#### Finding Happiness

Last updated: 2023/08/22, 11:48:21 EDT

Principles of Complex Systems, Vols. 1, 2, & 3D CSYS/MATH 6701, 6713, & a pretend number, 2023-2024 | @pocsvox

#### Prof. Peter Sheridan Dodds | @peterdodds

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



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

"Generalized word shift graphs: A method for



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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. [9]

#### **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."



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#### This is a Collateralized Debt Obligation:



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

"It measures everything except that which makes worthwhile. And it can tell us everything about America except why we are proud that we are Americans." [26, 25]

Basic Science  $\simeq$  Describe + Explain:

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From the Daily Show C (September 18, 2007; @5:13)  $\circledast$  The full inteview is here  $\mathbb{C}$ .

# A few key papers:

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"Measuring the happiness of large-scale written expression: Songs, blogs, and presidents." C, Dodds and Danforth, Journal of Happiness Studies, 11, 441-456, 2009. [11]



"Temporal patterns of happiness and information in a global social network: Hedonometrics and Twitter" Dodds et al.. PLoS ONE, 6, e26752, 2011. [13]

2389-2394, 2015, [10]

"Human language reveals a universal positivity bias" C, Dodds et al., Proc. Natl. Acad. Sci., 112,





#### Economics, Schmeconomics

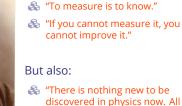
#### Greenspan continues:

"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."

#### Ion Stewart:

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





Lord Kelvin (possibly):

- that remains is more and more precise measurement."
- 🚳 "X-rays will prove to be a hoax."

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#### A brief history of measuring time:

- A 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 Longitude Who Solved the Greatest Scientific Problem References of His Time" 3 by Dava Sobel (2007). [39]

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

#### 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 C: Also: Inventing Temperature, Hasok Chang, 2004<sup>[3]</sup>

#### 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 @SilverWulpes 2: Also: Inventing Temperature, Hasok Chang, 2004<sup>[3]</sup>

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#### What matters and what's measurable:



Measuring Happiness and Sadness:



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Bentham:

hedonistic

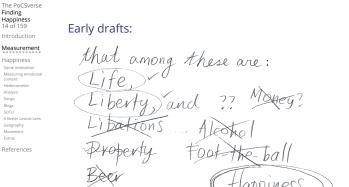
calculus

Socrates et al.: eudaimonia<sup>[23]</sup>

...the pursuit of happiness



lefferson:



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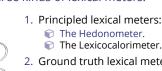
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References	Layard <sup>[29]</sup>	LEASONS FROM A VER SELENCE	References

#### [amazon]



2. Ground truth lexical meters: Insomniometer.

Bootstrap lexical meters:

- Boredometer.
- Hashtagometers.

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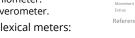
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#### Panometer—Three kinds of lexical meters:

- - Hangoverometer.



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

#### Dominant factors:

- 🚳 Family relationships
- 🚳 Financial
- situation
- 🚳 Work
- \delta Community and Friends
- 🐁 Health A Personal Values 🚳 Personal Freedom

#### Unimportant factors:

- 🗞 Age
- 🚳 Gender
- 🚳 Education
- 🙈 Inherent intelligence
- A Looks

#### Desiring happiness—not just for boffins:

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

#### A Plateau of Happiness



#### National indices of well-being: 🚳 Bhutan 🔏 UK 🚳 France 🚳 Australia

Some easy knocks:



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

#### Some easy knocks:

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#### Colbert: "Happiness is totally overrated ..."

#### "Happiness is for the weak."



Full interview with Jennifer Senior here C (2014/02/03)

#### 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.

#### Meaning rather than happiness:



"Flow" a. by Mihaly Csikszentmihalyi (1990).<sup>[6]</sup>

"Mindfulness in Plain English"

by Henepola Gunaratana (1992).<sup>[20]</sup>

#### 🗞 Can we measure Flow in a big data way?

A Maybe drops in social media usage indicate people are doing okay?

#### Emotional content

#### So how does one measure

1. happiness?

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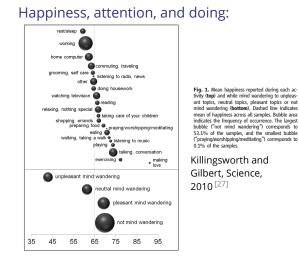
2. levels of other emotional states?

#### Just ask people how happy they are.

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

#### But self-reporting has some drawbacks:

- Relies on memory and self-perception
- induces misreporting<sup>[31]</sup>
- 🗞 costly



We'd like to build an 'hedonometer': An instrument to 'remotely-sense' emotional states and levels, in real time or post hoc. Ideally: \delta Transparent A Non-reactive

- 🗞 Fast 🚳 Based on written expression
- 🚳 Uses human evaluation

- lacktrianglementary to
- measures 🚳 Improvable

self-reported

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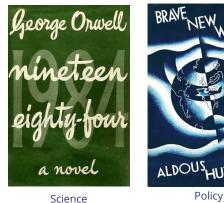
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#### We don't want to end up here:



# NEWWORLD ALDOUSHUXLEY

#### Ousiometrics before we called it that:

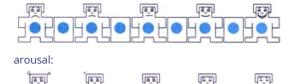
#### Measuring essential meaning<sup>[9]</sup>

- 🗞 Idea: Build on measures of the essential meaning of individual words.
- Second et al. (1957)<sup>[36]</sup> 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:
  - $\heartsuit$  Valence (or sometimes Pleasure): bad  $\leftrightarrow$  good
  - Arousal: passive  $\leftrightarrow$  active
  - $\bigcirc$  Dominance: weak  $\leftrightarrow$  strong
  - D
- AD became more commonly used framework.
- 3 VAD = EAP' (more later).

#### 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
- $\gg N = 1034$  words—previously identified as bearing emotional weight
- Participants = College students (\*cough\*)
- Results published by Bradley and Lang (1999)<sup>[2]</sup>

#### 1999 ANEW study-three 1-9 scales: <sup>[2]</sup> valence:





#### dominance:

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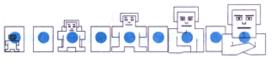
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#### ANEW study:

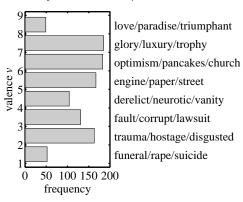
#### Valence = Happiness:

- lance 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."

#### ANEW study words—examples



#### Analysing text:

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Simplest measure for a text:

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

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

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

#### Measuring the perceived happiness of a text:



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

#### Daft Punk's "Around the World"

Around the world, around the world	Around the world, around the world	Around the world, around the world
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Magic: Low entry, high energy

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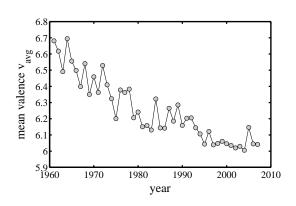
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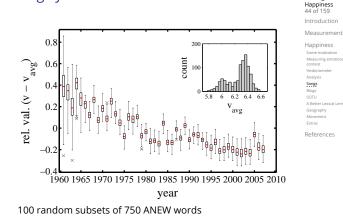
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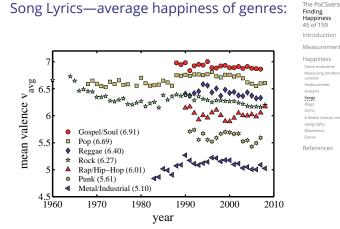
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#### Song Lyrics—average happiness



#### Song Lyrics—measurement robustness





#### Happiness Word Shift Graph (early version):

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Per word drop in valence of lyrics from 1980-2007 relative to valence of lyrics from 1960 Introduction

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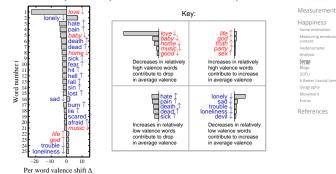
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🗞 Word shifts are word clouds for grown ups.

#### Word data shift details:

#### Given two texts $T_{ref}$ and $T_{comp}$ :

- Measure difference in average happiness:  $h_{\rm avg}^{\rm (comp)} - h_{\rm avg}^{\rm (ref)}$
- line words contribute the most to this change?
- 🗞 Break difference down by contributions from individual words:

$$\delta h_{\mathsf{avg},\,i} = \frac{100}{\left|h_{\mathsf{avg}}^{(\mathsf{comp})} - h_{\mathsf{avg}}^{(\mathsf{ref})}\right|} \underbrace{\left[h_{\mathsf{avg}}(w_i) - h_{\mathsf{avg}}^{(\mathsf{ref})}\right]}_{+/-} \underbrace{\left[p_i^{(\mathsf{comp})} - p_i^{(\mathsf{ref})}\right]}_{\uparrow/\downarrow}$$

Must have: 
$$\sum_i \delta h_{\text{avg},i} = \pm 100$$

 $\otimes$  Rank words by  $|on_{\mathsf{avg},i}|$ 

#### Word data shift details:

$$\begin{split} h_{\text{avg}}^{(\text{comp})} - h_{\text{avg}}^{(\text{ref})} &= \sum_{i=1}^{N} h_{\text{avg}}(w_i) p_i^{(\text{comp})} - \sum_{i=1}^{N} h_{\text{avg}}(w_i) p_i^{(\text{ref})} \\ &= \sum_{i=1}^{N} h_{\text{avg}}(w_i) \left[ p_i^{(\text{comp})} - p_i^{(\text{ref})} \right] \\ &= \sum_{i=1}^{N} \left[ h_{\text{avg}}(w_i) - h_{\text{avg}}^{(\text{ref})} \right] \left[ p_i^{(\text{comp})} - p_i^{(\text{ref})} \right] \end{split}$$
where

$$\sum_{i=1}^{N} h_{\text{avg}}^{(\text{ref})} \left[ p_i^{(\text{comp})} - p_i^{(\text{ref})} \right] = h_{\text{avg}}^{(\text{ref})} \sum_{i=1}^{N} \left[ p_i^{(\text{comp})} - p_i^{(\text{ref})} \right]$$

 $= h_{\text{avg}}^{(\text{ref})}(1-1) = 0.$ 

- +^: Increased usage of relatively positive words—If a word is happier than text  $T_{ref}$  (+) and appears relatively more often in text  $T_{\rm comp}$  (†), then the contribution to the difference  $h_{avg}^{(comp)} - h_{avg}^{(ref)}$  is positive;
  - -U: Decreased usage of relatively negative words—If a word is less happy than text  $T_{ref}$  (–) and appears relatively less often in text  $T_{\text{comp}}$  ( $\downarrow$ ), then the contribution to the difference  $\dot{h}_{
    m avg}^{
    m (comp)} - h_{
    m avg}^{
    m (ref)}$  is also positive;
  - $+\downarrow$ : Decreased usage of relatively positive words—If a word is happier than text  $T_{ref}$  (+) and appears relatively less often in text  $T_{\text{comp}}$  ( $\downarrow$ ), then the contribution to the difference  $h_{\text{avg}}^{(\text{comp})} - h_{\text{avg}}^{(\text{ref})}$  is negative; and
  - —↑: Increased usage of relatively negative words—If a word is less happy than text  $T_{ref}$  (–) and appears relatively more often in text  $T_{comp}$  ( $\uparrow$ ), then the contribution to the difference  $h_{\text{avg}}^{(\text{comp})} - h_{\text{avg}}^{(\text{ref})}$  is also negative.

#### Top 50 of $\simeq$ 20,000 artists:

Rank	Artist	$h_{avg}$	Rank	Artist	$h_{avg}$
1	All-4-One	7.15	26	Sarah Connor	6.86
2	Luther Vandross	7.12	27	Darlene Zschech	6.86
3	S Club 7	7.05	28	Mary J Blige	6.86
4	K Ci & JoJo	7.04	29	Steve Miller Band	6.86
5	Perry Como	7.04	30	New Edition	6.86
6	Diana Ross & The Supremes	7.03	31	Mandy Moore	6.86
7	Buddy Holly	7.02	32	Alicia Keys	6.85
8	Faith Evans	7.01	33	Cher	6.85
9	The Beach Boys	7.01	34	Modern Talking	6.85
10	Jon B	6.98	35	Mario	6.84
11	Dru Hill	6.96	36	Aretha Franklin	6.84
12	Earth Wind & Fire	6.95	37	Jessica Simpson	6.84
13	Ashanti	6.95	38	112	6.84
14	Otis Redding	6.93	39	Backstreet Boys	6.83
15	Faith Hill	6.93	40	Billy Gilman	6.83
16	NSync	6.93	41	B2K	6.82
17	The Supremes	6.91	42	Stevie Wonder	6.82
18	The Partridge Family	6.91	43	John Legend	6.81
19	Kelly Price	6.89	44	Ricky Nelson	6.79
20	Tamia	6.89	45	Lionel Richie	6.79
21	Avant	6.88	46	98 Degrees	6.79
22	Jennifer Lopez	6.88	47	Boyzone	6.79
23	Vanessa Williams	6.87	48	Gerald Levert	6.79
24	Babyface	6.87	49	Nat King Cole	6.78
25	E Rotic	6.87	50	Margues Houston	6.78

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

#### Bottom 50 of $\simeq$ 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	Flotsam 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 Tranquility	5.26	47	White Zombie	5.47
23	Jack Off Jill	5.28	48	Helloween	5.50
24	Evanescence	5.30	49	WASP	5.50
25	Twiztid	5.33	50	Green Day	5.50

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

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

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.

#### Blogs—Overall trend

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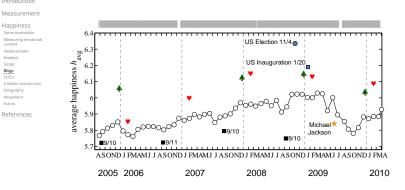
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## Lexicon Valley, Episode #62, June 17, 2015

#### All Mike Vuolo and Bob Garfield.



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Language has a Positivity Bi How did we measure that?

#### Data sets:

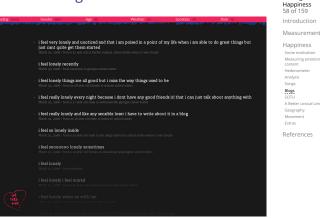
🗞 Blog phrases containing "I feel...", "I am feeling", etc., taken from wefeelfine.org C (API, 2005–2010)



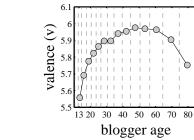


Created by **Jonathan Harris** & Sep Kamvar

#### wefeelfine.org:



#### From wefeelfine.org 🖓 by Jonathan Harris & Sep Kamvar



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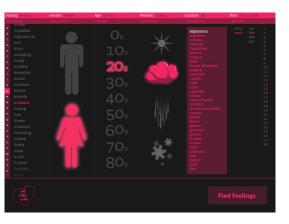
#### Average happiness as a function of the age bloggers report they will turn in the year of their posting.

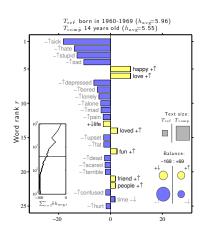
Blogs—Age

- 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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#### wefeelfine.org:





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

'people'

#### Presidential happiness:

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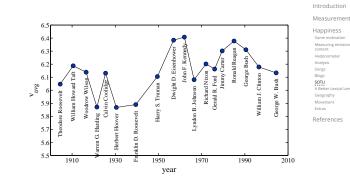
References

Measurement

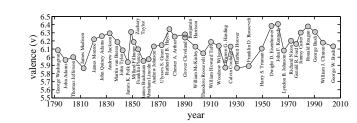
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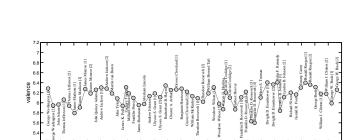
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#### Presidential happiness:





year

1020

1040 1050

1070 1080

1810 1820 1830 1840 185

# labMT 1.0:

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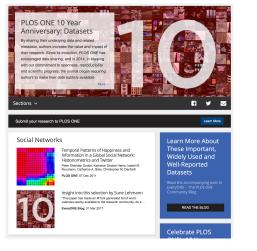
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language assessment by Mechanical Turk



#### 5000 most frequently used words for each corpus. 10.222 words, 50 evaluations each, 1–9 scale: <sup>[32]</sup>

~~	- /		,			, -		
T		I BAT			( ) ( )	(F)	ec	
1	2	3	4	5	6	7	8	9



std dev

valence

valence

rank

10

28 29

30

rich

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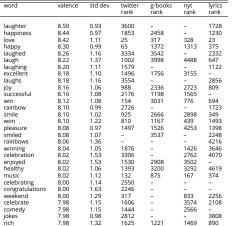
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1625

1221

890

Ο

twitter



Geograph

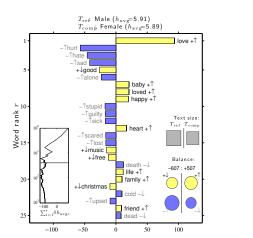
Extras

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#### 🗞 Decrease in 'good' and 5.8 5.8 5.75 5. 0 10 20 30 40 50 60 70

Blogs—Latitude

- latitude |degrees|
  - 🚯 Offset by decrease in 'hurt' and 'pain.'
  - More 'bed' and 'sleep.'



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

#### Blogs SOTU A Bette Near poles— Geography Movement

# social/psychological/climate

Near equator—social factors

lncrease in 'sad', 'bored',

'lonely', 'stupid', 'guilty'

🗞 Increase in 'sick', 'guilty', 'cold', 'depressed', and 'headache' and decrease of 'love' and 'life.'

valence rank	word	valence	std dev	twitter rank	g-books rank	nyt rank	lyrics rank
П	П	п	П	П	п	П	П
10193	violence	1.86	1.05	4299	1724	1238	2016
10193	cruel	1.84	1.15	2963	-	-	1447
10195	cry	1.84	1.28	1028	3075	_	226
10196	failed	1.84	1.00	2645	1618	1276	2920
10197	sickness	1.84	1.18	4735	-	-	3782
10198	abused	1.83	1.31	-	-	-	4589
10199	tortured	1.82	1.42	-	-	-	4693
10200	fatal	1.80	1.53	-	4089	-	3724
10201	killings	1.80	1.54	-	-	4914	-
10202	murdered	1.80	1.63	-	-	-	4796
10203	war	1.80	1.41	468	175	291	462
10204	kills	1.78	1.23	2459	-	-	2857
10205	jail	1.76	1.02	1642	-	2573	1619
10206	terror	1.76	1.00	4625	4117	4048	2370
10207	die	1.74	1.19	418	730	2605	143
10208	killing	1.70	1.36	1507	4428	1672	998
10209	arrested	1.64	1.01	2435	4474	1435	-
10210	deaths	1.64	1.14	-	-	2974	-
10211	raped	1.64	1.43	-	-	-	4528
10212	torture	1.58	1.05	3175	-	-	3126
10213	died	1.56	1.20	1223	866	208	826
10214	kill	1.56	1.05	798	2727	2572	430
10215	killed	1.56	1.23	1137	1603	814	1273
10216	cancer	1.54	1.07	946	1884	796	3802
10217	death	1.54	1.28	509	307	373	433
10218	murder	1.48	1.01	2762	3110	1541	1059
10219 10220	terrorism	1.48 1.44	0.91 0.79	- 3133	-	3192 4115	- 2977
10220	rape suicide	1.44	0.79	2124	- 4707	3319	2977
10221	terrorist	1.30	0.84	3576	4/0/	3026	2107
10222	terrofist	1.50	0.91	33/6	-	5026	-



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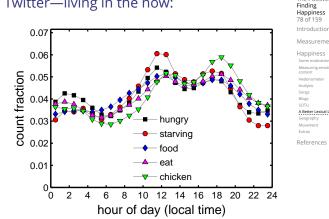
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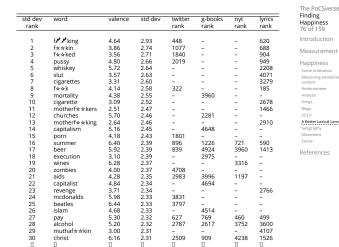
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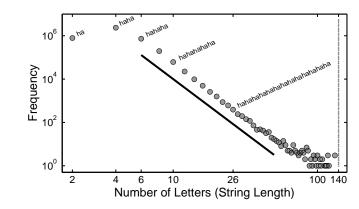
Measurement





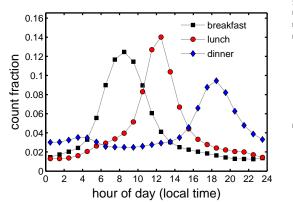
#### The happiest distribution:

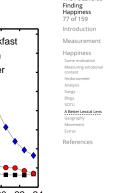




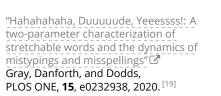


🗞 Quantifying the quotidian.





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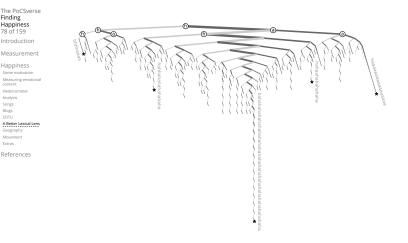
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- GOOOOOOOOAAAAAAAAL!!!!!!"
- An exploration of families of strange lexical creatures.
- 🚳 Regular expression festival.
- ldentified kernels: ha versus goal.
- line and measured stretch and balance
- Stretch: Inequality (Gini) coefficient; Balance: (Shannon's) entropy.
- Spelling trees!







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Individual tweets have all kinds of potential impact:

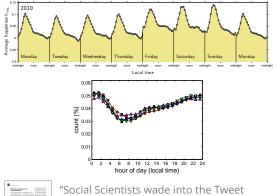


#### Mentions of CIA on Twitter, end of 2011:



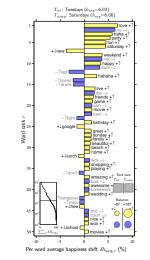
#### & See story here $\square$ for example [slate].

# The daily unravelling of the human mind:





stream" <sup>[2]</sup> Greg Miller, Science. **333**. 1814–1815. 2011. <sup>[34]</sup>



# Text element and context correlate in happiness scores:

- & Compare ambient happiness with text element happiness.
- $\ref{scalar}$  Spearman correlation coefficient:  $r_s\simeq 0.79, p\mbox{-value} < 10^{-10}.$

Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Ja

Apr May Jun Jul Aug Sep Oct Nov Der

В

С

Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Ja

Feb Mar Apr May Jun Jul Aug Sep Oct No

date

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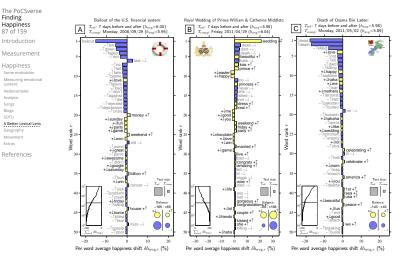
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- An on-average result: says nothing about any individual sentence.
- Extra random piece: stemming is fallible.



#### Ambient happiness:

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		Total Tweets	hara)		hanb)	Total Tweets	h(norm)
1. happy	+0.430	$1.65e \pm 07$ (13)	+1.104(1)	51. snow	-0.051	2.60e+06 (49)	+0.083(3)
2. Christmas	+0.404	$4.89e \pm 06(35)$	+0.953(3)	52. Jon Stewart	-0.052	5.21e+04 (97)	-0.024(48)
<ol><li>wegan</li></ol>	+0.315	1.84e + 05(90)	-0.015 (46)	53. school	-0.056	$9.25e \pm 06(24)$	+0.050(4)
4. :)	+0.274	$1.04e \pm 07$ (20)	+0.630(12)	54. Lehman Brothers	-0.078	8.50e+03 (100)	-0.721(79)
5. family	+0.251	5.01e + 06(32)	+0.716(7)	55. them		1.54e+07 (15)	-0.280 (60
6. 51	+0.228	$1.67e \pm 06(60)$	+0.560(16)	56. right	-0.090	$1.92e \pm 07(10)$	+0.126(3)
7. our	+0.207	1.41e+07 (16)	+0.159(33)	57. woman	-0.115	$2.54e \pm 06(51)$	+0.202 (3)
8. win	+0.204	7.98e+06 (26)	+0.924(4)	58. left	-0.118	4.89e+06 (34)	-0.383 (63
9. vacation	+0.200	9.35e+05 (67)	+0.817(5)	59. me		1.44e + 08(4)	+0.160(3
10. party	+0.170	$6.44e \pm 06(29)$	+0.679(9)	60. election	-0.127	5.60e+05 (75)	-0.306 (61
11. love	+0.164	4.67e+07 (6)	+0.977(2)	61. Sarah Palin	-0.128	2.26e+05 (87)	-0.681 (76
12. friends	+0.155	$7.67e \pm 06(27)$	+0.685(8)	62. no		9.51e+07 (5)	-1.415(90)
13. hope	+0.149	1.18e + 07(18)	+0.515(19)	63. rain	-0.134	$3.23e \pm 06(41)$	+0.050(4
14. coffee	+0.147	2.80e+06 (46)	+0.518(18)	64. climate	-0.135	$3.64e \pm 05(80)$	-0.160 (51
15. cash	+0.146	1.28e + 06(63)	+0.601(14)	65. gay	-0.152	$2.73e \pm 06(47)$	-0.552 (72
16. sun	+0.144	2.39e+06 (52)	+0.737(6)	66. lose	-0.157	2.06e+06 (55)	-1.181 (86
17. income	+0.137	5.10e+05 (76)	+0.621(13)	67. they	-0.159	2.74e+07 (8)	-0.208 (58
18. summer	+0.135	3.00e+06 (43)	+0.221 (29)	68. oil		$1.38e \pm 06(62)$	-0.411 (65
19 church	$\pm 0.131$	1.81e+06 (58)	-0.016 (47)	69. cold		3.67e+06 (36)	-0.546 (71
20. Valentine	+0.127	$2.47e \pm 05$ (84)	+0.593(15)	70. I feel		5.17e + 06(31)	-0.129 (50
21. Stephen Colbert		2.38e+04 (99)	+0.001(45)	71. man		$1.59e \pm 07(14)$	-0.163 (52
22. USA		$2.16e \pm 06(54)$	+0.325(26)			$2.30e \pm 05$ (86)	-0.539 (70
23.1	+0.106	3.44e+06 (40)	+0.195(31)	73. sad		3.56e+06 (38)	-1.366 (85
24 winter		1.26e + 06(64)	+0.050(43)	74. gas		$1.02e \pm 06(65)$	-0.471 (67
25. God		8.58e+06 (25)	+0.468(20)	75. economy		6.09e+05 (73)	-0.525 (69
26. hot		7.12e+06(28)	-0.172 (54)	76. Obama		2.98e+06 (44)	-0.173 (55
27. ;)		2.61e+06 (48)	+0.326(25)	77. Democrat		9.32e + 04(93)	-0.384 (64
28. Jesus	+0.094	2.03e+06(56)	+0.247(28)	78. Congress		$3.92e \pm 05(79)$	-0.580 (74
29. today		2.56e + 07(9)	+0.126(36)			6.27e+06 (30)	-1.551 (96
30. kiss		$1.70e \pm 06(59)$	+0.632(11)	80 side		$3.58e \pm 06(37)$	-1.630 (97
31. yes		1.16e + 07(19)	+0.321(27)	81. Muslim		$2.15e \pm 05(88)$	-0.569 (73
32. tomorrow		1.04e+07(21)	+0.086(38)	82 war		1.96e + 06(57)	-2.040 (10
33. you	+0.052	1.73e + 08(3)	+0.111(37)	83. Pope		1.52e + 05(91)	-0.316 (62
34. heaven		7.42e+05 (71)	+0.674(10)	84. hate		9.65e+06 (23)	-1.520 (94
35. :-)		9.39e+05 (66)	+0.395(23)	85 Glenn Beck		1.14e+05 (92)	-0.776 (82
36. we		3.91e+07 (7)	+0.146(34)	86. Islam		$1.87e \pm 05$ (89)	-0.710 (78
37. yesterday		3.08e + 06(42)	-0.168 (53)	87. George Bush		3.23e + 04(98)	-0.747 (80
38. dark		1.58e+06 (61)	-0.766 (81)	88. Goldman Sachs		5.27e+04 (96)	-0.984 (84
39. ?			-0.503 (68)	89. depressed		$2.81e \pm 05(82)$	-1.541 (95
40. RT		3.39e+08 (1)	-0.443 (66)	90 Senate		4.48e+05 (78)	-0.601 (75
41 Michael Jackson		8.26e+05 (70)	-0.213 (59)	91. BP		5.82e + 05(74)	-0.902 (83
42. night	+0.010	1.71e+07(12)	+0.074(40)	92. gun		6.81e+05 (72)	-1.476 (92
42. hight 43. life		1.40e+07 (12)	+0.074(40) +0.422(22)	93. drugs		5.10e+05 (77)	-1.470 (92
43. me 44. health		2.58e+06 (50)	+0.422(22) +0.447(21)	<ol> <li>urugs</li> <li>headache</li> </ol>		8.57e+05 (69)	-1.881 (98
45. sex	-0.000	3.55e+06 (39)	+0.447 (21) +0.542 (17)			3.40e+05 (81)	-1.174 (85
46. work	-0.008	1.84e+07 (11)	-0.174 (56)	96. :(		2.89e+06 (45)	-1.288 (88
47. girl	-0.010	1.01e+07 (22)	+0.331(24)	97. Afghanistan		2.74e+05 (83)	-1.458 (92
48. boy	-0.010	4.93e+06 (33)	+0.331(24) +0.062(41)	98. moscue		6.98e+04 (95)	-0.694 (77
49. I	-0.048	$3.08e \pm 08(2)$	-0.062 (49)	99 flu		9.01e+05 (68)	-1.912 (95

#### Simpson lexical size, $N_{\rm S}$ :

Word	h(amb)	Total Tweets	h <sub>arra</sub>	Word	h(amb)	Total Tweets	h(norm)
1. happy	+0.430	$1.65e \pm 07$ (13)	+1.104(1)	51. snow	-0.051	2.60e+06 (49)	+0.083(39)
2. Christmas	+0.404	$4.89e \pm 06(35)$	+0.953(3)	52. Jon Stewart	-0.052	$5.21e \pm 04$ (97)	-0.024(48)
3. wegan	+0.315	1.84e + 05(90)	-0.015 (46)	53. school	-0.056	9.25e+06 (24)	+0.050(42)
4. c)	$\pm 0.274$	1.04e + 07(20)	+0.630(12)	54. Lehman Brothers	-0.078	8.50e+03 (100)	-0.721 (79)
5. family	+0.251	5.01e+06 (32)	+0.716(7)	55. them		1.54e+07 (15)	-0.280 (60)
6. 51	$\pm 0.228$	1.67e + 06(60)	+0.560(16)	56. right	-0.090	$1.92e \pm 07(10)$	+0.126(35
7. our	+0.207	1.41e+07(16)	+0.159(33)	57. woman	-0.115	2.54e+06 (51)	+0.202(30)
8. win	+0.204	$7.98e \pm 06$ (26)	+0.924(4)	58. left	-0.118	4.89e+06 (34)	-0.383 (63)
9. vacation	+0.200	9.35e+05 (67)	+0.817(5)	59. me	-0.119	1.44e + 08(4)	+0.160(32)
10. party		$6.44e \pm 06(29)$	+0.679(9)	60. election	-0.127	5.60e+05 (75)	-0.306 (61)
11. love	+0.164	4.67e+07 (6)	+0.977(2)	61. Sarah Palin	-0.128	$2.25e \pm 05(87)$	-0.681 (76)
12. friends	+0.155	7.67e+06 (27)	+0.685(8)	62. no	-0.132	$9.51e \pm 07(5)$	-1.415(90)
13. hope	+0.149	1.18e + 07(18)	+0.515(19)	63. rain	-0.134	3.23e+06 (41)	+0.050(44
14. coffee	+0.147	$2.80e \pm 05$ (46)	+0.518(18)	64. climate	-0.135	3.64e+05 (80)	-0.160 (51)
15. cash	+0.146	1.28e + 06(63)	+0.601(14)	65. gay		2.73e+06 (47)	-0.552(72)
16. sun	+0.144	$2.39e \pm 06(52)$	+0.737(6)	66. lose			-1.181 (86)
17. income	+0.137	5.10e+05 (76)	+0.621(13)	67. they	-0.159	2.74e + 07(8)	-0.208(58)
18 summer		3.00e+05(43)	+0.221(29)	68. oil		$1.38e \pm 06(62)$	-0.411 (65)
19. church			-0.016 (47)	69 cold		3.67e+06 (36)	-0.546 (71)
20. Valentine		2.47e + 05 (84)	+0.593(15)	70. I feel		5.17e+06 (31)	-0.129 (50)
21. Stephen Colber			+0.001(45)			$1.59e \pm 07(14)$	-0.163 (52)
22. USA		2.16e + 06(54)		72. Republican		2.30e+05 (86)	-0.539 (70)
23 1		3.44e + 06(40)		73. sad		3.56e+06 (38)	-1.366 (89)
24 winter		1.26e + 06(64)	+0.050(43)	74. gas		$1.02e \pm 06(65)$	-0.471 (67)
25. God		8.58e+06 (25)	+0.468(20)	75. economy		6.09e+05 (73)	-0.525 (69)
26 hot		7.12e+05(28)	-0.172 (54)	76. Obama		2.98e+06 (44)	-0.173 (55)
27. :)				77. Democrat		9.32e+04 (93)	-0.384 (64)
28. Jesus		2.03e+06(56)		78. Congress			-0.580 (74)
29. today		2.56e + 07(9)	+0.126(36)			6.27e+06 (30)	-1.551 (96)
30. kiss		1.70e+06(59)	+0.632(11)	80. sick		3.58e+06 (37)	-1.630(97)
31. yes		1.16e + 07(19)	+0.321(27)			$2.15e \pm 05$ (88)	-0.569 (73)
32. tomorrow		1.04e+07(21)	+0.086(38)	82. war		1.96e+06 (57)	-2.040 (100
33. you		1.73e + 08(3)	+0.111(37)			1.52e + 05(91)	-0.316 (62)
34. heaven		7.42e+05(71)	+0.674(10)	84. hate		9.65e+06 (23)	-1.520(94)
35. :-)		9.39e+05 (66)	+0.395(23)	85. Glenn Beck		1.14e + 05(92)	-0.776 (82)
36 we		3.91e+07(7)	+0.146(34)	86. Islam		$1.87e \pm 05$ (89)	-0.710 (78)
37. vesterday			-0.168 (53)	87. George Bush		3.23e+04 (98)	-0.747 (80)
38. dark		1.58e+06 (61)	-0.766 (81)	88. Goldman Sachs		5.27e+04 (96)	-0.984 (84)
39. ?			-0.503 (68)	89. depressed		$2.81e \pm 05(82)$	-1.541(95)
40 RT	+0.028		-0.443 (66)	90 Senate			-0.601 (75)
41. Michael Jackson			-0.213 (59)	91. BP		5.82e+05 (74)	-0.902 (83)
42. night	+0.014		+0.074(40)	92. gun		6.81e+05 (72)	-1.476(93)
43 life		1.40e + 07(17)		93. drugs		5.10e+05 (77)	-1.452 (91)
44 health		$2.58e \pm 06(50)$		94. headache		8.57e+05 (69)	-1.881 (98)
45 sev			+0.542(17)			3.40e + 05(81)	-1.174 (85)
46 work		1.84e+07(11)	-0.174 (56)	96. :(		2.89e+06 (45)	1.288 (88)
47. girl	-0.010	1.01e+07(22)		97. Afghanistan		2.74e+05 (83)	-1.458 (92)
48. boy	-0.026	4.93e+06 (33)		98. mosque		6.98e+04 (95)	-0.694 (77)
49. I		3.08e+08 (2)	-0.062 (41)	99. flu		9.01e+05 (68)	-1.912 (99)
<ol> <li>commute</li> </ol>		9.01e+04 (2)		100. Iraq			-1.282 (87)

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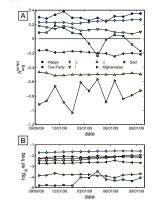
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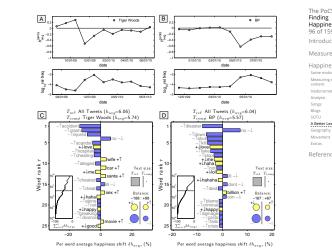
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#### Ambient happiness:





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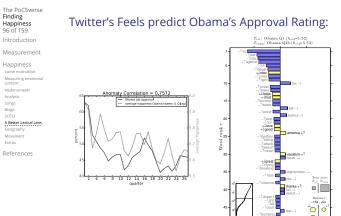
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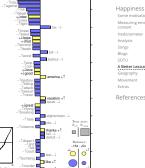
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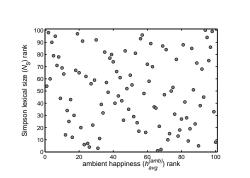
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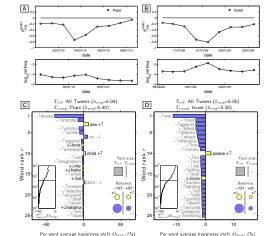
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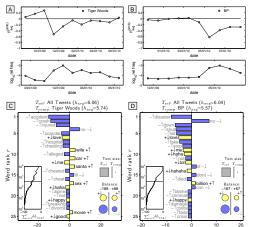
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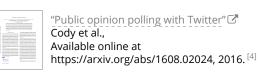


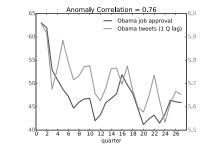






Per word average happiness shift  $\delta h_{aver}$  (%) Per word average happiness shift  $\delta h_{aver}$  (%)





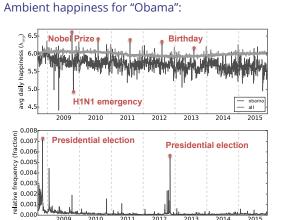


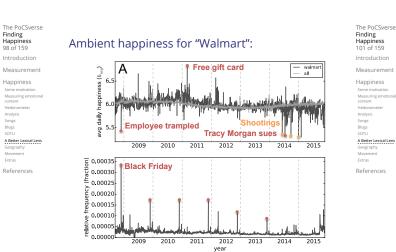
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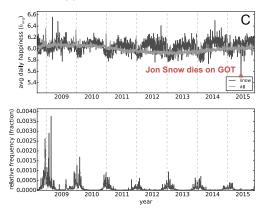
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#### Ambient happiness for "snow":



#### The very surprising tunable hedonometer:

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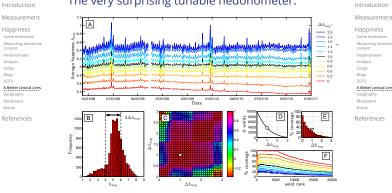
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## hedonometer.org

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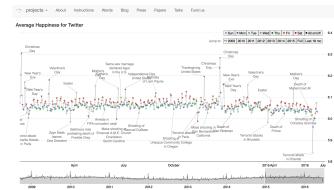
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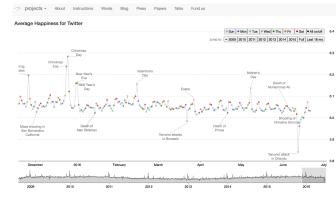
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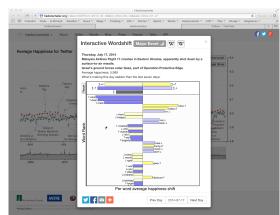
#### 🚳 Machine: @andyreagan 🗹

#### hedonometer.org



🚳 Machine: @andyreagan 🗹

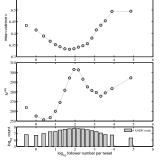
#### hedonometer.org **∠—word shifts**:



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## Dunbar number action:

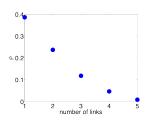


🗞 Early Twitter data—follower counts are not worth so much.

#### 🗞 Unpublished.

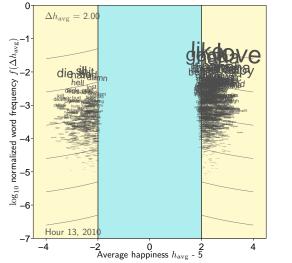


"Twitter reciprocal reply networks exhibit assortativity with respect to happiness" Bliss et al., Journal of Computational Science, 3, 388-397, 2012.<sup>[1</sup>



lecay in happiness correlation in social network.

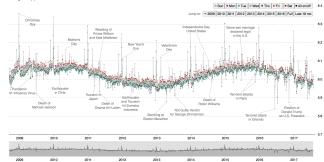
🗞 Not a test of contagion ...



#### Online instrument: hedonometer.org

projects -

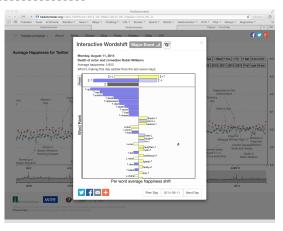




🚳 Machine: @andyreagan 🗹

A Planned happiness versus tragedies.

#### 



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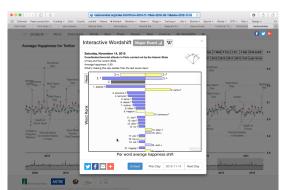
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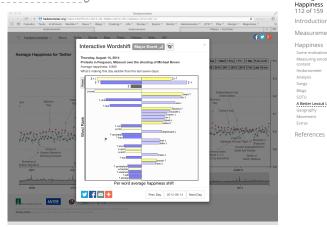


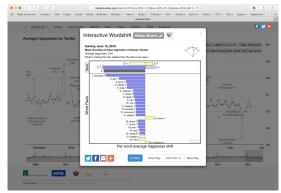


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#### hedonometer.org C-word shifts:







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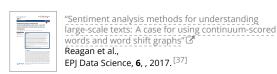
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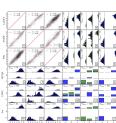
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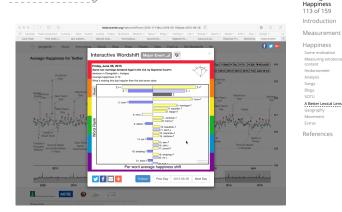


Quokka Labs

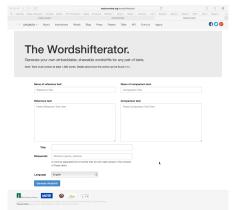


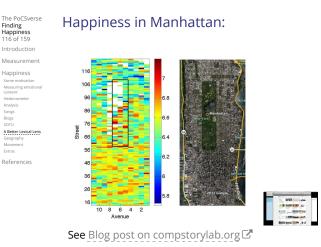
Upshots: (1) do use wordshifts, and (2) do not use LIWC ...

#### hedonometer.org C-word shifts:



#### Make your own:





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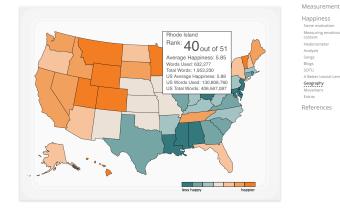
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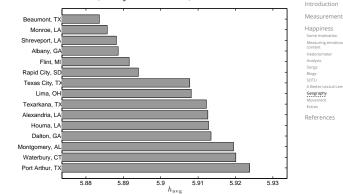
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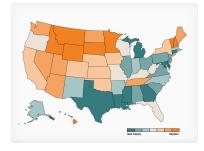
Average Happiness of United States for 2013 -







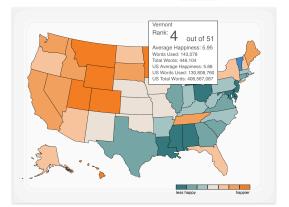
#### The Geography of Happiness:

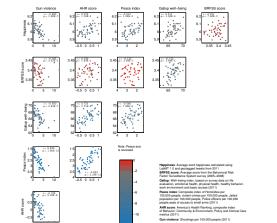


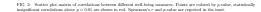
- Mitchell et al., PLoS ONE, 2013. [35]
- 🚳 It's a paper that tweets: @geographyofhapp 🗹
- 🚯 Online Appendices 🗹
- Much interesting and amusing press ...
- 🚳 Online, interactive US map at hedonometer.org 🗹

#### Online, interactive US map at hedonometer.org

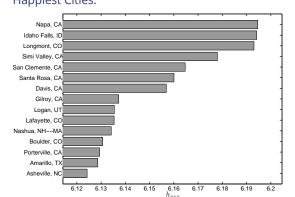
Average Happiness of United States for 2013 -







#### Happiest Cities:





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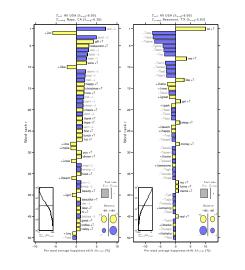
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rednnneecckckkkkkkkk 2013/02/18 at 8:53 pm (Edit)



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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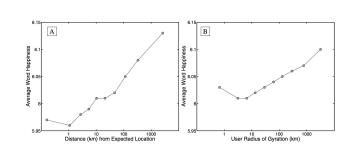


Figure 6 | (A) Average happiness of words written as a function of distance from an author's expected location, with tweets grouped into ten equally populated bins. Expressed happiness grows logarithmically with distance distance from expected location. (B) A similar trend is observed when individuals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

🗞 We grow fonder as we wander.

The PoCSverse



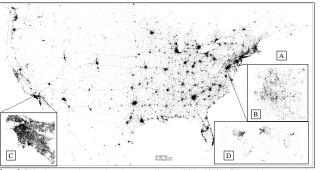
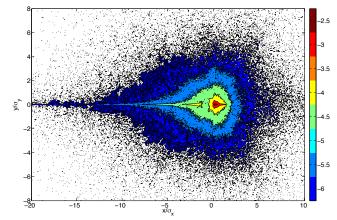


Figure 1. Each point corresponds to a geo-located tweet posted between 1/1/11 and 8/10/11. Twitter activity seems to correlate with urban areas. Note that the image contains no cartographic borders, simply a small dot for each message. Insets: A (U.S.), B (Washington, D.C.), C (Los Angeles, C.A.), and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

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	Elizabether and a second secon

"Happiness and the Patterns of Life: A Study of Geolocated Tweets" C Frank et al., Nature Scientific Reports, **3**, 2625, 2013.<sup>[16]</sup>



- & Raw movement patterns agree with cell phone data findings.<sup>[18]</sup>
- line spent at locations locations
  - Summarize the PLOS one publication entitles "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. Sommarize the PINAS 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, Levis Michell, Kameron Decker Harris, Isabel M Kloumann, James P Bagrow, Karine Megerdoomian, Matthew T McMahon, Brian F Tivnan, and Christopher M Danforth, Write the summary in a rhyming Scheme like Dr. Seuss.

#### 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.

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

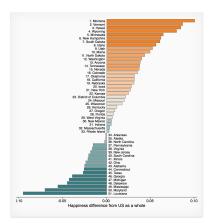
Upon Twitter's vast and dreary plain, A study sought to find what brings us pain, By analyzing tweets from sea to sea, To uncover what plagues our society.

"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

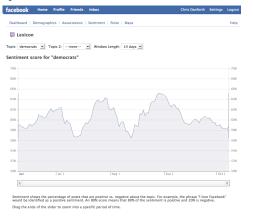
So take heed, dear reader, and look around, Your community's health may be easily found, In the words that we tweet and the things that we say, Our well-being is tied to our environment, come what ma



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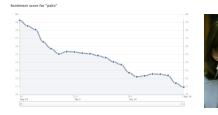
Developmental Sankey diagrams states 🗹 and cities 🗹.

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



#### Facebook Lexicon Sentiment Analysis

#### Binary decision on emotional content



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

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