

# Finding Happiness

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Principles of Complex Systems,  
Vols. 1, 2, 3D, 4 Fourever, V for Vendetta

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## Outline

- Introduction
- Measurement
- Happiness
  - Some motivation
  - Measuring emotional content
  - Hedonometer
  - Analysis
  - Songs
  - Blogs
  - SOTU
  - A Better Lexical Lens
  - Geography
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  - Extras

## References

## A few key papers:

- “Measuring the happiness of large-scale written expression: Songs, blogs, and presidents.” [↗](#), Dodds and Danforth, *Journal of Happiness Studies*, **11**, 441–456, 2009. <sup>[11]</sup>
- “Temporal patterns of happiness and information in a global social network: Hedonometrics and Twitter” [↗](#), Dodds et al., *PLoS ONE*, **6**, e26752, 2011. <sup>[13]</sup>
- “Positivity of the English language” [↗](#), Kloumann et al., *PLoS ONE*, **7**, e29484, 2012. <sup>[28]</sup>
- “Human language reveals a universal positivity bias” [↗](#), Dodds et al., *Proc. Natl. Acad. Sci.*, **112**, 2389–2394, 2015. <sup>[10]</sup>

## A few more key papers:

- “Sentiment analysis methods for understanding large-scale texts: A case for using continuum-scored words and word shift graphs” [↗](#), Reagan et al., *EPJ Data Science*, **6**, 2017. <sup>[37]</sup>
- “Generalized word shift graphs: A method for visualizing and explaining pairwise comparisons between texts” [↗](#), Gallagher et al., *EPJ Data Science*, **10**, 4, 2021. <sup>[17]</sup>
- “Ousiometrics and Telegnomics: The essence of meaning conforms to a two-dimensional powerful-weak and dangerous-safe framework with diverse corpora presenting a safety bias” [↗](#), Dodds et al., 2021. <sup>[9]</sup>

## Economics, Schmeconomics

### Alan Greenspan (September 18, 2007):

“I’ve been dealing with these big mathematical models of forecasting the economy ...  
If I could figure out a way to determine whether or not people are more fearful or changing to more euphoric, I don’t need any of this other stuff.  
I could forecast the economy better than any way I know.”



<http://wikipedia.org>

## Economics, Schmeconomics

### Greenspan continues:

“The trouble is that we can’t figure that out. I’ve been in the forecasting business for 50 years. I’m no better than I ever was, and nobody else is. Forecasting 50 years ago was as good or as bad as it is today. And the reason is that human nature hasn’t changed. We can’t improve ourselves.”

### Jon Stewart:

“You just bummed the @\*!# out of me.”



[wildbluffmedia.com](http://wildbluffmedia.com)

- From the [Daily Show](#) [↗](#) (September 18, 2007; @5:13)
- The full interview was once [here](#) [↗](#).

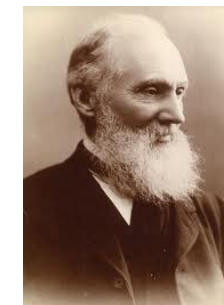
## This is a Collateralized Debt Obligation:



### Robert Kennedy on the Gross Domestic Product (GDP) in 1968:

“It measures everything except that which makes life worthwhile. And it can tell us everything about America except why we are proud that we are Americans.” <sup>[26, 25]</sup>

## Basic Science ≈ Describe + Explain:

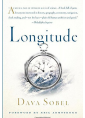


### Lord Kelvin (possibly):

- “To measure is to know.”
- “If you cannot measure it, you cannot improve it.”
- But also:
- “There is nothing new to be discovered in physics now. All that remains is more and more precise measurement.”
- “X-rays will prove to be a hoax.”

## A brief history of measuring time:

- Megaliths for Big Time
- Sundials, 1500 BC, Egypt (solid for over 2000 years)
- Escapements (200s), Hourglasses (1300s?), Pendulum clocks (Galileo, 1500s)
- Chronometers, 1700s:



"Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time" [a](#) [t](#)  
by Dava Sobel (2007).<sup>[39]</sup>

- Billionths of a second accuracy: Atomic clocks (Lord Kelvin, 1879)

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## Measuring temperature was thought impossible:

The properties measured by our instruments usually begin as subjective judgments. Temperature is a good example. People were aware of variations in temperature long before there were any objective measurements of temperature. Judgments of temperature are imperfectly correlated among different persons, or even the same person at different times, depending on the humidity, the person's activity level and age, surrounding air currents, and so on. **The idea that anything as subtle and complex as all the manifestations of changes in temperature could be measured and quantified on a single numerical scale was scoffed at as impossible, even by the leading philosophers of the sixteenth century.** The first thermometer invented by Galileo in 1592 did not go far in dispelling the notion that temperature was inherently unmeasurable, because the earliest thermometers, for about their first hundred years, were so imperfect as to make it possible for those who wished to do so to argue that no one could ever succeed in measuring temperature. Temperature was then confounded with all the subtleties of subjective judgment, which easily seem incompatible with a single numerical scale of measurement. How could the height of a column of mercury in a glass tube possibly reflect the rich varieties of temperature—damp cold, dank cold, frosty cold, crisp cold, humid heat, searing heat, scalding heat, dry heat, feverish heat, prickly heat, and so on?

From "Bias in Mental Testing", Arthur Jensen, 1980<sup>[22]</sup>  
per @SilverVVulpes [t](#): Also: Inventing Temperature, Hasok Chang, 2004<sup>[3]</sup>

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## Measuring temperature was thought impossible:

The early thermometers were inconsistent, both with themselves and with each other. Because they consisted of open-ended glass tubes, they were sensitive to changes in barometric pressure as well as to temperature. And there were problems of calibration, such as where to locate the zero point and how to divide the column of mercury into units. It was believed, incorrectly, that all caves had the same temperature, so thermometers were calibrated in caves. The freezing and boiling points of water were also used in calibration, but, as these vary with impurities in the water and the barometric pressure, the calibration of different thermometers at different times and places resulted in thermometers that failed to correlate perfectly with one another in any given instance. They lacked reliability, as we now would say.

All the while, no one knew what temperature is in a theoretical or scientific sense. There was no theory of thermodynamics that could explain temperature phenomena and provide a complete scientific rationale for the construction and calibration of thermometers. Yet quite adequate and accurate thermometers, hardly differing from those we use today, were eventually developed by the middle of the eighteenth century. Thus the objective measurement of temperature considerably preceded the development of an adequate theory of temperature and heat, and necessarily so, as the science of thermodynamics could not possibly have developed without first having been able to quantify or measure the temperatures of liquids, gasses, and other substances independently of

From "Bias in Mental Testing", Arthur Jensen, 1980<sup>[22]</sup>  
per @SilverVVulpes [t](#): Also: Inventing Temperature, Hasok Chang, 2004<sup>[3]</sup>

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## What matters and what's measurable:



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## Panometer—Three kinds of lexical meters:



- Principled lexical meters:
  - The Hedonometer.
  - The Lexicorimometer.
- Ground truth lexical meters:
  - Insomniometer.
  - Hangovermeter.
- Bootstrap lexical meters:
  - Boredometer.
  - Hashtagometers.

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## Measuring Happiness and Sadness:



Socrates et al.: eudaimonia<sup>[23]</sup>      Bentham: hedonistic calculus      Jefferson: ...the pursuit of happiness

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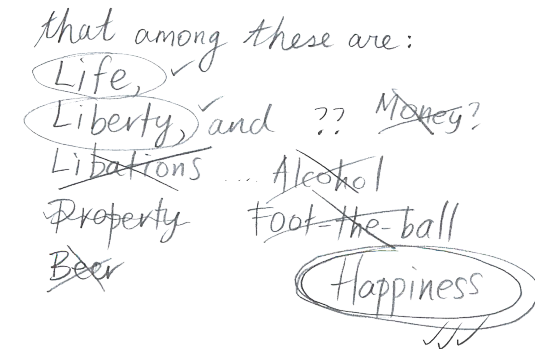
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## Early drafts:



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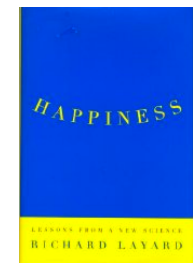
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## Happiness:

Even the odd modern economist is happy:  
"Happiness" by Richard Layard<sup>[29]</sup>



[amazon](#) [t](#)

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# What makes us happy?—Layard’s summary:

## Dominant factors:

- Family relationships
- Financial situation
- Work
- Community and Friends
- Health
- Personal Values
- Personal Freedom

## Unimportant factors:

- Age
- Gender
- Education
- Inherent intelligence
- Looks

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# Some easy knocks:



“The Passionate State of Mind: And Other Aphorisms”  
by Eric Hoffer (1954). [21]

“The search for happiness is one of the chief sources of unhappiness.”

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# Desiring happiness—not just for boffins:

- Average people routinely report being happy is what they want most in life [29, 30, 8]
- And it matters: “Happy people live longer...” Survey by Diener and Chan. [8]

## A Plateau of Happiness

A country's wealth may not always dictate the happiness of its people.

As part of the World Values Survey project, inhabitants of different countries and territories were asked how happy or satisfied they were. Below is a sampling of happiness rankings, along with economic status.



## National indices of well-being:

- Bhutan
- UK
- France
- Australia

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## 30 Rock, S7E8:

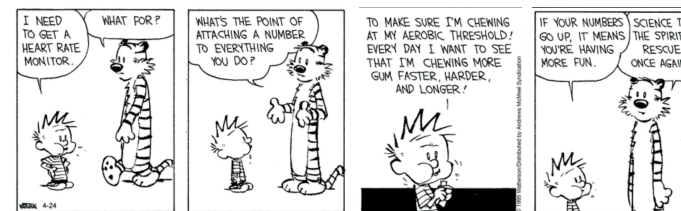


JD: “Before she died, Colleen told me—she just wants me to be happy. ‘I just want you to be happy.’ You know who you say that to? A loser. Someone who can’t hope for anything more in life than just being happy. You say that to someone who has disappointed you.”  
LL: “Jack.”

JD: “No. It’s perfect. She’s a genius. One last twist of the knife. Well, thank you for coming, Lemon, but I better get going. The funeral is tomorrow. Colleen wanted to be buried before the rest of the family found out and sold her body to a haunted house. And, of course, I get to eulogize Colleen at the service. One more chance to disappoint her as she looks up at me from her throne in hell.”

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# Some easy knocks:

Colbert: “Happiness is totally overrated ...”

“Happiness is for the weak.”

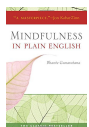


Full interview with Jennifer Senior was [here](#)

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# Meaning rather than happiness:



“Mindfulness in Plain English”  
by Henepola Gunaratana (1992). [20]



“Flow”  
by Mihaly Csikszentmihalyi (1990). [6]

- Can we measure Flow in a big data way?
- Maybe drops in social media usage indicate people are doing okay?

# Emotional content

## So how does one measure

- happiness?
- levels of other emotional states?

## Just ask people how happy they are.

- Experience sampling [5, 7, 6] (Csikszentmihalyi et al.)
- Day reconstruction [24] (Kahneman et al.)

## But self-reporting has some drawbacks:

- relies on memory and self-perception
- induces misreporting [31]
- costly

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# Happiness, attention, and doing:

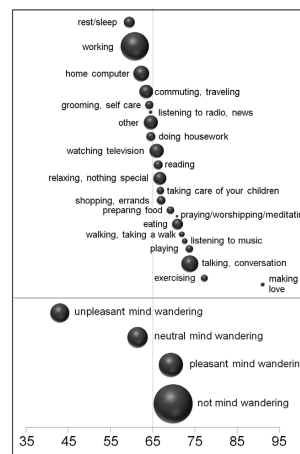


Fig. 1. Mean happiness reported during each activity (top) and while mind wandering to unpleasant topics, neutral topics, pleasant topics or not mind wandering (bottom). Dashed line indicates mean of happiness across all samples. Bubble area indicates the frequency of occurrence. The largest bubble (“not mind wandering”) corresponds to 53.1% of the samples, and the smallest bubble (“praying/worshipping/meditating”) corresponds to 0.1% of the samples.

Killingsworth and Gilbert, Science, 2010 [27]

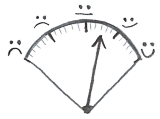
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We'd like to build an 'hedonometer':



An instrument to 'remotely-sense' emotional states and levels, in real time or post hoc.

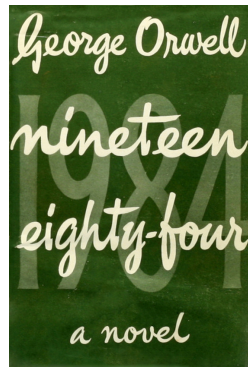
Ideally:

- Transparent
- Fast
- Based on written expression
- Uses human evaluation
- Non-reactive
- Complementary to self-reported measures
- Improvable

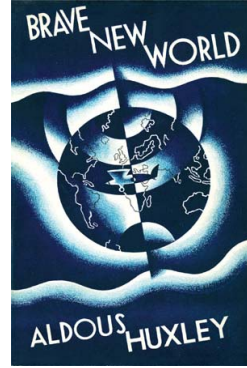
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We don't want to end up here:



Science



Policy

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Ousiometrics before we called it that:

Measuring essential meaning [9]

- Idea: Build on measures of the essential meaning of individual words.
- Osgood et al. (1957) [36] identified a basis of three psychological variables as semantic differentials:
  - Evaluation, Potency, and Activation.
- EPA was recast by Mehrabian and Russell (1974) [33] in the context of emotion:
  - Valence (or sometimes Pleasure): bad ↔ good
  - Arousal: passive ↔ active
  - Dominance: weak ↔ strong
- VAD became more commonly used framework.
- 'VAD ≡ EAP' (more later).

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ANEW study

- ANEW = "Affective Norms for English Words"
- Study: participants shown lists of isolated words
- Asked to grade each word's valence, arousal, and dominance level
- Integer scale of 1-9
- $N = 1034$  words—previously identified as bearing emotional weight
- Participants = College students (\*cough\*)
- Results published by Bradley and Lang (1999) [2]

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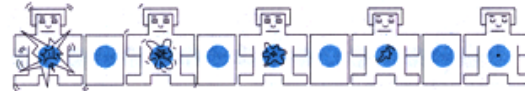
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1999 ANEW study—three 1-9 scales: [2]

valence:



arousal:



dominance:



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ANEW study:

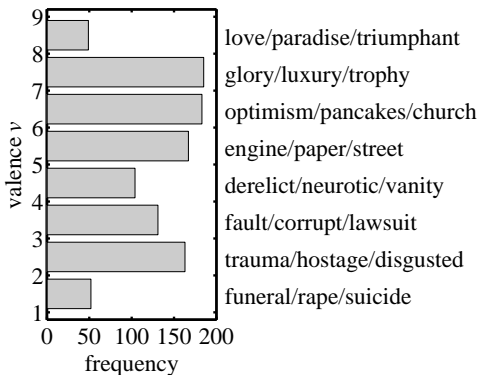
Valence = Happiness:

- Valence scale presented to participants as a 'happy-unhappy scale.'
- Participants were further told:
  - "At one extreme of this scale, you are happy, pleased, satisfied, contented, hopeful. ..."
  - The other end of the scale is when you feel completely unhappy, annoyed, unsatisfied, melancholic, despaired, or bored."

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ANEW study words—examples



- love/paradise/triumphant
- glory/luxury/trophy
- optimism/pancakes/church
- engine/paper/street
- derelict/neurotic/vanity
- fault/corrupt/lawsuit
- trauma/hostage/disgusted
- funeral/rape/suicide

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Analysing text:

- Simplest measure for a text:

$$\theta_{avg} = \sum_{i=1}^N p_i \theta_i$$

where  $p_i$  is fractional abundance of word  $i$  and  $\theta$  is average valence, arousal, or dominance for word  $i$ .

- Focus on happiness (valence),  $\theta = h$ .
- Average happiness typically falls between 5 and 7.

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Measuring the perceived happiness of a text:

Lyrics for Michael Jackson's Billie Jean

"She was more like a **beauty queen** from a **movie** scene.  
And **mother** always told me, be careful who you **love**.  
And be careful of what you do 'cause the **lie** becomes the **truth**.  
Billie Jean is not my lover, She's just a **girl** who claims that I am the one.

ANEW words

k	word	$v_k$	$f_k$
1	love	8.72	1
2	mother	8.39	1
3	baby	8.22	3
4	beauty	7.82	1
5	truth	7.80	1
6	people	7.33	2
7	strong	7.11	1
8	young	6.89	2
9	girl	6.87	4
10	movie	6.86	1
11	perfume	6.76	1
12	queen	6.44	1
13	name	5.55	1
14	lie	2.79	1

$$v_{text} = \frac{\sum_k v_k f_k}{\sum_k f_k}$$

↓

$$v_{Billie\ Jean} = 7.1$$

-----

$$v_{Thriller} = 6.3$$

-----

$$v_{Michael\ Jackson} = 6.4$$

- Temperature-like measure—large numbers only.
- Not meant to be used at level of sentence, paragraph, song, tweet, ...
- Important: Social measure of sentiment.
- Later: see instrument is tunable.



## Bottom 50 of $\approx 20,000$ artists:

Rank	Artist	$h_{avg}$	Rank	Artist	$h_{avg}$
1	Slayer	4.80	26	Nine Inch Nails	5.34
2	Misfits	4.88	27	Sevendust	5.34
3	Staind	4.93	28	Annihilator	5.35
4	Slipknot	4.98	29	Biohazard	5.36
5	Darkthrone	4.98	30	Insane Clown Posse	5.36
6	Death	5.02	31	Megadeth	5.36
7	Black Label Society	5.05	32	Manowar	5.37
8	Pig	5.08	33	Zebrahead	5.38
9	Voivod	5.14	34	Danzig	5.39
10	Fear Factory	5.15	35	Acid Drinkers	5.40
11	Iced Earth	5.16	36	Dag Nasty	5.40
12	Simple Plan	5.16	37	Iron Maiden	5.40
13	Machine Head	5.17	38	Florsam And Jetsam	5.41
14	Metallica	5.19	39	Powerman 5000	5.42
15	Dimmu Borgir	5.20	40	Anthrax	5.43
16	Mudvayne	5.21	41	Rhapsody	5.43
17	Linkin Park	5.22	42	Korn	5.43
18	Papa Roach	5.22	43	Rage	5.44
19	Audioslave	5.24	44	Accept	5.45
20	Rage Against The Machine	5.24	45	Esham	5.46
21	Cradle Of Filth	5.25	46	Blind Guardian	5.46
22	Dark Tranquillity	5.26	47	White Zombie	5.47
23	Jack Off Jill	5.28	48	Helloween	5.50
24	Evanescence	5.30	49	W.A.S.P.	5.50
25	Twiztid	5.33	50	Green Day	5.50

(criteria:  $\geq 50$  songs and  $\geq 1000$  ANEW words)

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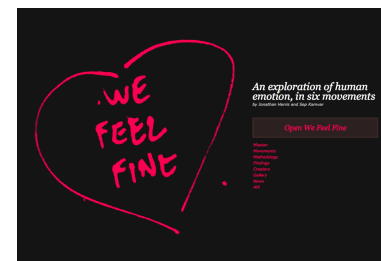
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Text:	$h_{avg}$	Words with a similar score:
Soul/Gospel lyrics [12]	6.9	chocolate (6.88), leisurely (6.88), penthouse (6.81)
Pop lyrics [12]	6.7	dream (6.73), honey (6.73), sugar (6.74)
Dante's Paradise [2]	6.5	muffin (6.57), rabbit (6.57), smooth (6.58)
Tweets, 9/9/2008 to 12/31/2010	6.4	thought (6.39), face (6.39), blond (6.42)
Rock lyrics [12]	6.3	church (6.28), tree (6.32), air (6.34)
Enron Emails [2]	6.2	clouds (6.18), alert (6.20), computer (6.24)
State of the Union Messages [12]	6.1	grass (6.12), idol (6.12), bottle (6.15)
New York Times (1987–2007) [38]	6.0	hotel (6.00), tennis (6.02), wonder (6.03)
Blogs [12]	5.8	owl (5.80), whistle (5.81), humble (5.86)
Dante's Inferno [2]	5.5	glacier (5.50), repentant (5.53), mischief (5.57)
Heavy Metal lyrics [12]	5.4	lamp (5.41), elevator (5.44), truck (5.47)

## Data sets:

Blog phrases containing “I feel...”, “I am feeling”, etc., taken from [wefeelfine.org](http://wefeelfine.org) (API, 2005–2010, RIP)



Created by Jonathan Harris & Sep Kamvar

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## Harris:

- So I really consider myself a storyteller.
- But I don't really tell stories in the usual way, in the sense that I don't usually tell my own stories.
- Instead, I'm really interested in building tools that allow large numbers of other people to tell their stories, people all around the world.
- I do this because I think that people actually have a lot in common.
- I think people are very similar, but I also think that we have trouble seeing that.

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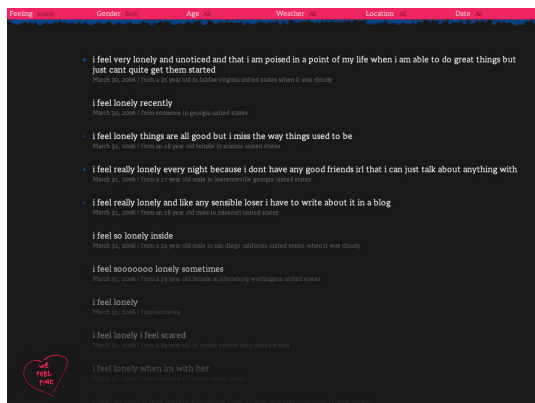
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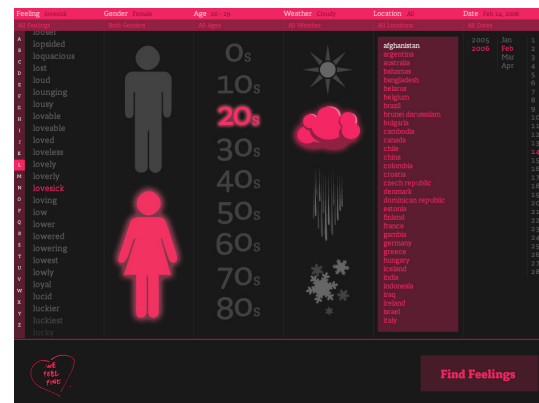
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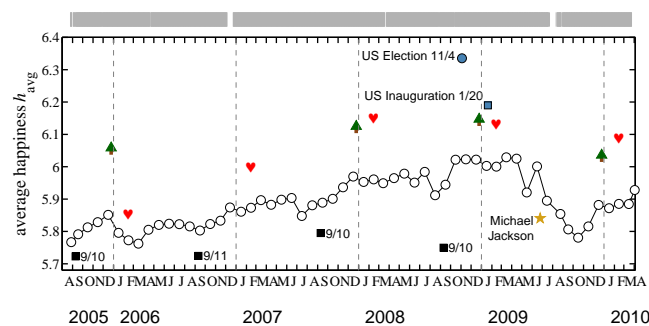
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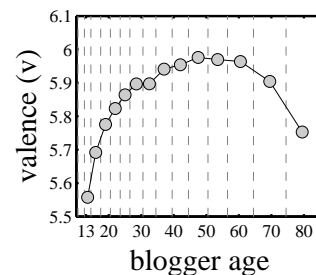
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## Blogs—Overall trend



From [wefeelfine.org](http://wefeelfine.org) by Jonathan Harris & Sep Kamvar



Average happiness as a function of the age bloggers report they will turn in the year of their posting.

## Blogs—Age

- Self-report studies find **little variation** in happiness with age [14, 15]
- Surprising: Expect a rise and fall.
- A ‘challenge’ for theory...
- Related to the Easterlin Paradox: **Money doesn't buy happiness**
- But maybe it does a little bit—Veenhoven & Hagerty (2003) and Wolfers & Stevenson (2008).

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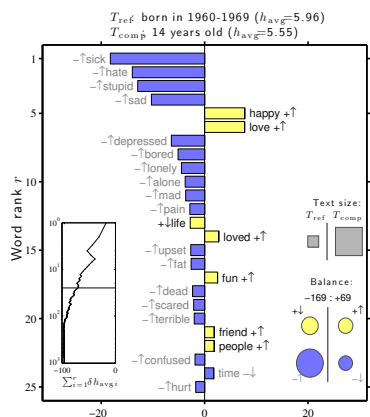
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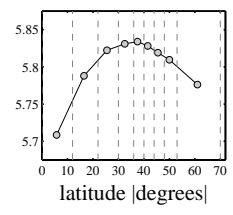
References



Per word average happiness shift  $\delta h_{avg,r}$  (%)

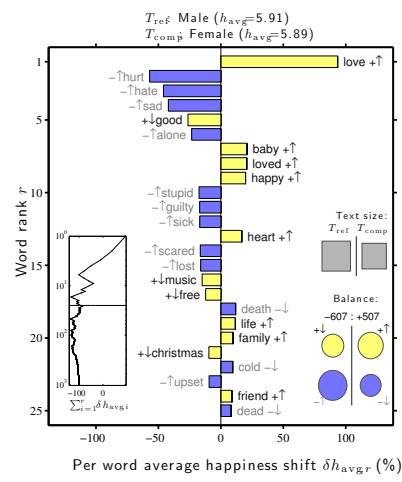
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### Blogs—Latitude



- Near equator—social factors**
- Increase in 'sad', 'bored', 'lonely', 'stupid', 'guilty'
  - Decrease in 'good' and 'people'
- Near poles—social/psychological/climate**
- Increase in 'sick', 'guilty', 'cold', 'depressed', and 'headache' and decrease of 'love' and 'life.'
  - Offset by decrease in 'hurt' and 'pain.'
  - More 'bed' and 'sleep.'

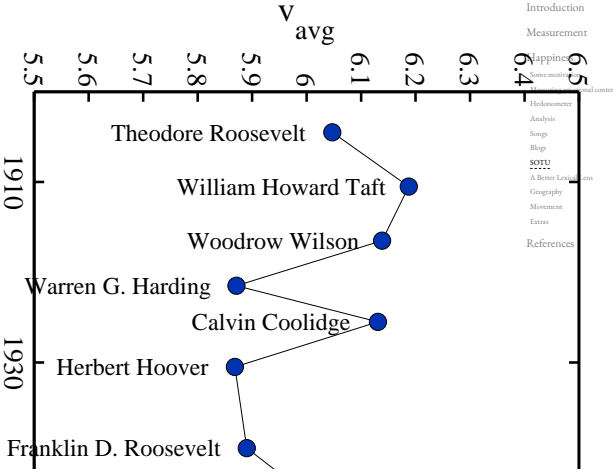
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Per word average happiness shift  $\delta h_{avg,r}$  (%)

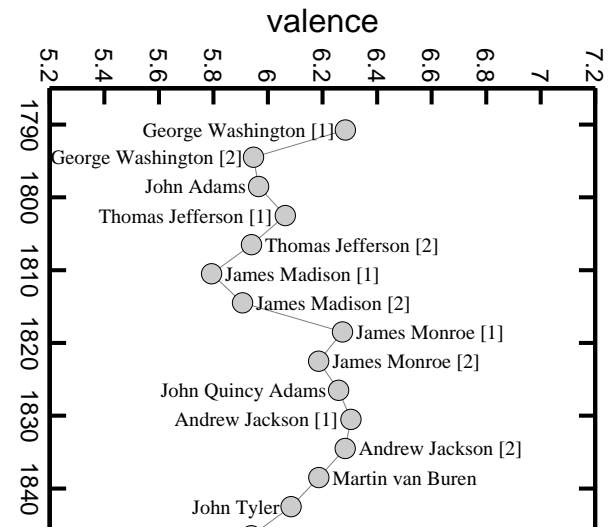
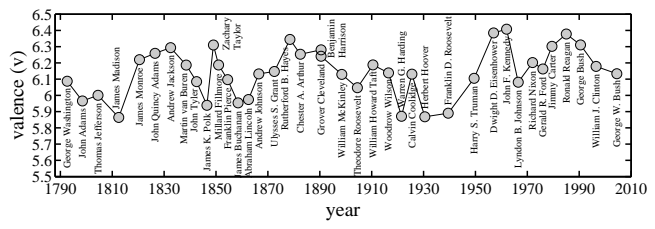
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### labMT 1.0: language assessment by Mechanical Turk



- Four corpora:
- Twitter
  - Google Books
  - Music Lyrics
  - New York Times

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valence rank	word	valence	std dev	twitter rank	g-books rank	nyt rank	lyrics rank
1	laughter	8.50	0.93	3600	-	-	1728
2	happiness	8.44	0.97	1853	2458	-	1230
3	love	8.42	1.11	25	317	328	23
4	happy	8.30	0.99	65	1372	1313	375
5	laughed	8.26	1.16	3334	3542	-	2332
6	laugh	8.22	1.37	1002	3998	4488	647
7	laughing	8.20	1.11	1579	-	-	1122
8	excellent	8.18	1.10	1496	1756	3155	-
9	laughs	8.18	1.16	3554	-	-	2856
10	joy	8.16	1.06	988	2336	2723	809
11	successful	8.16	1.08	2176	1198	1565	-
12	win	8.12	1.08	154	3031	776	694
13	rainbow	8.10	0.99	2726	-	-	1723
14	smile	8.10	1.02	925	2666	2898	349
15	won	8.10	1.22	810	1167	439	1493
16	pleasure	8.08	0.97	1497	1526	4253	1398
17	smiled	8.08	1.07	-	3537	-	2248
18	rainbows	8.06	1.36	-	-	-	4216
19	winning	8.04	1.05	1876	-	1426	3646
20	celebration	8.02	1.53	3306	-	2762	4070
21	enjoyed	8.02	1.53	1530	2908	3502	-
22	healthy	8.02	1.06	1393	3200	3292	4619
23	music	8.02	1.12	132	875	167	374
24	celebrating	8.00	1.14	2550	-	-	-
25	congratulations	8.00	1.63	2246	-	-	-
26	weekend	8.00	1.29	317	-	833	2256
27	celebrate	7.98	1.15	1606	-	3574	2108
28	comedy	7.98	1.15	1444	-	2566	-
29	jokes	7.98	0.98	2812	-	-	3808
30	rich	7.98	1.32	1625	1221	1469	890

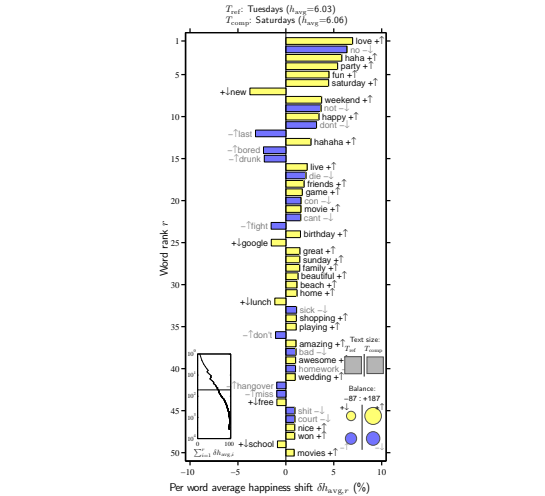
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5000 most frequently used words for each corpus.  
10,222 words, 50 evaluations each, 1–9 scale: [32]



Individual tweets have all kinds of potential impact:

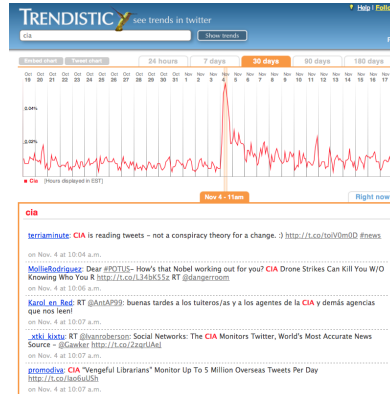
Meme come true: Fleetwood Mac re-enter US charts thanks



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Mentions of CIA on Twitter, end of 2011:

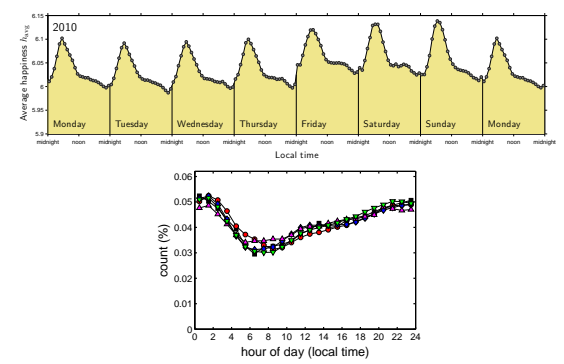


See story here for example [slate].

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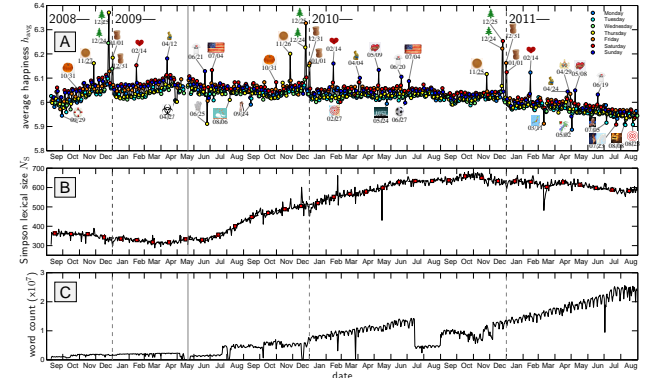
The daily unravelling of the human mind:



“Social Scientists waded into the Tweet stream”  
Greg Miller,  
Science, 333, 1814–1815, 2011. [34]

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Text element and context correlate in happiness scores:

- Compare ambient happiness with text element happiness.
- Rank correlation coefficient:  $r_s \approx 0.79, p\text{-value} < 10^{-10}$ .
- An on-average result: says nothing about any individual sentence.
- Extra random piece: stemming is fallible.

Ambient happiness:

Word	Delta	Total Tweets	Delta	Total Tweets	Delta	Total Tweets
1. happy	+0.041	3,567,017 (11)	+0.101	2,566,189 (8)	+0.008	1,000 (0)
2. Christmas	+0.004	4,906,196 (35)	+0.953 (1)	52,904 (4)	+0.024 (4)	1,000 (0)
3. vegan	+0.313	1,846,405 (90)	+0.005 (46)	30,500 (1)	+0.050 (42)	1,000 (0)
4. hope	+0.273	1,846,405 (90)	+0.010 (12)	1,000 (0)	+0.000 (0)	1,000 (0)
5. family	+0.251	5,014,406 (32)	+0.716 (7)	55,500 (1)	+0.280 (60)	1,000 (0)
6. our	+0.229	2,786,046 (24)	+0.000 (0)	1,000 (0)	+0.126 (35)	1,000 (0)
7. woman	+0.207	1,434,407 (16)	+0.159 (18)	61,302 (3)	+0.202 (38)	1,000 (0)
8. win	+0.200	9,356,405 (67)	+0.817 (5)	59,500 (1)	+0.360 (82)	1,000 (0)
9. vacation	+0.178	2,786,046 (24)	+0.077 (9)	49,500 (1)	+0.292 (63)	1,000 (0)
10. love	+0.164	4,676,407 (6)	+0.977 (2)	118,206,405 (87)	+0.681 (70)	1,000 (0)
11. love	+0.150	7,676,406 (27)	+0.656 (9)	33,500 (1)	+0.110 (9)	1,000 (0)
12. friends	+0.149	1,186,407 (18)	+0.615 (19)	63,500 (1)	+0.600 (41)	1,000 (0)
13. coffee	+0.147	2,586,406 (48)	+0.518 (14)	41,500 (1)	+0.100 (1)	1,000 (0)
14. cash	+0.140	1,286,406 (63)	+0.601 (14)	65,500 (1)	+0.502 (74)	1,000 (0)
15. man	+0.134	2,286,406 (52)	+0.727 (6)	66,500 (1)	+0.133 (36)	1,000 (0)
16. game	+0.129	5,186,405 (65)	+0.622 (13)	67,500 (1)	+0.208 (58)	1,000 (0)
17. success	+0.128	5,186,405 (65)	+0.221 (29)	69,500 (1)	+0.411 (95)	1,000 (0)
18. church	+0.133	1,816,406 (58)	+0.656 (47)	69,500 (1)	+0.546 (71)	1,000 (0)
19. validation	+0.127	2,286,406 (58)	+0.656 (15)	71,500 (1)	+0.129 (36)	1,000 (0)
20. Stephen Colbert	+0.126	2,386,407 (94)	+0.001 (43)	1,000 (0)	+0.163 (52)	1,000 (0)
21. rock	+0.118	2,686,406 (54)	+0.509 (16)	69,500 (1)	+0.339 (79)	1,000 (0)
22. God	+0.108	3,446,406 (48)	+0.195 (31)	73,500 (1)	+0.366 (89)	1,000 (0)
14. success	+0.109	1,286,406 (58)	+0.601 (14)	65,500 (1)	+0.471 (97)	1,000 (0)
23. 1	+0.099	8,586,406 (25)	+0.468 (20)	75,500 (1)	+0.525 (99)	1,000 (0)
24. success	+0.099	1,286,406 (58)	+0.601 (14)	65,500 (1)	+0.471 (97)	1,000 (0)
27. 3	+0.094	2,616,406 (48)	+0.326 (25)	77,500 (1)	+0.384 (64)	1,000 (0)
26. Obama	+0.093	2,286,406 (58)	+0.247 (29)	79,500 (1)	+0.500 (74)	1,000 (0)
29. today	+0.090	2,286,407 (9)	+0.126 (60)	79,500 (1)	+0.251 (96)	1,000 (0)
30. kiss	+0.072	1,786,406 (59)	+0.622 (11)	80,500 (1)	+0.630 (97)	1,000 (0)
31. use	+0.069	1,166,407 (19)	+0.261 (27)	81,500 (1)	+0.309 (70)	1,000 (0)
32. tomorrow	+0.061	1,386,407 (21)	+0.096 (38)	82,500 (1)	+0.380 (83)	1,000 (0)
33. Page	+0.057	1,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
14. heaven	+0.044	7,486,405 (71)	+0.074 (10)	83,500 (1)	+0.120 (34)	1,000 (0)
35. 3	+0.041	9,356,405 (66)	+0.836 (20)	86,500 (1)	+0.776 (92)	1,000 (0)
36. success	+0.039	1,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
37. yesterday	+0.033	3,086,406 (42)	+0.168 (33)	87,500 (1)	+0.747 (88)	1,000 (0)
38. success	+0.032	1,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
39. 7	+0.030	2,286,406 (53)	+0.503 (58)	89,500 (1)	+0.541 (95)	1,000 (0)
40. RTT	+0.028	1,886,406 (51)	+0.443 (59)	90,500 (1)	+0.443 (59)	1,000 (0)
41. Michael Jackson	+0.018	8,266,405 (70)	+0.213 (59)	91,500 (1)	+0.902 (83)	1,000 (0)
42. middle	+0.018	2,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
43. life	+0.012	1,486,407 (17)	+0.422 (22)	92,500 (1)	+0.422 (22)	1,000 (0)
14. health	+0.010	2,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
45. use	+0.008	3,286,406 (29)	+0.452 (17)	95,500 (1)	+0.174 (95)	1,000 (0)
46. work	+0.010	4,286,407 (11)	+0.174 (56)	96,500 (1)	+0.288 (88)	1,000 (0)
47. get	+0.008	2,286,407 (22)	+0.430 (24)	96,500 (1)	+0.430 (24)	1,000 (0)
48. top	+0.028	4,286,406 (22)	+0.621 (41)	96,500 (1)	+0.621 (41)	1,000 (0)
49. 1	+0.048	3,286,406 (21)	+0.621 (41)	96,500 (1)	+0.621 (41)	1,000 (0)
50. comment	+0.048	8,016,405 (14)	+0.366 (57)	100,500 (1)	+0.282 (97)	1,000 (0)

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Simpson lexical size,  $N_S$ :

Word	Delta	Total Tweets	Delta	Total Tweets	Delta	Total Tweets
1. happy	+0.041	3,567,017 (11)	+0.101	2,566,189 (8)	+0.008	1,000 (0)
2. Christmas	+0.004	4,906,196 (35)	+0.953 (1)	52,904 (4)	+0.024 (4)	1,000 (0)
3. school	+0.313	1,846,405 (90)	+0.005 (46)	30,500 (1)	+0.050 (42)	1,000 (0)
4. hope	+0.273	1,846,405 (90)	+0.010 (12)	1,000 (0)	+0.000 (0)	1,000 (0)
5. family	+0.251	5,014,406 (32)	+0.716 (7)	55,500 (1)	+0.280 (60)	1,000 (0)
6. our	+0.229	2,786,046 (24)	+0.000 (0)	1,000 (0)	+0.126 (35)	1,000 (0)
7. woman	+0.207	1,434,407 (16)	+0.159 (18)	61,302 (3)	+0.202 (38)	1,000 (0)
8. win	+0.200	9,356,405 (67)	+0.817 (5)	59,500 (1)	+0.360 (82)	1,000 (0)
9. vacation	+0.178	2,786,046 (24)	+0.077 (9)	49,500 (1)	+0.292 (63)	1,000 (0)
10. love	+0.164	4,676,407 (6)	+0.977 (2)	118,206,405 (87)	+0.681 (70)	1,000 (0)
11. love	+0.150	7,676,406 (27)	+0.656 (9)	33,500 (1)	+0.110 (9)	1,000 (0)
12. friends	+0.149	1,186,407 (18)	+0.615 (19)	63,500 (1)	+0.600 (41)	1,000 (0)
13. coffee	+0.147	2,586,406 (48)	+0.518 (14)	41,500 (1)	+0.100 (1)	1,000 (0)
14. cash	+0.140	1,286,406 (63)	+0.601 (14)	65,500 (1)	+0.502 (74)	1,000 (0)
15. man	+0.134	2,286,406 (52)	+0.727 (6)	66,500 (1)	+0.133 (36)	1,000 (0)
16. game	+0.129	5,186,405 (65)	+0.622 (13)	67,500 (1)	+0.208 (58)	1,000 (0)
17. success	+0.128	5,186,405 (65)	+0.221 (29)	69,500 (1)	+0.411 (95)	1,000 (0)
18. church	+0.133	1,816,406 (58)	+0.656 (47)	69,500 (1)	+0.546 (71)	1,000 (0)
19. validation	+0.127	2,286,406 (58)	+0.656 (15)	71,500 (1)	+0.129 (36)	1,000 (0)
20. Stephen Colbert	+0.126	2,386,407 (94)	+0.001 (43)	1,000 (0)	+0.163 (52)	1,000 (0)
21. rock	+0.118	2,686,406 (54)	+0.509 (16)	69,500 (1)	+0.339 (79)	1,000 (0)
22. God	+0.108	3,446,406 (48)	+0.195 (31)	73,500 (1)	+0.366 (89)	1,000 (0)
14. success	+0.109	1,286,406 (58)	+0.601 (14)	65,500 (1)	+0.471 (97)	1,000 (0)
23. 1	+0.099	8,586,406 (25)	+0.468 (20)	75,500 (1)	+0.525 (99)	1,000 (0)
24. success	+0.099	1,286,406 (58)	+0.601 (14)	65,500 (1)	+0.471 (97)	1,000 (0)
27. 3	+0.094	2,616,406 (48)	+0.326 (25)	77,500 (1)	+0.384 (64)	1,000 (0)
26. Obama	+0.093	2,286,406 (58)	+0.247 (29)	79,500 (1)	+0.500 (74)	1,000 (0)
29. today	+0.090	2,286,407 (9)	+0.126 (60)	79,500 (1)	+0.251 (96)	1,000 (0)
30. kiss	+0.072	1,786,406 (59)	+0.622 (11)	80,500 (1)	+0.630 (97)	1,000 (0)
31. use	+0.069	1,166,407 (19)	+0.261 (27)	81,500 (1)	+0.309 (70)	1,000 (0)
32. tomorrow	+0.061	1,386,407 (21)	+0.096 (38)	82,500 (1)	+0.380 (83)	1,000 (0)
33. Page	+0.057	1,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
14. heaven	+0.044	7,486,405 (71)	+0.074 (10)	83,500 (1)	+0.120 (34)	1,000 (0)
35. 3	+0.041	9,356,405 (66)	+0.836 (20)	86,500 (1)	+0.776 (92)	1,000 (0)
36. success	+0.039	1,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
37. yesterday	+0.033	3,086,406 (42)	+0.168 (33)	87,500 (1)	+0.747 (88)	1,000 (0)
38. success	+0.032	1,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
39. 7	+0.030	2,286,406 (53)	+0.503 (58)	89,500 (1)	+0.541 (95)	1,000 (0)
40. RTT	+0.028	1,886,406 (51)	+0.443 (59)	90,500 (1)	+0.443 (59)	1,000 (0)
41. Michael Jackson	+0.018	8,266,405 (70)	+0.213 (59)	91,500 (1)	+0.902 (83)	1,000 (0)
42. middle	+0.018	2,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
43. life	+0.012	1,486,407 (17)	+0.422 (22)	92,500 (1)	+0.422 (22)	1,000 (0)
14. health	+0.010	2,286,406 (58)	+0.121 (62)	83,500 (1)	+0.166 (62)	1,000 (0)
45. use	+0.008	3,286,406 (29)	+0.452 (17)	95,500 (1)	+0.174 (95)	1,000 (0)
46. work	+0.010	4,286,407 (11)	+0.174 (56)	96,500 (1)	+0.288 (88)	1,000 (0)
47. get	+0.008	2,286,407 (22)	+0.430 (24)	96,500 (1)	+0.430 (24)	1,000 (0)
48. top	+0.028	4,286,406 (22)	+0.621 (41)	96,500 (1)	+0.621 (41)	1,000 (0)
49. 1	+0.048	3,286,406 (21)	+0.621 (41)	96,500 (1)	+0.621 (41)	1,000 (0)
50. comment	+0.048	8,016,405 (14)	+0.366 (57)	100,500 (1)	+0.282 (97)	1,000 (0)

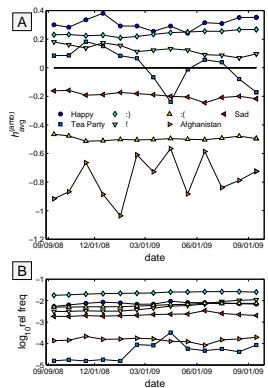
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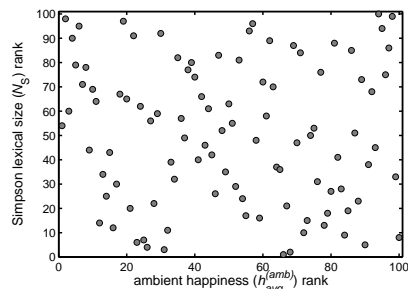
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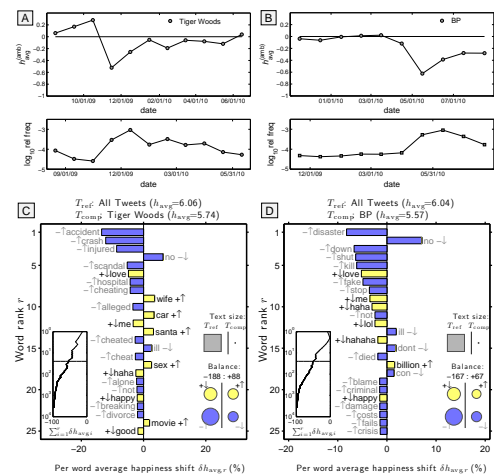
## Ambient happiness:



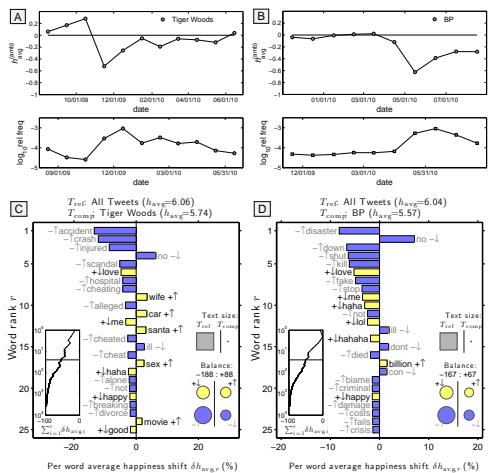
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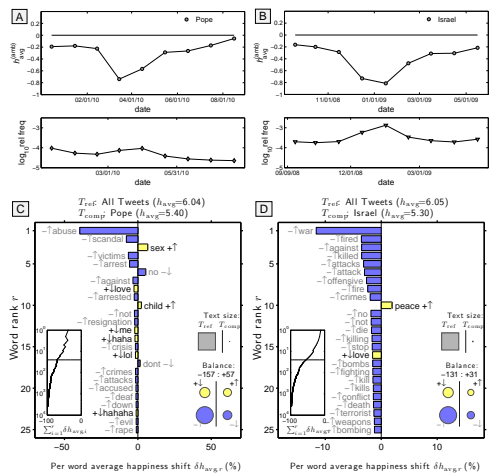
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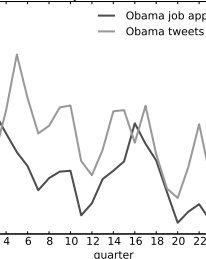


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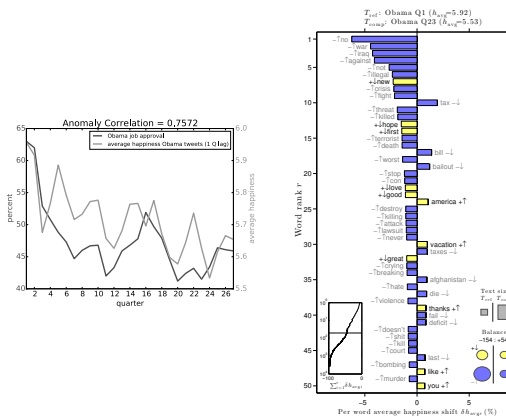
“Public opinion polling with Twitter”  
Cody et al.,  
Available online at  
<https://arxiv.org/abs/1608.02024>, 2016. [4]

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Anomaly Correlation = 0.76

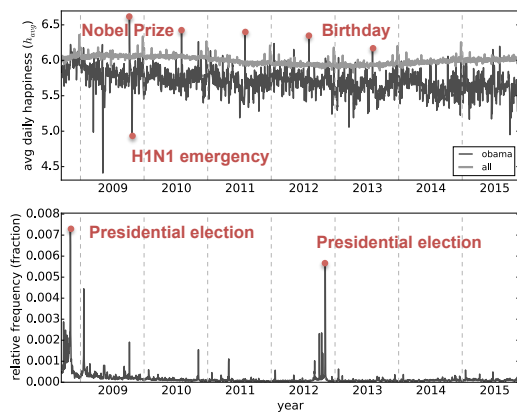


## Twitter's Feels predict Obama's Approval Rating:



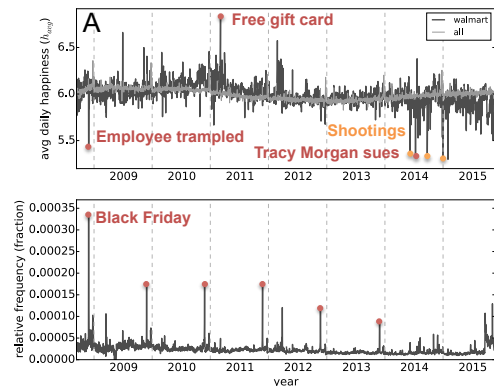
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## Ambient happiness for “Obama”:



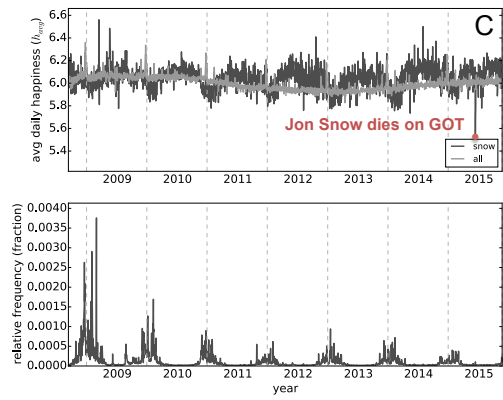
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## Ambient happiness for “Walmart”:



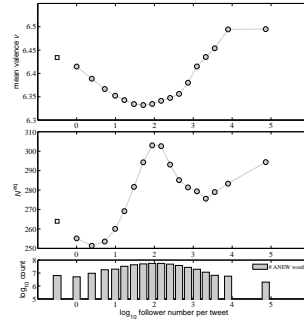
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# Ambient happiness for "snow":



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# Dunbar number action:

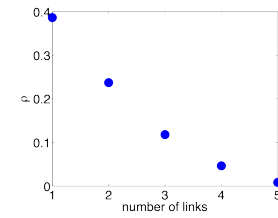


- Early Twitter data—follower counts are not worth so much.
- Unpublished.

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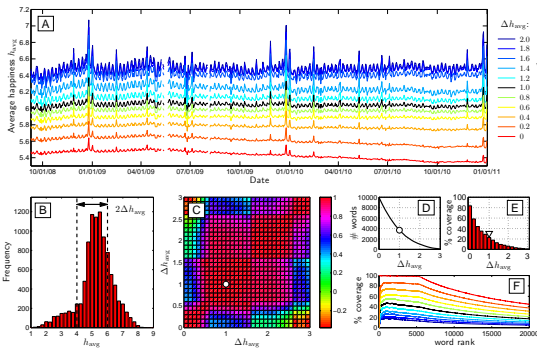
“Twitter reciprocal reply networks exhibit assortativity with respect to happiness”  
Bliss et al.,  
Journal of Computational Science, 3, 388–397, 2012. [1]



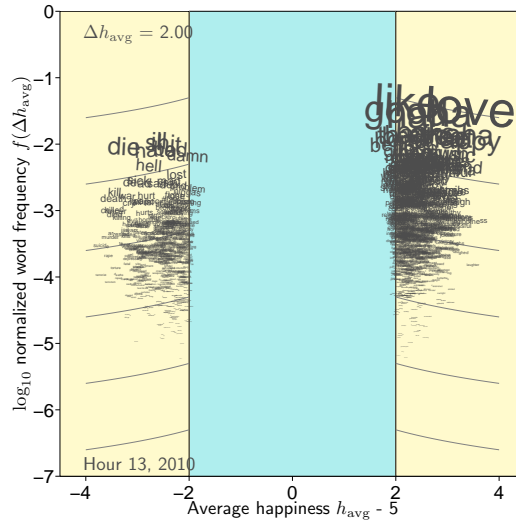
- Decay in happiness correlation in social network.
- Not a test of contagion ...

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# The very surprising tunable hedonometer:

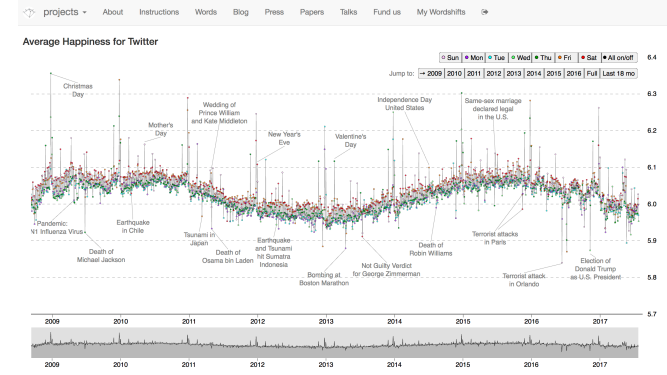


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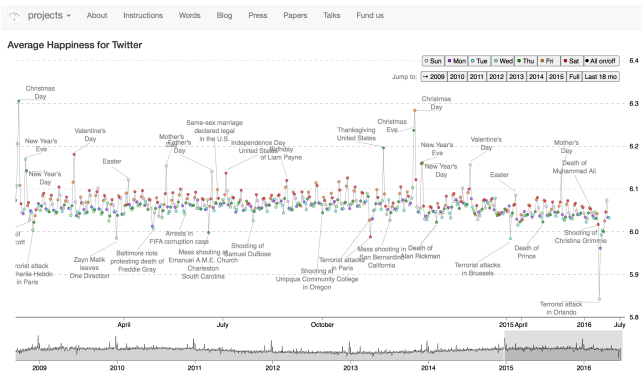
# Online instrument: hedonometer.org



- Machine: @andyreagan
- Planned happiness versus tragedies.

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# hedonometer.org



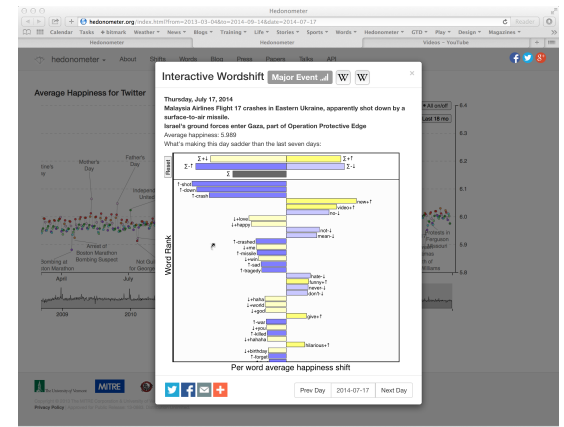
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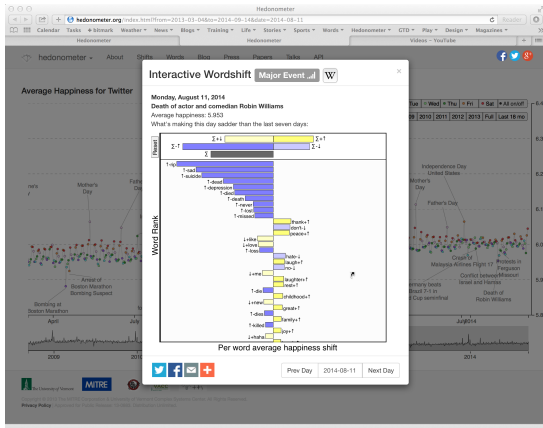
# hedonometer.org



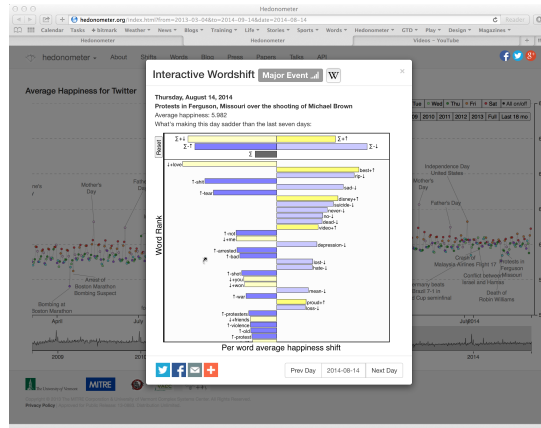
Machine: @andyreagan

# hedonometer.org—word shifts:

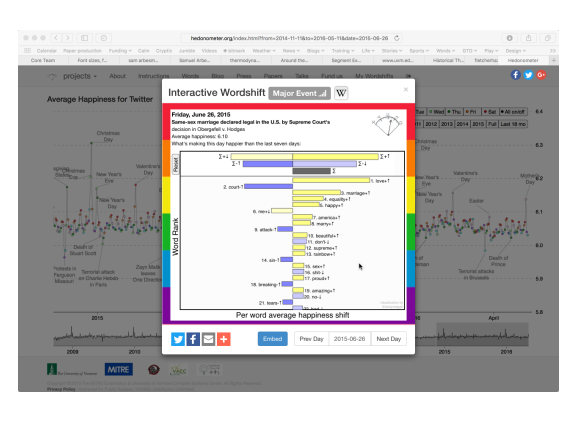




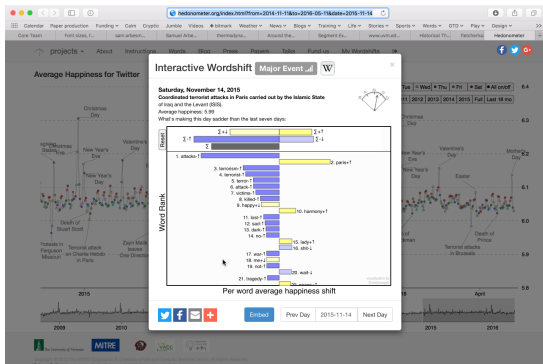
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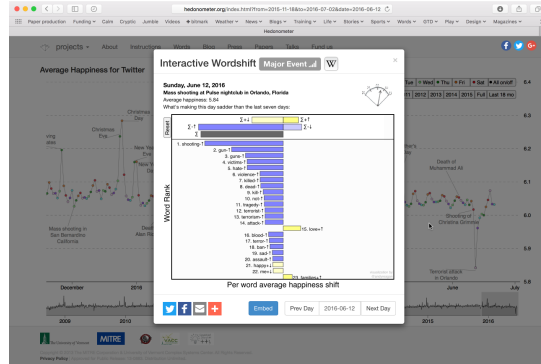
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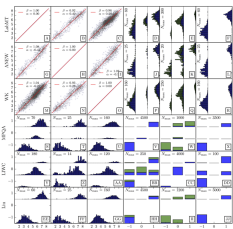
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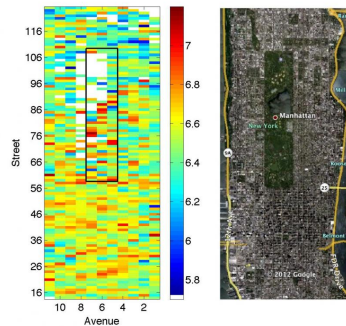
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“Sentiment analysis methods for understanding large-scale texts: A case for using continuum-scored words and word shift graphs”  
Reagan et al.,  
EPJ Data Science, 6, 2017. [37]



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### Happiness in Manhattan:



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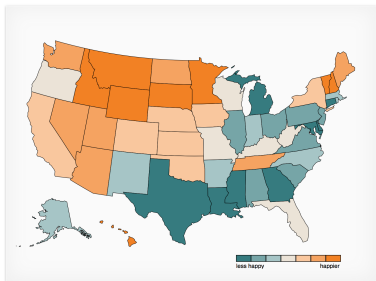


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Upshots: (1) do use wordshifts, and (2) do not use LIWC ...

See Blog post on compstorylab.org

# The Geography of Happiness:



Mitchell et al., PLoS ONE, 2013. [35]

It's a paper that tweets: @geographyofhapp

Online Appendices

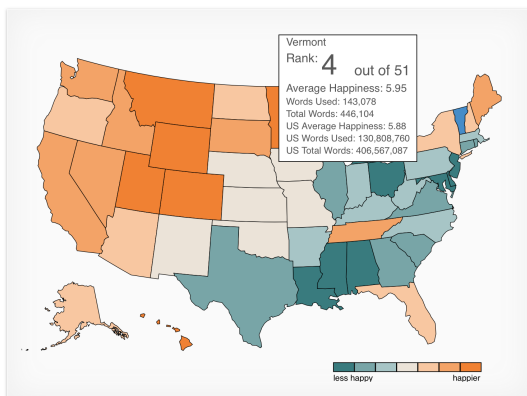
Much interesting and amusing press ...

Online, interactive US map at hedonometer.org

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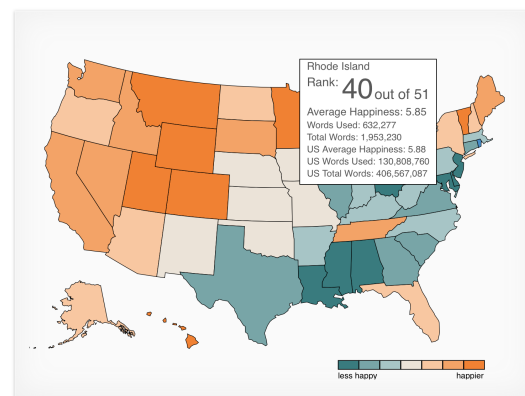
Average Happiness of United States for 2013



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Online, interactive US map at hedonometer.org

Average Happiness of United States for 2013



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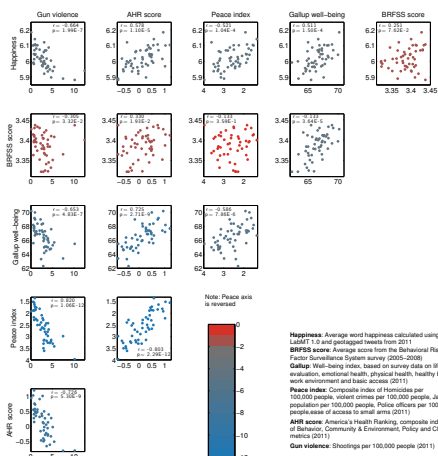
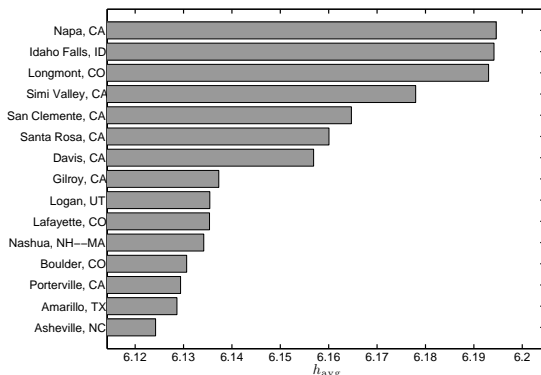


FIG. 2: Scatter plot matrix of correlations between different well-being measures. Points are colored by p-value, statistically insignificant correlations above  $p = 0.01$  are shown in red. Spearman's  $r$  and  $p$ -value are reported in the inset.

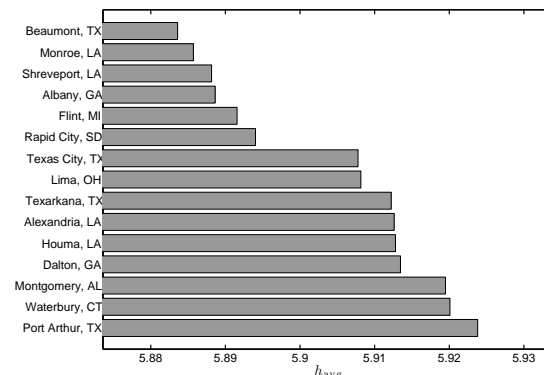
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## Happiest Cities:



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## Saddest Cities (Sorry Beaumont):



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rednnneecckckkkkkkkkk

2013/02/18 at 8:53 pm (Edit)



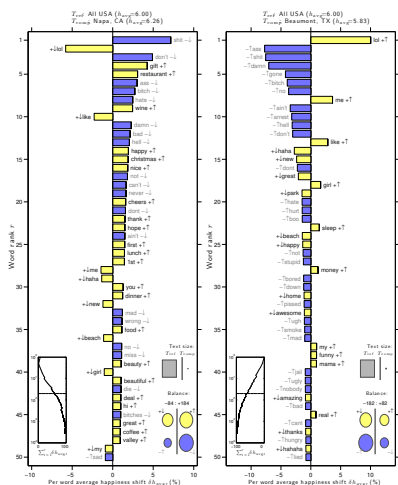
I've lived in quite a few places. The most recently Beaumont, TX. Its a pure hellhole. Hot, humid, trashy, terrible schools, corrupt government, lots of crime, no public parks or activities, terrible culture (other than crawfish boils), completely lacks diversity. This study confirms my suspicions that cities don't get any more miserable than this.

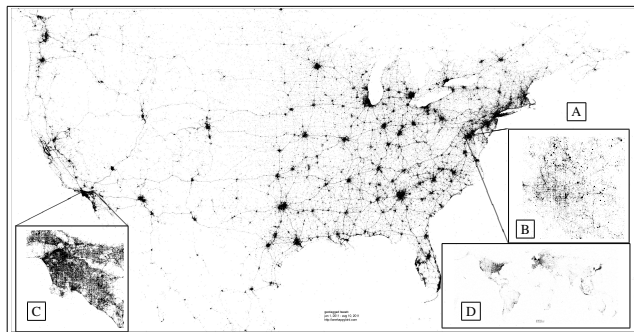
Reply

Blog post: [Where is the happiest city in the US?](#)

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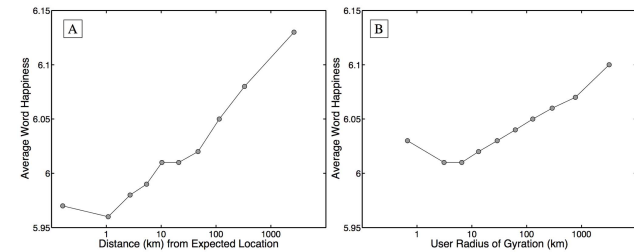
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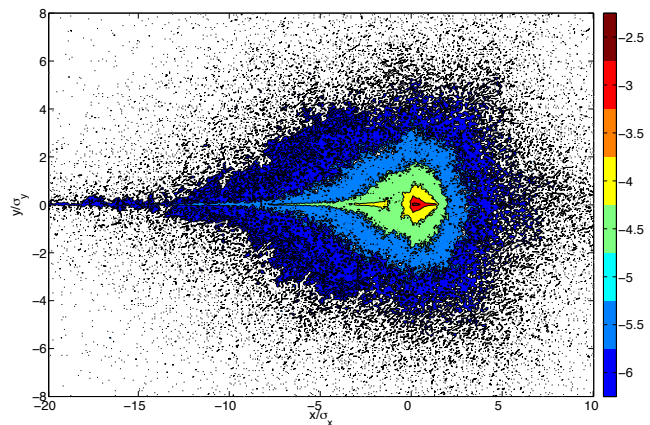
**Figure 1.** Each point corresponds to a geo-located tweet posted between 1/1/11 and 8/10/11. Twitter activity seems to correlate with urban areas. Note that the image contains no cartographic borders, simply a small dot for each message. Insets: **A** (U.S.), **B** (Washington, D.C.), **C** (Los Angeles, C.A.), and **D** (Earth).

“Happiness and the Patterns of Life: A Study of Geolocated Tweets”  
 Frank et al.,  
 Nature Scientific Reports, 3, 2625, 2013. [16]



**Figure 6** (A) Average happiness of words written as a function of distance from an author's expected location, with tweets grouped into ten equally populated bins. Expressed happiness grows logarithmically with distance from expected location. (B) A similar trend is observed when individuals are grouped into ten equally populated bins according to their gyration. Both trends persist through variations in binning and different measures of mobility.

We grow fonder as we wander.



Raw movement patterns agree with cell phone data findings. [18]

For cell phone data: Time spent at locations decays as an

MS Summarize the PNAS article entitled "Human language reveals a universal positivity bias" by Peter Sheridan Dodds, Eric M Clark, Suma Desu, Morgan R Frank, Andrew J Reagan, Jake Ryland Williams, Lewis Mitchell, Kameron Decker Harris, Isabel M Kloumann, James P Bagrow, Karine Megerdooian, Matthew T McMahon, Brian F Tivnan, and Christopher M Danforth. Write the summary in a rhyming scheme like Dr. Seuss.

2/2 This study looked at language, and what it can teach, About how people express themselves when they speak. The researchers analyzed words that were used, To see if there was a bias, positive or abused.

And what they found was quite revealing, A positivity bias, all people revealing. From English to Chinese, to Spanish and more, People speak positively, that's what the data bore.

Words like "love" and "happy" are used with more weight, Than negative ones like "hate" that people debate. This bias is universal, across all tongues, A happy outlook, with few pessimistic lungs.

So next time you're talking, try to keep in mind, That positive words can be quite a find. They make people happier, and that's no fable, As this study shows, with language on the table.

MS Summarize the PLOS one publication entitled "The Geography of Happiness: Connecting Twitter Sentiment and Expression, Demographics, and Objective Characteristics of Place" by Lewis Mitchell, Morgan R. Frank, Kameron Decker Harris, Peter Sheridan Dodds, and Christopher M. Danforth using a rhyme scheme like Dr. Seuss

In this study of sentiment on Twitter, The authors sought to see if they could deliver A connection between happiness and place, By analyzing tweets and what they could trace.

They found that location played a big part, In the positivity of a Twitter art, With income, education, and nature too, All contributing to a happier view.

The words people used were also telling, In happier places, there was more yelling, About love and friends and other good things, And fewer mentions of money or bling.

Overall, the study makes clear, That social media data can help us steer, Towards a better understanding of community well-being, And how we can improve it, by seeing what we're feeling.

MS Summarize the PLOS one publication entitled "The Geography of Happiness: Connecting Twitter Sentiment and Expression, Demographics, and Objective Characteristics of Place" by Lewis Mitchell, Morgan R. Frank, Kameron Decker Harris, Peter Sheridan Dodds, and Christopher M. Danforth. Write the summary as a sad poem in the style of Edgar Allan Poe.

Upon Twitter's vast and dreary plain, A study sought to find what brings us pain, By analyzing tweets from sea to sea, To uncover what plagues our society.

"The Geography of Happiness" was its name, A study in PLOS ONE that sought to claim, That our well-being is tied to location, And objective factors cause our damnation.

Income, education, and access to nature, Were all factors that could shape our future, And the sentiment expressed on Twitter, Could reveal what makes us bitter.

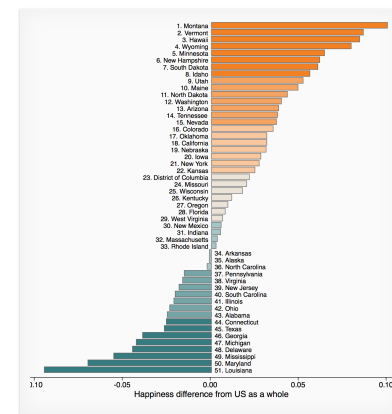
In sad communities, words were often bleak, Depression, suicide, and loneliness we'd seek, But in happier places, joy was all around, Hope, laughter, and love could be easily found.

So take heed, dear reader, and look around, Your community's health may be easily found, In the words that we tweet and the things that we say, Our well-being is tied to our environment, come what may.



Quokka Labs

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Developmental Sankey diagrams [states](#) and [cities](#).

## Or here: Facebook Lexicon Sentiment Analysis (2008)



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## Facebook Lexicon Sentiment Analysis

### Binary decision on emotional content



- Limitation: Sentiments are classified as either **positive** or **negative**.
- 'I like Sarah Palin' given same score as 'Sarah Palin's voice fills me with unbridled joy!'

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