Computing with Affective Lexicons

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Adapted by R. Tedesco

Affective, Sentimental, and Connotative Meaning in the Lexicon

Affective meaning

- Drawing on literatures in
  - affective computing (Picard 95)
  - linguistic subjectivity (Wiebe and colleagues)
  - social psychology (Pennebaker and colleagues)
- Can we model the lexical semantics relevant to:
  - sentiment
  - emotion
  - personality
  - mood
  - attitudes

Why compute affective meaning?

- Detecting:
  - sentiment towards politicians, products, countries, ideas
  - frustration of callers to a help line
  - stress in drivers or pilots
  - depression and other medical conditions
  - confusion in students talking to e-tutors
  - emotions in novels (e.g., for studying groups that are feared over time)
- Could we generate:
  - emotions or moods for literacy tutors in the children's storybook domain
  - emotions or moods for computer games
  - personalities for dialogue systems to match the user

Scherer's typology of affective states

Emotion: relatively *brief episode* of synchronized response of all or most organismic subsystems in response to the evaluation of an event as being of major significance

angry, sad, joyful, fearful, ashamed, proud, desperate

Mood: diffuse affect state …change in subjective feeling, of low intensity but relatively *long duration*, often without apparent cause

cheerful, gloomy, irritable, listless, depressed, buoyant

Interpersonal stance: affective stance taken toward another person *in a specific interaction*, coloring the interpersonal exchange

distant, cold, warm, supportive, contemptuous

Attitudes: relatively enduring, affectively colored beliefs, *preferences predispositions* towards objects or persons

liking, loving, hating, valuing, desiring

Personality traits: emotionally laden, *stable personality dispositions* and behavior tendencies, typical for a person

nervous, anxious, reckless, morose, hostile, envious, jealous

Connotation in the lexicon

- Words have **connotation** as well as sense
- Connotation: an idea or feeling that a word invokes in addition to its literal or primary meaning
- Can we build lexical resources that represent these connotations?
- And use them in these computational tasks?

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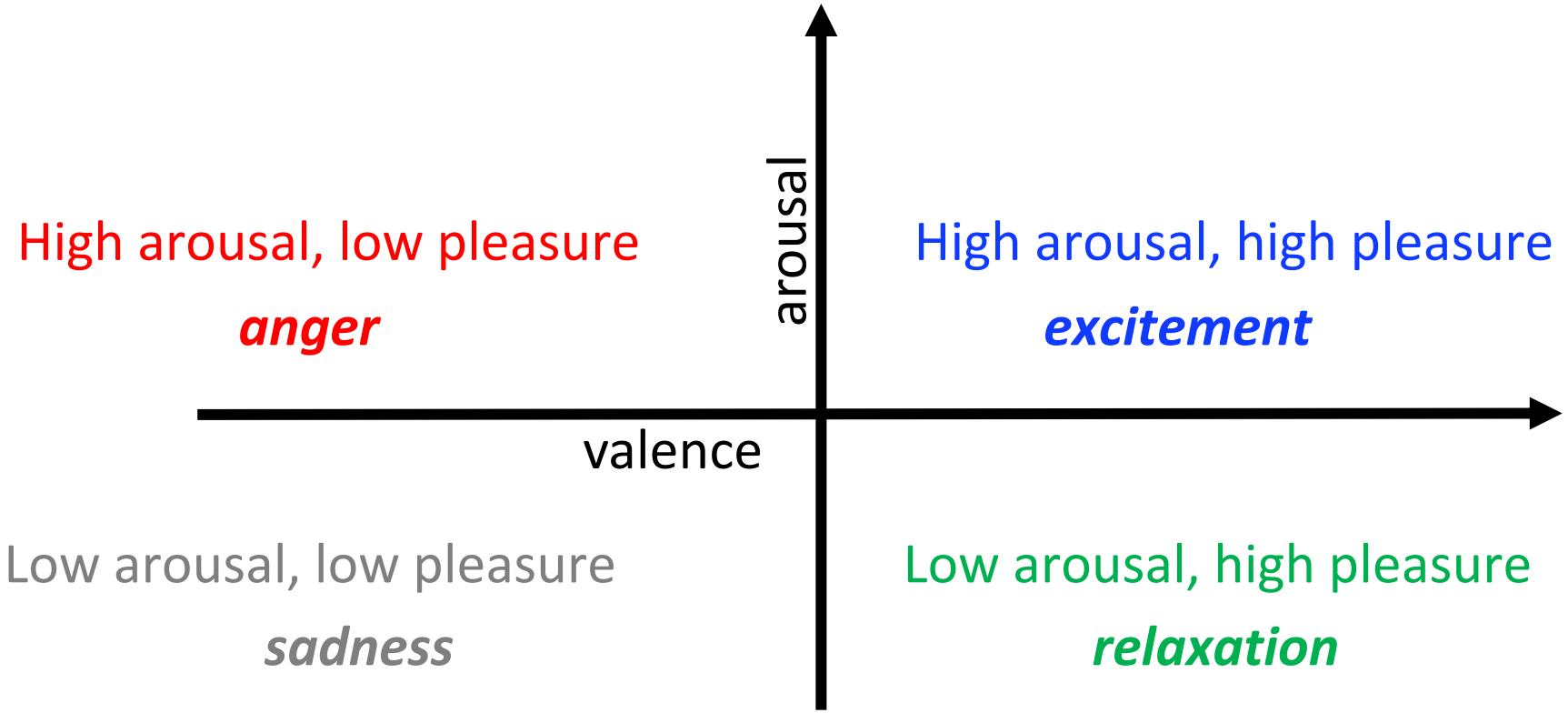
Two families of theories of emotion

- Atomic basic emotions
  - A finite list of 6 or 8, from which others are generated
- Dimensions of emotion
  - Valence (positive negative)
  - Arousal (strong, weak)
  - Control

Ekman's 6 basic emotions:

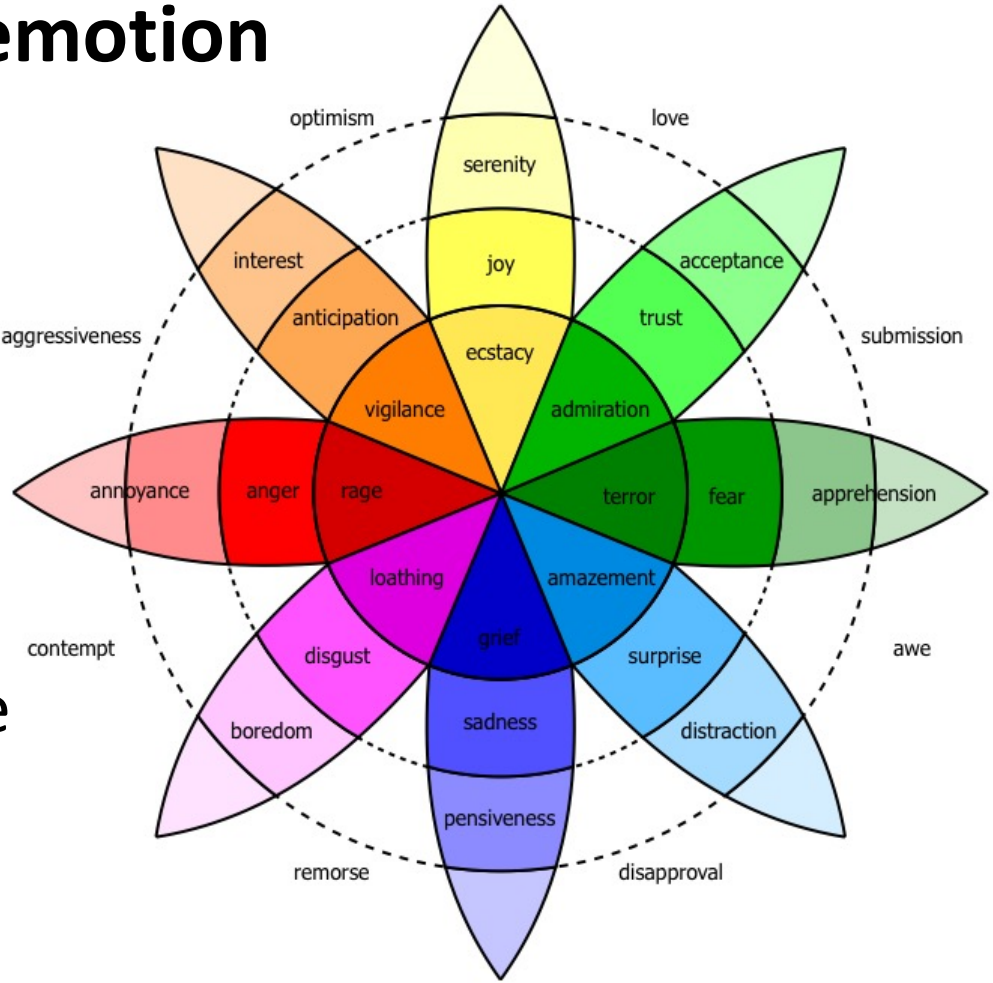
Surprise, happiness, anger, fear, disgust, sadness

Valence/Arousal Dimensions



Plutchick's wheel of emotion

- 8 basic emotions
- in four opposing pairs:
  - joy–sadness
  - anger–fear
  - trust–disgust
  - anticipation–surprise



Atomic units vs. Dimensions

Distinctive

- Emotions are units.
- Limited number of basic emotions.
- Basic emotions are innate and universal

Dimensional

- Emotions are dimensions.
- Limited number of labels but unlimited number of emotions.
- Emotions are culturally learned.

Adapted from Julia Braverman

One emotion lexicon from each paradigm!

1. 8 basic emotions:
   - NRC Word-Emotion Association Lexicon (Mohammad and Turney 2011)
2. Dimensions of valence/arousal/dominance
   - Warriner, A. B., **Kuperman**, V., and Brysbaert, M. (2013)

- Both built using Amazon Mechanical Turk (AMT)

3. Label & dimensions:
   - IEMOCAP (2008): https://sail.usc.edu/iemocap/

1. NRC Word-Emotion Association Lexicon

Mohammad and Turney 2011

- 10,000 words chosen mainly from earlier lexicons
- Labeled by Amazon Mechanical Turk
- 5 Turkers per hit
- Give Turkers an idea of the relevant sense of the word
- Result:

```
amazingly   anger   0
amazingly   anticipation    0
amazingly   disgust 0
amazingly   fear    0
amazingly   joy 1
amazingly   sadness 0
amazingly   surprise    1
amazingly   trust   0
amazingly   negative    0
amazingly   positive    1
```

2. Lexicon of valence, arousal, and dominance

- Warriner, A. B., **Kuperman**, V., and Brysbaert, M. (2013). Norms of valence, arousal, and dominance for 13,915 English lemmas. *Behavior Research Methods 45, 1191-1207.*
- http://www.humanities.mcmaster.ca/~vickup/Warriner-etal-BRM-2013.pdf
- Supplemental material:
- http://www.humanities.mcmaster.ca/~vickup/Warriner_et_al%20emot%20ratings.csv

- **Ratings for 14,000 words for emotional dimensions:**
  - **valence** (the pleasantness of the stimulus)
  - **arousal** (the intensity of emotion provoked by the stimulus)
  - **dominance** (the degree of control exerted by the stimulus)

Lexicon of valence, arousal, and dominance

- **valence** (the pleasantness of the stimulus)
  - 9: happy, pleased, satisfied, contented, hopeful
  - 1: unhappy, annoyed, unsatisfied, melancholic, despaired, or bored
- **arousal** (the intensity of emotion provoked by the stimulus)
  - 9: stimulated, excited, frenzied, jittery, wide-awake, or aroused
  - 1: relaxed, calm, sluggish, dull, sleepy, or unaroused;
- **dominance** (the degree of control exerted by the stimulus)
  - 9: in control, influential, important, dominant, autonomous, or controlling
  - 1: controlled, influenced, cared-for, awed, submissive, or guided

- Again produced by AMT

Concreteness versus abstractness

- The degree to which the concept denoted by a word refers to a perceptible entity.
  - Do concrete and abstract words differ in connotation?
- Brysbaert, M., Warriner, A. B., and Kuperman, V. (2014) Concreteness ratings for 40 thousand generally known English word lemmas *Behavior Research Methods 46, 904-911.* http://www.humanities.mcmaster.ca/~vickup/Brysbaert-BRM-2013.pdf
- 37,058 English words and 2,896 two-word expressions ("zebra crossing" and "zoom in")
- Rating from 1 (abstract) to 5 (concrete)
- Some example ratings from the final dataset of 40,000 words and phrases:

banana	5	badass	2.5
bathrobe	5	basically	1.32
bagel	5	belief	1.19
brisk	2.5	although	1.07

Perceptual Strength Norms

Per item *WORD*

Adjectives (2009) were normed using an object property phrasing:

To what extent do you experience something being WORD
By feeling through touch
By hearing
By seeing
By smelling
By tasting

Nouns (2013) and all other unpublished word types were normed using a general concept phrasing

To what extent do you experience WORD
By feeling through touch
By hearing
By seeing
By smelling
By tasting

- Connell and Lynott norms
- Rate your experience of particular concepts and properties using the five senses: hearing, sight, touch, taste, smell
- The rating scale runs from 0 (not experienced at all with that sense) to 5 (experienced greatly with that sense).

	Perceptual strength						
Word	Auditory	Gustatory	Haptic	Olfactory	Visual	Concreteness	Imageability
soap	0.35	1.29	4.12	4.00	4.06	589	600
noisy	4.95	0.05	0.29	0.05	1.67	293	138
atom	1.00	0.63	0.94	0.50	1.38	481	499
republic	0.53	0.67	0.27	0.07	1.79	376	356

https://www.lancaster.ac.uk/staff/connelll/lab/norms.html

Classifiers

- Use these features
- Possibly together with others…

- Supervised learning

- Classify sentences… use a classifier of your choice

Computing with Affective Lexicons

Sentiment Lexicons and an algorithm for sentiment anaysis

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MPQA Subjectivity Cues Lexicon

Theresa Wilson, Janyce Wiebe, and Paul Hoffmann (2005). Recognizing Contextual Polarity in Phrase-Level Sentiment Analysis. Proc. of HLT-EMNLP-2005.

Riloff and Wiebe (2003). Learning extraction patterns for subjective expressions. EMNLP-2003.

- Home page: http://www.cs.pitt.edu/mpqa/subj_lexicon.html
- 6885 words from 8221 lemmas
  - 2718 positive
  - 4912 negative
- Each word annotated for intensity (strong, weak)
- GNU GPL

SentiWordNet

Stefano Baccianella, Andrea Esuli, and Fabrizio Sebastiani. 2010 SENTIWORDNET 3.0: An Enhanced Lexical Resource for Sentiment Analysis and Opinion Mining. LREC-2010

- Home page: http://sentiwordnet.isti.cnr.it/
- All WordNet synsets automatically annotated for degrees of positivity, negativity, and neutrality/objectiveness
- [estimable(J,#3)] “may be computed or estimated”

  `Pos 0 Neg 0 Obj 1`
- [estimable(J,#1)] “deserving of respect or high regard”

  `Pos .75 Neg 0 Obj .25`

Turney Algorithm

Turney (2002): Thumbs Up or Thumbs Down? Semantic Orientation Applied to Unsupervised Classification of Reviews

Rate a review

1. Extract a *phrasal lexicon* from reviews
2. Learn polarity of each phrase
3. Rate a review by the average polarity of its phrases

Extract two-word phrases with adjectives

First Word	Second Word	Third Word (not extracted)
JJ	NN or NNS	anything
RB, RBR, RBS	JJ	Not NN nor NNS
JJ	JJ	Not NN or NNS
NN or NNS	JJ	Nor NN nor NNS
RB, RBR, or RBS	VB, VBD, VBN, VBG	anything

How to measure polarity of a phrase?

- Positive phrases co-occur more with *“excellent”*
- Negative phrases co-occur more with *“poor”*
- But how to measure co-occurrence?

Mutual Information

- Between 2 random variables X and Y
- The amount of information (in bits) obtained about one random variable through observing the other random variable
- Measure of the mutual dependence between the two random variables

$$\mathrm{I}(X,Y) = \sum_{x \in X} \sum_{y \in Y} P(x,y) \log_2 \frac{P(x,y)}{P(x)P(y)}$$

Pointwise Mutual Information

- **Pointwise mutual information**:
  - How much more do specific events x and y co-occur than if they were independent?

$$\text{PMI}(x, y) = \log_2 \frac{P(x,y)}{P(x)P(y)}$$

For a given $x \in X$ and $y \in Y$

- **PMI between two words**:
  - How much more do two words co-occur than if they were independent?

$$\text{PMI}(word_1, word_2) = \log_2 \frac{P(word_1, word_2)}{P(word_1)P(word_2)}$$

How to Estimate Pointwise Mutual Information

- From a (huge) text collection
- $P(word) \cong hits(word)/N = \mathrm{C}(word)/N$
- $P(word_1,word_2) \cong hits(word_1\ \mathrm{NEAR}_k word_2)/(kN) =$

$$= \frac{C(w_1,w_2)+C(w_1,*,w_2)+\cdots+C(w_1,\overbrace{*\cdots*}^{k\text{-}1},w_2)}{\underbrace{N+N+\cdots+N}_{k}}$$

- For simplicity, we'll use N instead of kN

$$\mathrm{PMI}(word_1,word_2) = \log_2 \frac{\frac{1}{N} hits(word_1\ \mathrm{NEAR}\ word_2)}{\frac{1}{N} hits(word_1)\frac{1}{N} hits(word_2)}$$

Does phrase appear more with “poor” or “excellent”?

$$\text{Polarity}(phrase) = \text{PMI}(phrase, \text{"excellent"}) - \text{PMI}(phrase, \text{"poor"})$$

$$= \log_2 \frac{\frac{1}{N}\text{hits}(phrase \text{ NEAR "excellent"})}{\frac{1}{N}\text{hits}(phrase)\frac{1}{N}\text{hits}(\text{"excellent"})} - \log_2 \frac{\frac{1}{N}\text{hits}(phrase \text{ NEAR "poor"})}{\frac{1}{N}\text{hits}(phrase)\frac{1}{N}\text{hits}(\text{"poor"})}$$

$$= \log_2 \frac{\text{hits}(phrase \text{ NEAR "excellent"})}{\text{hits}(phrase)\text{hits}(\text{"excellent"})} \frac{\text{hits}(phrase)\text{hits}(\text{"poor"})}{\text{hits}(phrase \text{ NEAR "poor"})}$$

$$= \log_2 \left(\frac{\text{hits}(phrase \text{ NEAR "excellent"})\text{hits}(\text{"poor"})}{\text{hits}(phrase \text{ NEAR "poor"})\text{hits}(\text{"excellent"})} \right)$$

Phrases from a thumbs-up review

- Example
  - Polarity of sentences
  - Belonging to a positive review
- Most of them are positive (as expected)

Phrase	POS tags	Polarity
online service	JJ NN	2.8
online experience	JJ NN	2.3
direct deposit	JJ NN	1.3
local branch	JJ NN	0.42
…		
low fees	JJ NNS	0.33
true service	JJ NN	−0.73
other bank	JJ NN	−0.85
inconveniently located	JJ NN	−1.5
Average		0.32

Phrases from a thumbs-down review

- Example
  - Polarity of sentences
  - Belonging to a negative review
- Most of them are negative (as expected)

Phrase	POS tags	Polarity
direct deposits	JJ NNS	5.8
online web	JJ NN	1.9
very handy	RB JJ	1.4
…		
virtual monopoly	JJ NN	-2.0
lesser evil	RBR JJ	-2.3
other problems	JJ NNS	-2.8
low funds	JJ NNS	-6.8
unethical practices	JJ NNS	-8.5
Average		-1.2

Classifiers

- Use this feature (positive/negative word)
- Possibly together with other features

- Supervised learning

- Classify sentences… use a classifier of your choice

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Sample affective task: personality detection

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The Big Five Dimensions of Personality

Extraversion vs. Introversion

sociable, assertive, playful vs. aloof, reserved, shy

Emotional stability vs. Neuroticism

calm, unemotional vs. insecure, anxious

Agreeableness vs. Disagreeable

friendly, cooperative vs. antagonistic, faultfinding

Conscientiousness vs. Unconscientious

self-disciplined, organised vs. inefficient, careless

Openness to experience

intellectual, insightful vs. shallow, unimaginative

Various text corpora labeled for personality of author

Pennebaker, James W., and Laura A. King. 1999. "Linguistic styles: language use as an individual difference." *Journal of personality and social psychology* 77, no. 6.

- 2,479 essays from psychology students (1.9 million words), “write whatever comes into your mind” for 20 minutes

Mehl, Matthias R, SD Gosling, JW Pennebaker. 2006. Personality in its natural habitat: manifestations and implicit folk theories of personality in daily life. Journal of personality and social psychology 90 (5), 862

- Speech from Electronically Activated Recorder (EAR)
- Random snippets of conversation recorded, transcribed
- 96 participants, total of 97,468 words and 15,269 utterances

Schwartz, H. Andrew, Johannes C. Eichstaedt, Margaret L. Kern, Lukasz Dziurzynski, Stephanie M. Ramones, Megha Agrawal, Achal Shah et al. 2013. "Personality, gender, and age in the language of social media: The open-vocabulary approach." *PloS one* 8, no. 9

- Facebook
- 75,000 volunteers
- 309 million words
- All took a personality test

Classifiers

- **Mairesse**, François, Marilyn A. Walker, Matthias R. Mehl, and Roger K. Moore. "Using linguistic cues for the automatic recognition of personality in conversation and text." *Journal of artificial intelligence research* (2007): 457-500.
  - Various classifiers, lexicon-based and prosodic features
- **Schwartz**, H. Andrew, Johannes C. Eichstaedt, Margaret L. Kern, Lukasz Dziurzynski, Stephanie M. Ramones, Megha Agrawal, Achal Shah et al. 2013. "Personality, gender, and age in the language of social media: The open-vocabulary approach." *PloS one* 8, no.
  - regression and SVM, lexicon-based and all-words

Sample LIWC Features

LIWC (Linguistic Inquiry and Word Count)

Pennebaker, J.W., Booth, R.J., & Francis, M.E. (2007). Linguistic Inquiry and Word Count: LIWC 2007. Austin, TX

Feature	Type	Example
Anger words	LIWC	hate, kill, pissed
Metaphysical issues	LIWC	God, heaven, coffin
Physical state/function	LIWC	ache, breast, sleep
Inclusive words	LIWC	with, and, include
Social processes	LIWC	talk, us, friend
Family members	LIWC	mom, brother, cousin
Past tense verbs	LIWC	walked, were, had
References to friends	LIWC	pal, buddy, coworker
Imagery of words	MRC	Low: future, peace - High: table, car
Syllables per word	MRC	Low: a - High: uncompromisingly
Concreteness	MRC	Low: patience, candor - High: ship
Frequency of use	MRC	Low: duly, nudity - High: he, the

Using all words instead of lexicons (Schwartz et al 2013, Facebook study)

- Use all the words, as features
- Choosing phrases with $\mathrm{PMI}(phrase) > 2 \cdot \mathrm{Length}(phrase)$ [in words]

$$\mathrm{PMI}(phrase) = \log \frac{p(phrase)}{\Pi_{w \in phrase} p(w)}$$

- Only use words/phrases used by at least 1% of writers
- Normalize counts of words and phrases by writer

$$p(phrase \mid subject) = \frac{freq(phrase, subject)}{\sum_{phrase' \in vocab(subject)} freq(phrase', subject)}$$

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Affect extraction: of course it's not just the lexicon

Ranganath et al (2013), McFarland et al (2014)

- Detecting interpersonal stance in conversation
- Speed dating study, 1000 4-minute speed dates
- Subjects labeled **selves** and **each other** for
  - friendly (each on a scale of 1-10)
  - awkward
  - flirtatious
  - assertive

Affect extraction: of course it's not just the lexicon

A classifier with the following features:

- LIWC lexicons
- Other lexical features
- Prosody (pitch and energy means and variance)
- Discourse features
  - Interruptions
  - Dialog acts/Adjacency pairs
    - sympathy ("Oh, that's terrible")
    - clarification question ("What?")
    - appreciations ("That's awesome!")