.5744	1948.	review	0.0055
5.	a	2.2996	1949.	wage	0.0055
6.	in	2.1010	1950.	motor	0.0055
7.	that	1.0428	1951.	fifteen	0.0055
8.	is	0.9943	1952.	regarded	0.0055
9.	was	0.9661	1953.	draw	0.0055
10.	he	0.9392	1954.	wheel	0.0055
11.	for	0.9340	1955.	organized	0.0055
12.	it	0.8623	1956.	vision	0.0055
13.	with	0.7176	1957.	wild	0.0055
14.	as	0.7137	1958.	Palmer	0.0055
15.	his	0.6886	1959.	intensity	0.0055

## Jonathan Harris's Wordcount:

A word frequency distribution explorer:



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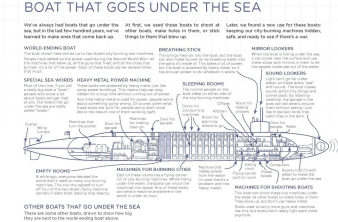
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"Thing Explainer: Complicated Stuff in Simple Words" [a](#) [a](#)  
by Randall Munroe (2015). [14]



Up goer five [a](#) [a](#)

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## Outline

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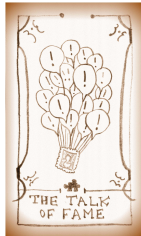
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## The everywhere-ness of algorithms and stories:



"On the Origin of Stories: Evolution, Cognition, and Fiction" [a](#) [a](#)  
by Brian Boyd (2010). [3]



"The Storytelling Animal: How Stories Make Us Human" [a](#) [a](#)  
by Jonathan Gottschall (2013). [10]



"The Written World: How Literature Shaped Civilization" [a](#) [a](#)  
by Martin Puchner (2017). [17]

## Algorithms, recipes, stories, ...



"The Code Economy: A Forty-Thousand Year History" [a](#) [a](#)  
by Philip E. Auerwald (2017). [11]



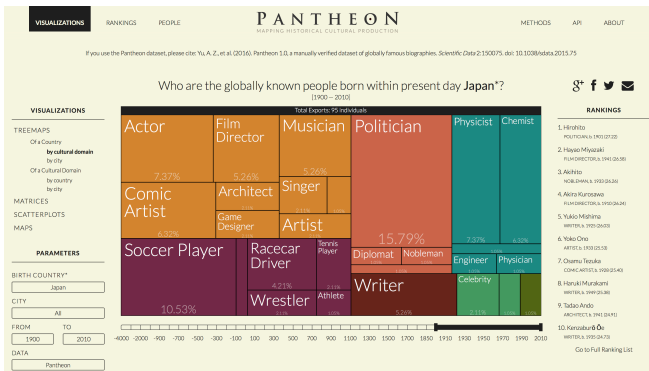
"Algorithms to Live By" [a](#) [a](#)  
by Christian and Griffiths (2016). [6]



"Once Upon an Algorithm" [a](#) [a](#)  
by Martin Erwig (2017). [9]

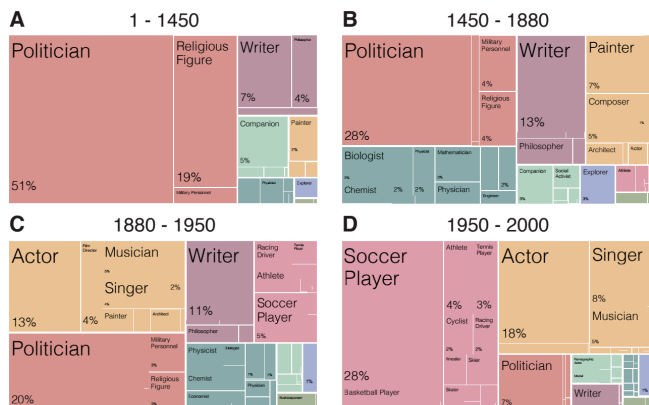
Also: Numerical Recipes in C [16] and How to Bake  $\pi$  [4]

# The famous are storytellers—Japan:



For people born 1950–

[http://pantheon.media.mit.edu/treemap/country\\_exports/P/all/1900/2010/H15/pantheon](http://pantheon.media.mit.edu/treemap/country_exports/P/all/1900/2010/H15/pantheon)



<https://www.media.mit.edu/projects/pantheon-new/overview/>

## Super Survival of the Stories:



The Desirability of Storytellers, The Atlantic, Ed Yong, 2017-12-05.

- Study of Agta, Filipino hunter-gatherers.
- Storytelling valued well above all other skills including hunting.
- Stories encode prosocial norms such as cooperation.
- Like the best stories, the best storytellers reproduce more successfully.

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# The most famous painting in the world:



## The dismal predictive powers of editors .....



Twelve ...

## The completely unpredicted fall of Eastern Europe:



Timur Kuran: [12] "Now Out of Never: The Element of Surprise in the East European Revolution of 1989"

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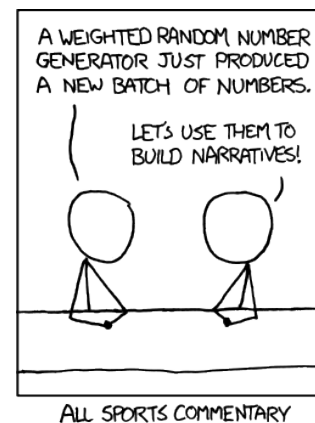


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# We understand bushfire stories:

- Sparks start fires.
- System properties control a fire's spread.
- But for three reasons, we make two mistakes about Social Fires ...

## Reason 1—We are Homo Narrativus.



<http://xkcd.com/904/>

## Reason 2—"We are all individuals."

Individual narratives are not enough to understand distributed, networked minds.

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### Reason 3—We are spectacular imitators.

BBC/David Attenborough.

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Mistake 1:  
Success is due to intrinsic properties

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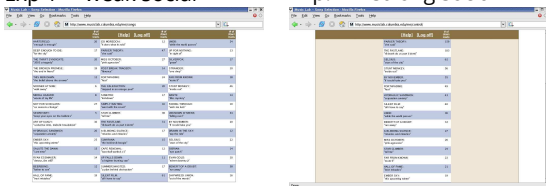
See "Becoming Mona Lisa" by David Sassoon



48 songs  
30k participants

Exp 1— weak social

Exp. 2—strong social

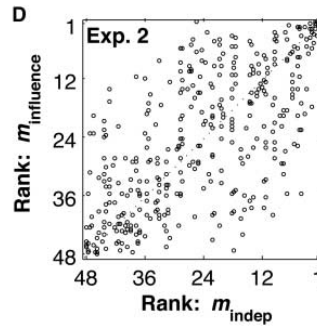


"An experimental study of inequality and unpredictability in an artificial cultural market"  
Salganik, Dodds, and Watts,  
Science, 311, 854–856, 2006. [18]



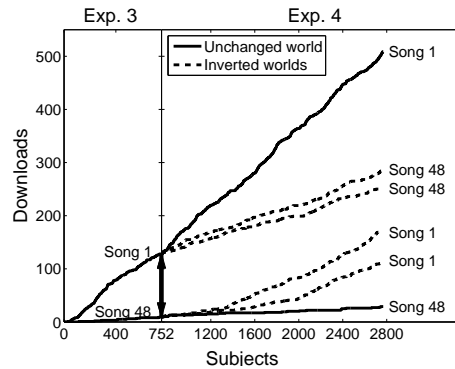
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### Resolving the paradox:



Increased social awareness leads to  
Stronger inequality + Less predictability.

Payola/Deceptive advertising hurts us all:



"Mistake" 2:  
Seeing success is 'due to social' and  
wanting to say 'all your interactions are  
belong to us'



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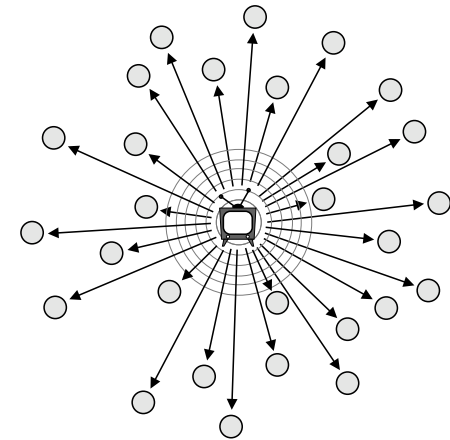
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### "This is truly the last time, believe me"



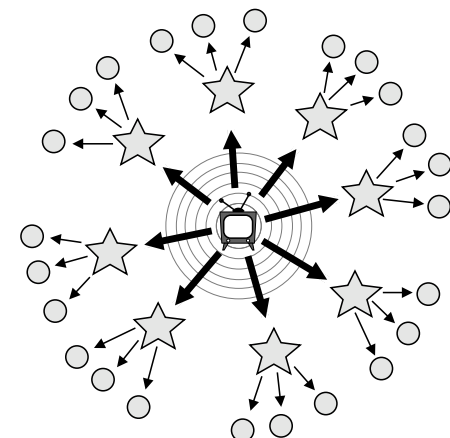
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The hypodermic model of influence:



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The two step model of influence: [11]



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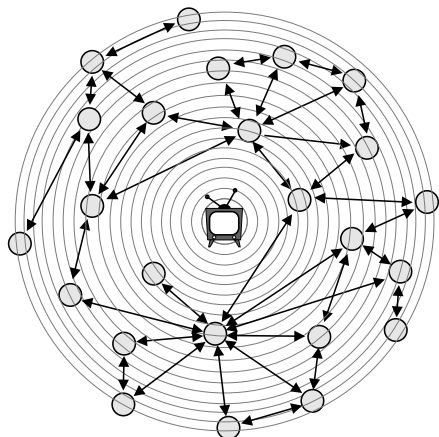
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## The network model of influence:



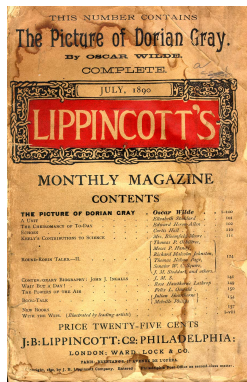
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## Oscar Wilde, The Picture of Dorian Gray: Raw Fame



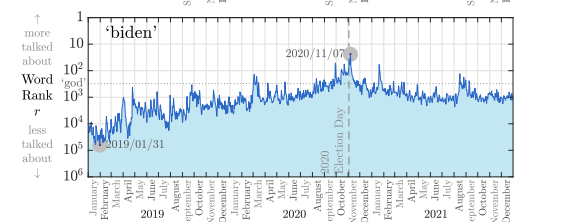
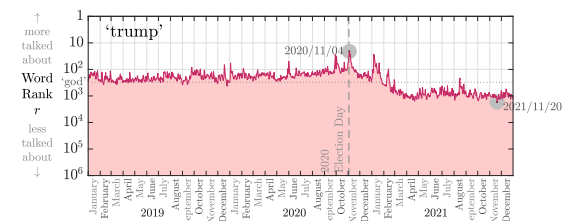
“There is only one thing in the world worse than being talked about, and that is not being talked about.”

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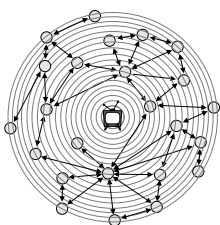
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## The network model of influence:



How superspreading works: Many interconnected, average, trusting people must benefit from both receiving and sharing a message far from its source.

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## Ultrafame: Nobody expects the Spanish Inquisition K-pop:



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## Etymological clarity:

- Fate**—from the Latin *fatus*: meaning “spoken”.
- Fate is talk that has been done. “It is written”, fore-tell, pre-dict.
- “There is no such thing as fate, only the story of fate.”
- Destiny is probabilistic.
- Fame**—from the Latin *fāma*: meaning “to talk.”
- Fame is inherently the social discussion about the thing, not the thing itself.
- Renown**: Repeatedly named, talked about. Old French *renon*, from re- + non (“name”).
- Réclame**: “Clamo”—Proto-Indo-European: “to shout” (again). Connected to “lowing”.

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“Fame and Ultrafame: Measuring and comparing daily levels of ‘being talked about’ for United States’ presidents, their rivals, God, countries, and K-pop”

Dodds et al., Available online at <https://arxiv.org/abs/1910.00149>, 2019. [7]

“Computational timeline reconstruction of the stories surrounding Trump: Story turbulence, narrative control, and collective chronopathy”

Dodds et al., 2020. [8]

- POTUSometer with the Smorgasdashbord: <http://compstorylab.org/potusometer/>
- Stories surrounding Trump: <http://compstorylab.org/trumpstoryturbulence/>

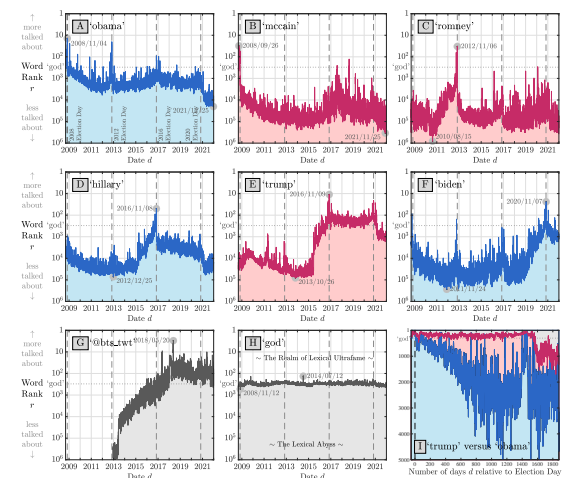
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## Vox (2019-04-17): BTS, the band that changed K-pop, explained



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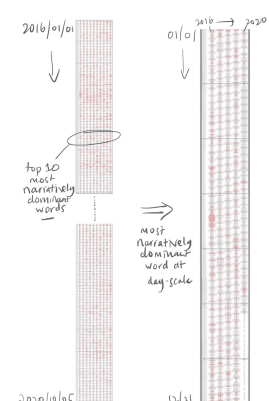
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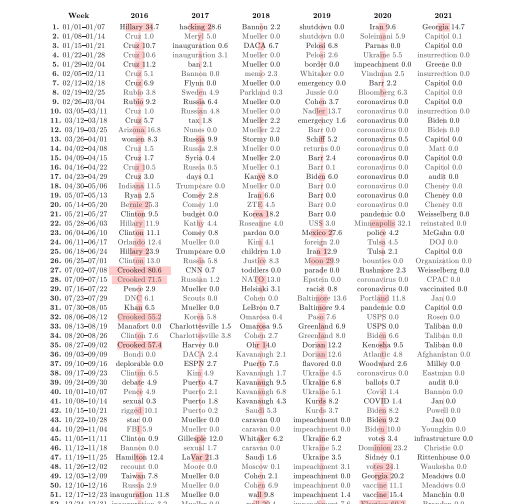
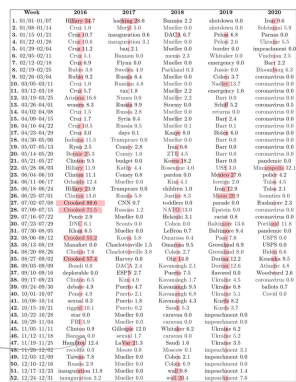
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## 2011 Whitehouse Correspondents' Dinner



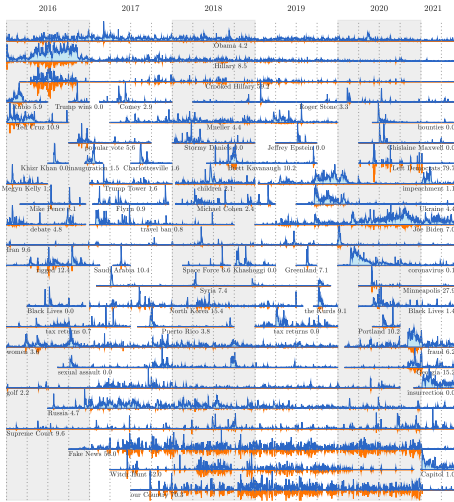


<http://compstorylab.org/trumpstoryturbulence/>



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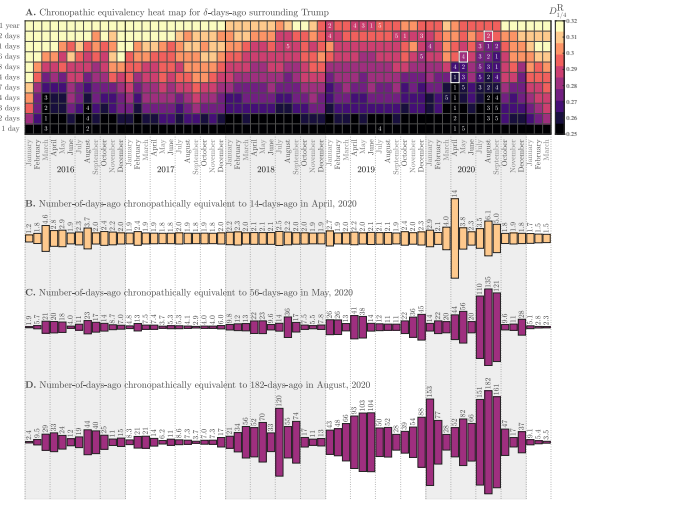
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On Instagram at pratchett\_the\_cat

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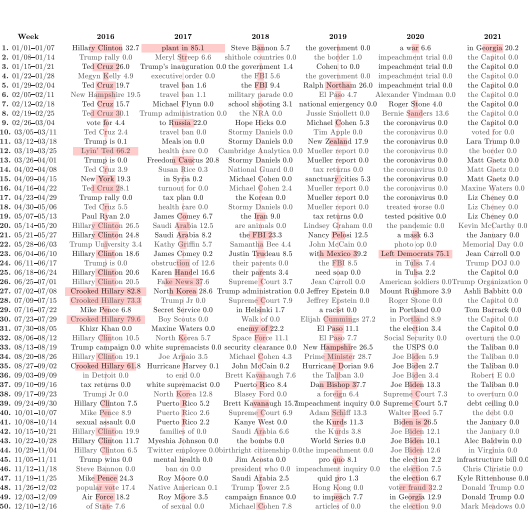
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## Theories bloom in darkness

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## Understanding the Sociotechnocene—Stories:

Toward a Science of Stories.

Claim: **How narratives** —we run on stories.

“What’s the John Dory?”

“They’ve lost the plot/thread”

Narrative hierarchies and scalability of stories.

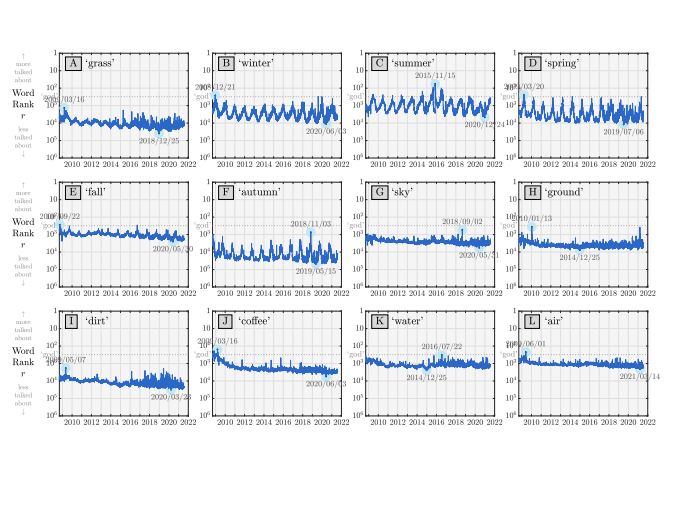
Research: Real-time and offline extraction of metaphors, frames, plots, narratives, conspiracy theories, and stories from large-scale text.

Research: The taxonomy of human stories.

To be built: Storyscopes—improvable, online, interactive instruments.

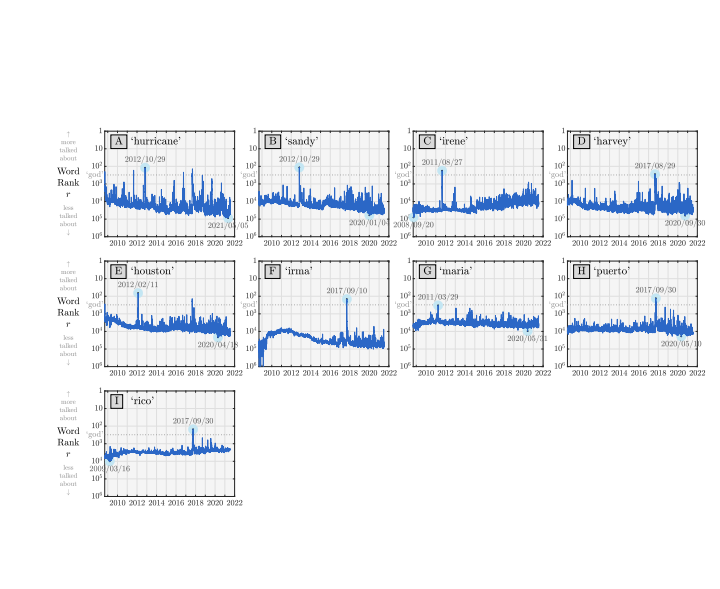
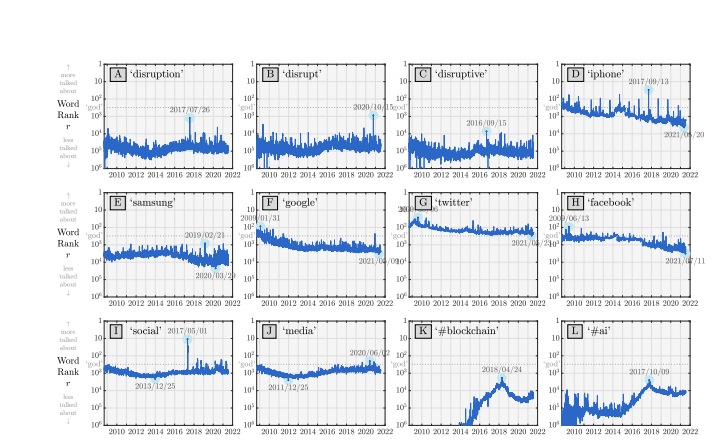
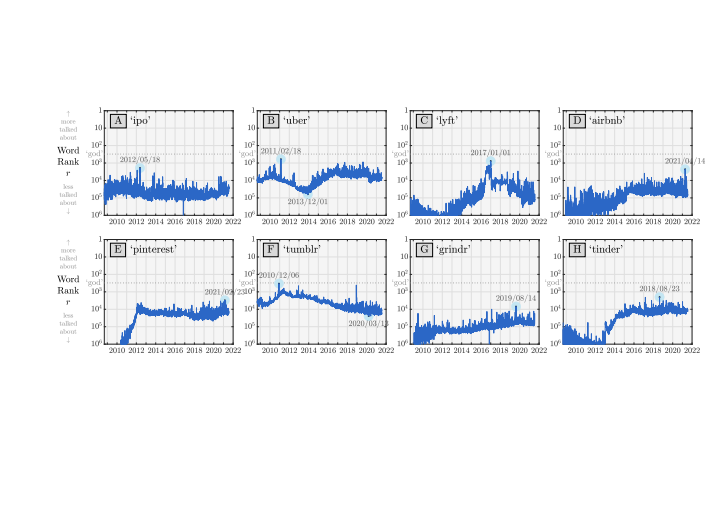
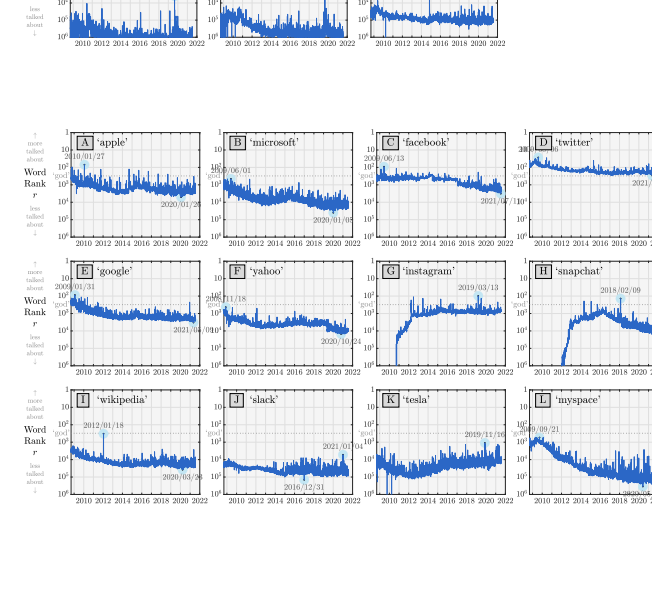
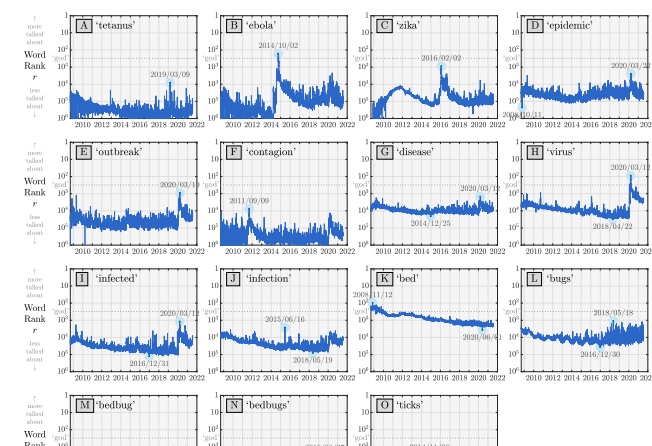
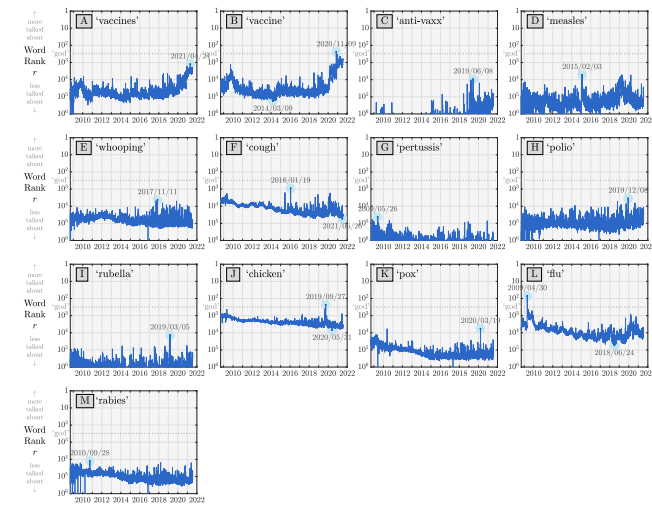
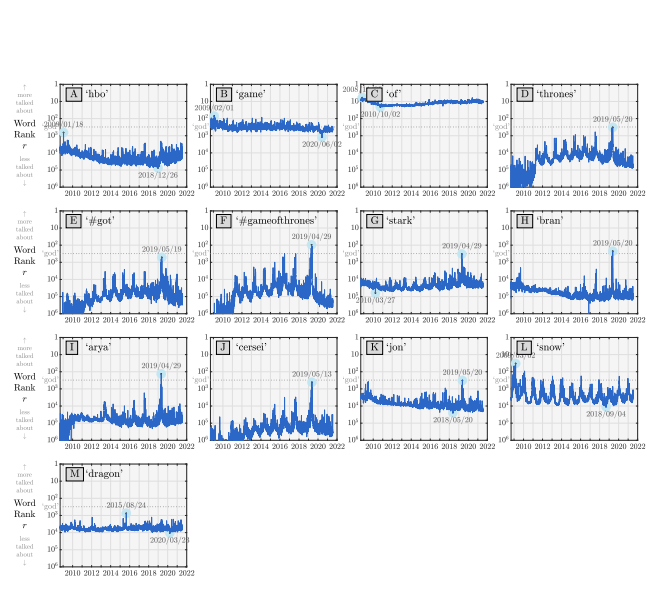
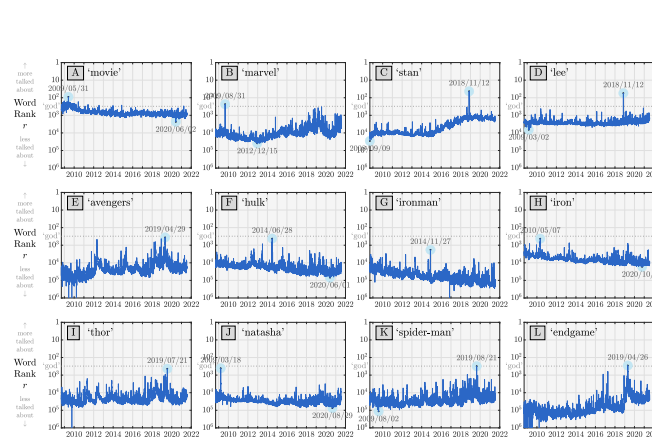
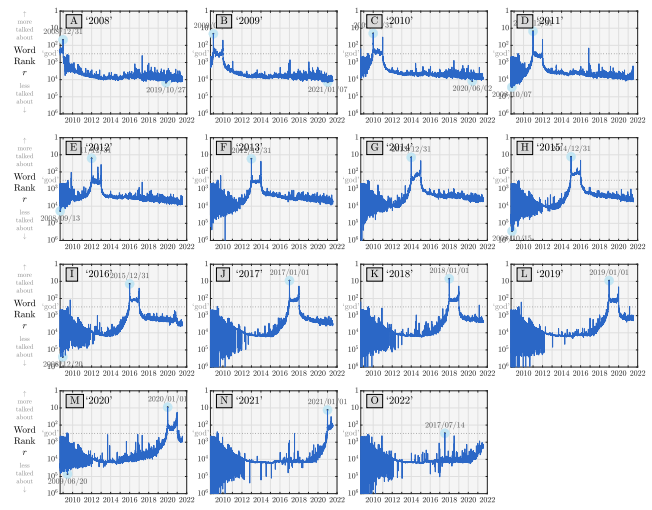
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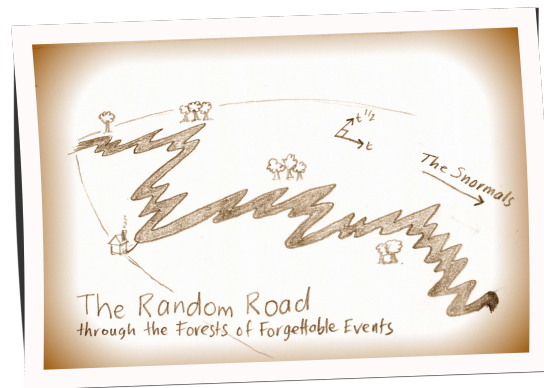
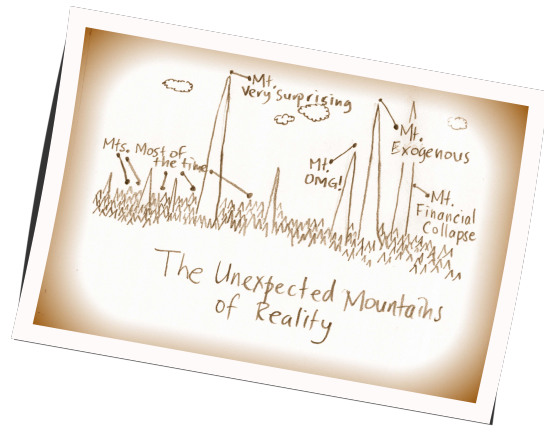
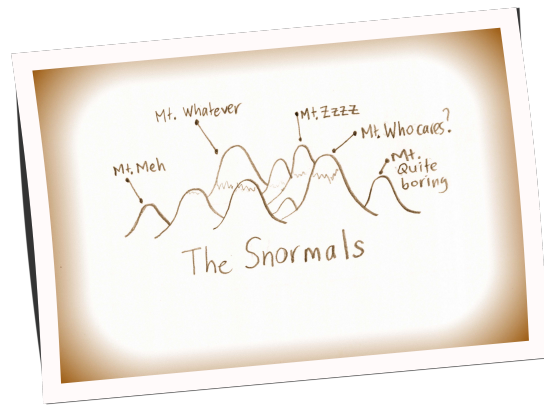
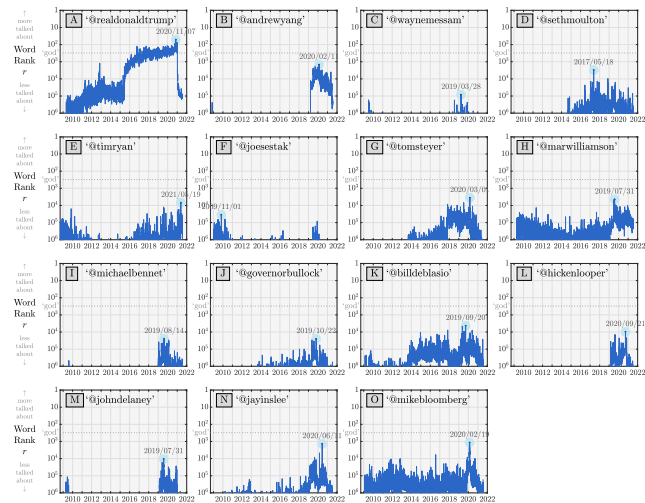
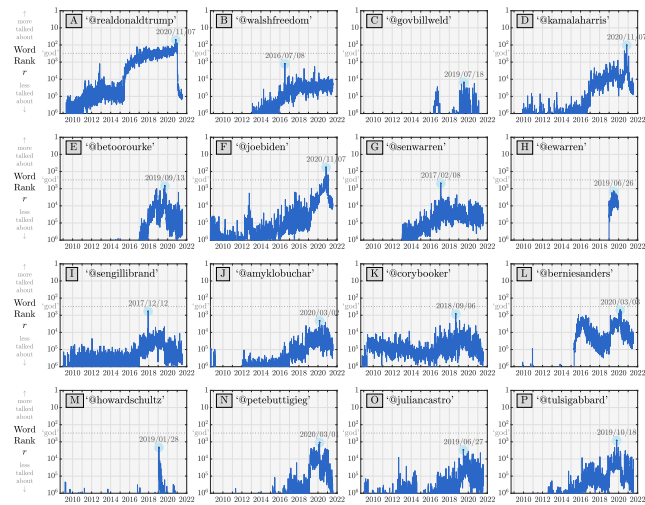
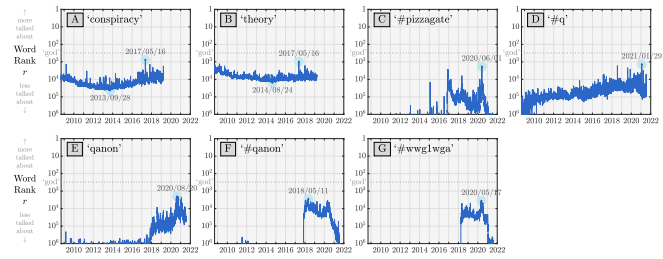
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## The long tail:



Money  
≡  
Belief

## Two questions about wealth distribution in the United States:

1. Estimate the percentage of all wealth owned by individuals when grouped into quintiles.
2. Estimate what you believe each quintile should own, ideally.
3. Extremes: 100, 0, 0, 0, 0 and 20, 20, 20, 20, 20

"Building a better America—One wealth quintile at a time"  
Norton and Ariely, 2011. [15]

## Wealth distribution in the United States: [15]

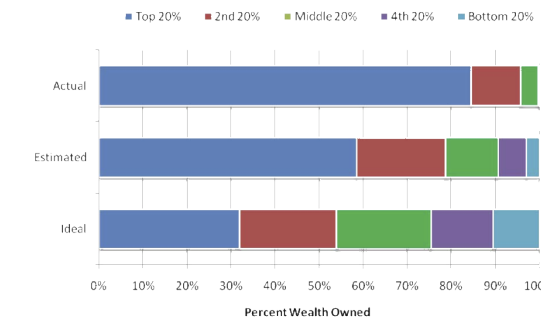


Fig. 2. The actual United States wealth distribution plotted against the estimated and ideal distributions across all respondents. Because of their small percentage share of total wealth, both the "4th 20%" value (0.2%) and the "Bottom 20%" value (0.1%) are not visible in the "Actual" distribution.

"Building a better America—One wealth quintile at a time"  
Norton and Ariely, 2011. [15]

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## Wealth distribution in the United States: [15]

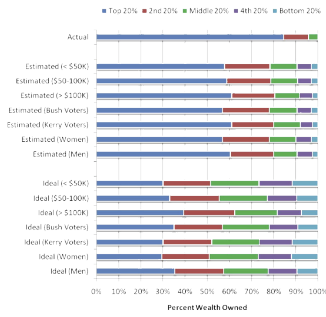


Fig. 3. The actual United States wealth distribution plotted against the estimated and ideal distributions of respondents of different income levels, political affiliations, and genders. Because of their small percentage share of total wealth both the "4th 20%" value (0.2%) and the "Bottom 20%" value (0.1%) are not visible in the "Actual" distribution.

Aside: The 1% framing may be effective but makes no sense.

## My, what big words you have ...



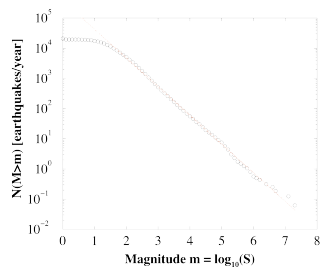
Test capitalizes on word frequency following a heavily skewed frequency distribution with a decaying power-law tail.

This Man Can Pronounce Every Word in the Dictionary (story here)

Best of Dr. Bailly

## The statistics of surprise:

### Gutenberg-Richter law

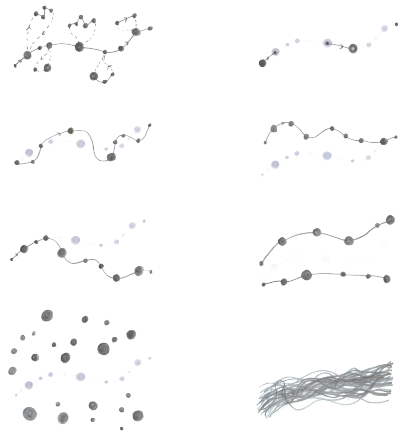


Log-log plot  
Base 10  
Slope = -1  
 $N(M > m) \propto m^{-1}$

From both the very awkwardly similar Christensen et al. and Bak et al.: "Unified scaling law for earthquakes" [5, 2]

## Adjacent narratives — why mistruths and conspiracy theories exist and flourish:

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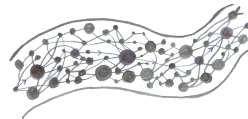
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## Why adjacent narratives exist and untrue stories flourish:

1/4. A real story is never recorded and retold completely

- Impossible to record every detail.
- Recording entails compression to scale of medium (narrative hierarchy).
- Story logic will be favored, and seemingly irrelevant aspects discarded.

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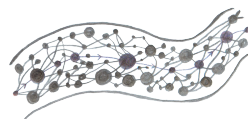
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## Why adjacent narratives exist and untrue stories flourish:

2/4. The infinitude of adjacent stories will afford "better" stories

- Better = More engaging, more motivating to spread, more durable under spreading.
- Better stories exist for truthful recorders and retellers (journalists).

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## Why adjacent narratives exist and untrue stories flourish:

3/4. The infinitude of adjacent stories means "better" stories exist for those who would disinform

- Adjacent stories may be truth-limited and/or falsehood-bearing.
- There may exist adjacent stories that conform to a world view/ideology.
- Even the seemingly non-adjacent must have some plausibility (Pizzagate).

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## Why adjacent narratives exist and untrue stories flourish:

4/4. Character is the short cut to story

- The barely implausible can be believed if the character can make it so.
- A believe-to-be evil character can do anything.
- Iterate between character and story to make the character fixed.



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## Things that spread quickly:



## + News + Conspiracy Theories ...

buzzfeed.com

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# The boiled-down essence of stories:

## The three fundamental events of (non-clone) life:

- ☿ Hatchings, Matchings, and Dispatchings.
- ☿ Stories encode survival algorithms.
- ☿ Survival algorithms are for both individuals and groups.
- ☿ Stories are dynamic paths of the true, the possible, the unlikely.
- ☿ The unifying theme of existence is existence.

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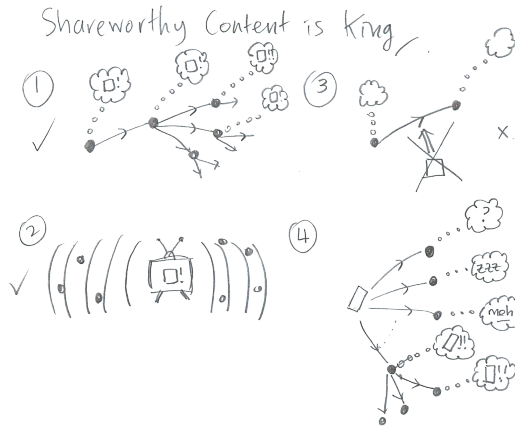
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## Deep fame:



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## Shareworthy Content is "King":

1. Build entities/messages/stories that have intrinsic and social value out in the **Social Wild**.
2. Advertise but lay off the social interactions.
3. Just keep trying and be trustworthy.
4. Of course it can all go wrong and be used for any purpose: good, stupid, bad, evil, ...
5. Essential implication: Billions of people can be harmoniously wrong.
6. Beware the evil, payola version.
7. Challenge: What's the societal vaccine for conspiracy theories?

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# Fame: Zipfian rank-frequency plots

## George Kingsley Zipf:

- ☿ Noted various rank distributions have power-law tails, often with exponent near -1 (word frequency, city sizes, species numbers, ...)
- ☿ Zipf's 1949 Magnum Opus:



"Human Behaviour and the Principle of Least-Effort" by G. K. Zipf (1949). [20]

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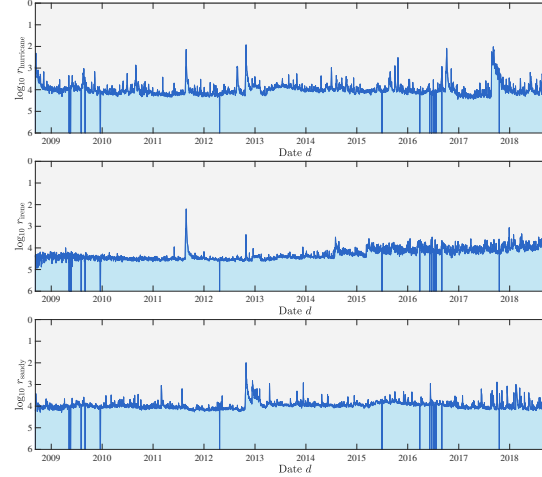
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## Awareness and Memory: Hurricanes



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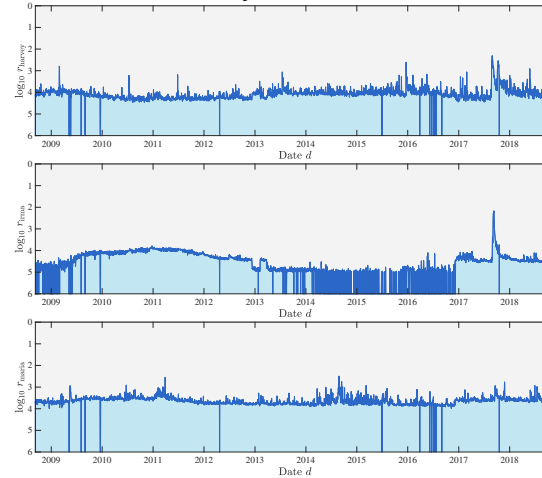
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## Awareness and Memory: Hurricanes



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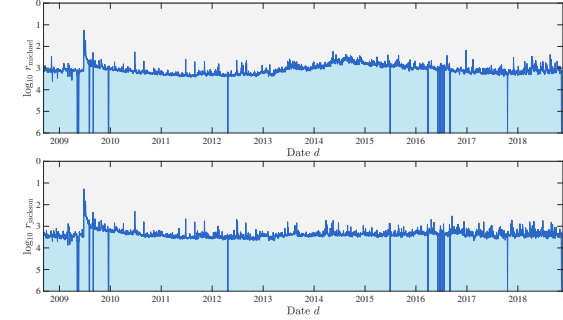
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## Michael Jackson



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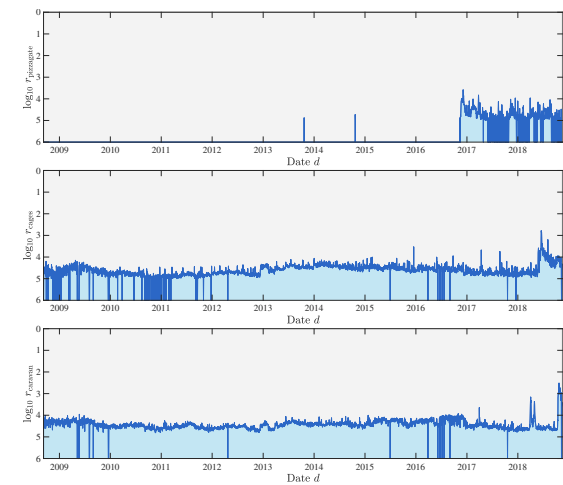
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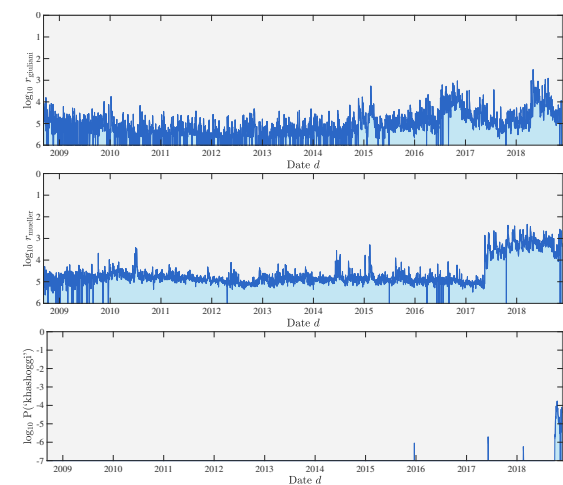
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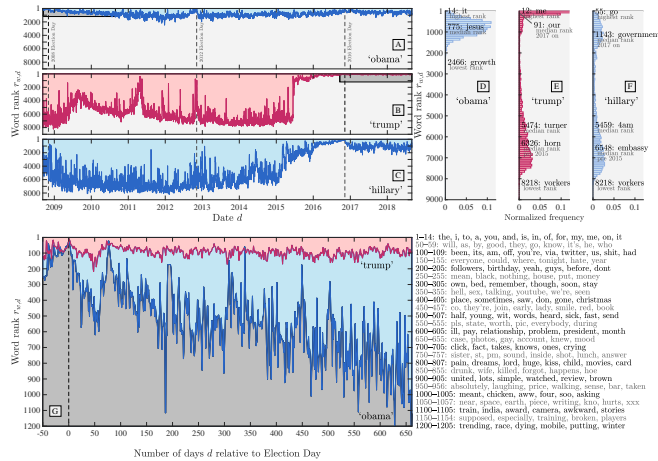
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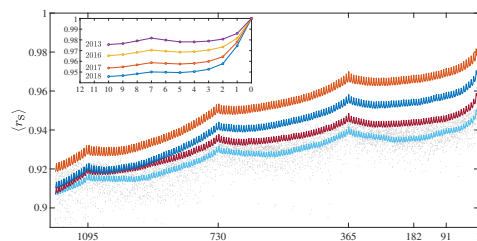
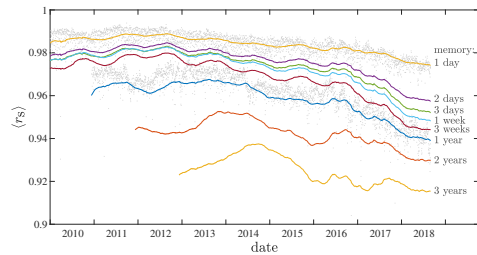
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## Lexical fame of POTUSes and possible POTUSes:



## Story turbulence:



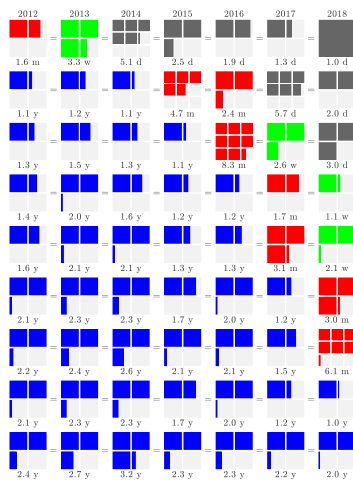
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