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Using Artificial Neural Networks to Model Affective Word Meaning

Sven Buechel

Jena University Language and Information Engineering (JULIE) Lab
Friedrich-Schiller-Universität Jena,
Jena, Germany

<https://julielab.de>

sunshine

calm

terrorism

What is „Affective Word Meaning“?

- Psycholinguistic quality to evoke emotion in recipients
- Speakers mostly agree on it
 - *part of connotative lexical semantics*
- Graphematic word (type), mere character sequences
- No context!

Application Domains

- Product and enterprise analytics
- Social sciences
 - voting behavior / approval rate
 - happiness across geographic/socio-economic positions



The delights of "Spider-Man: Into the Spider-Verse" bring a newfound sense of joy and playfulness to the beloved character

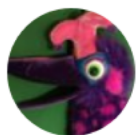
Dec 14, 2018 | Rating: 4/4 | [Full Review...](#)



Katie Walsh

Tribune News Service

★ Top Critic



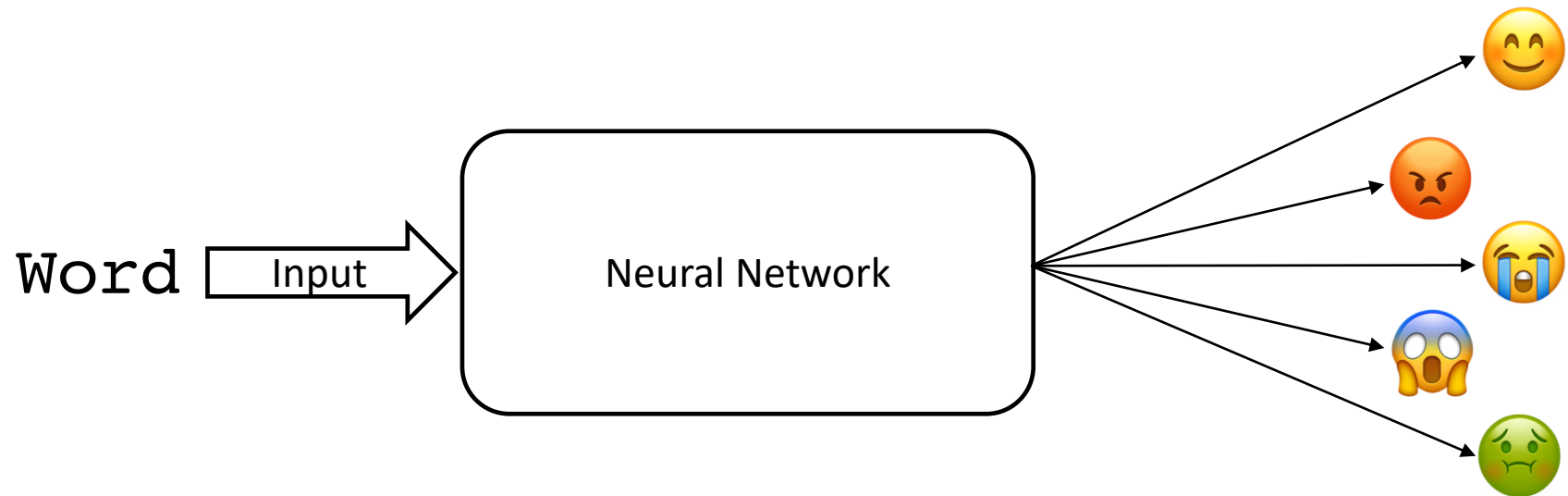
Xavidub @jimdoherthy09 · 2 Min.

I see [#Erdogan](#) is on course to get 101% of the vote 😞

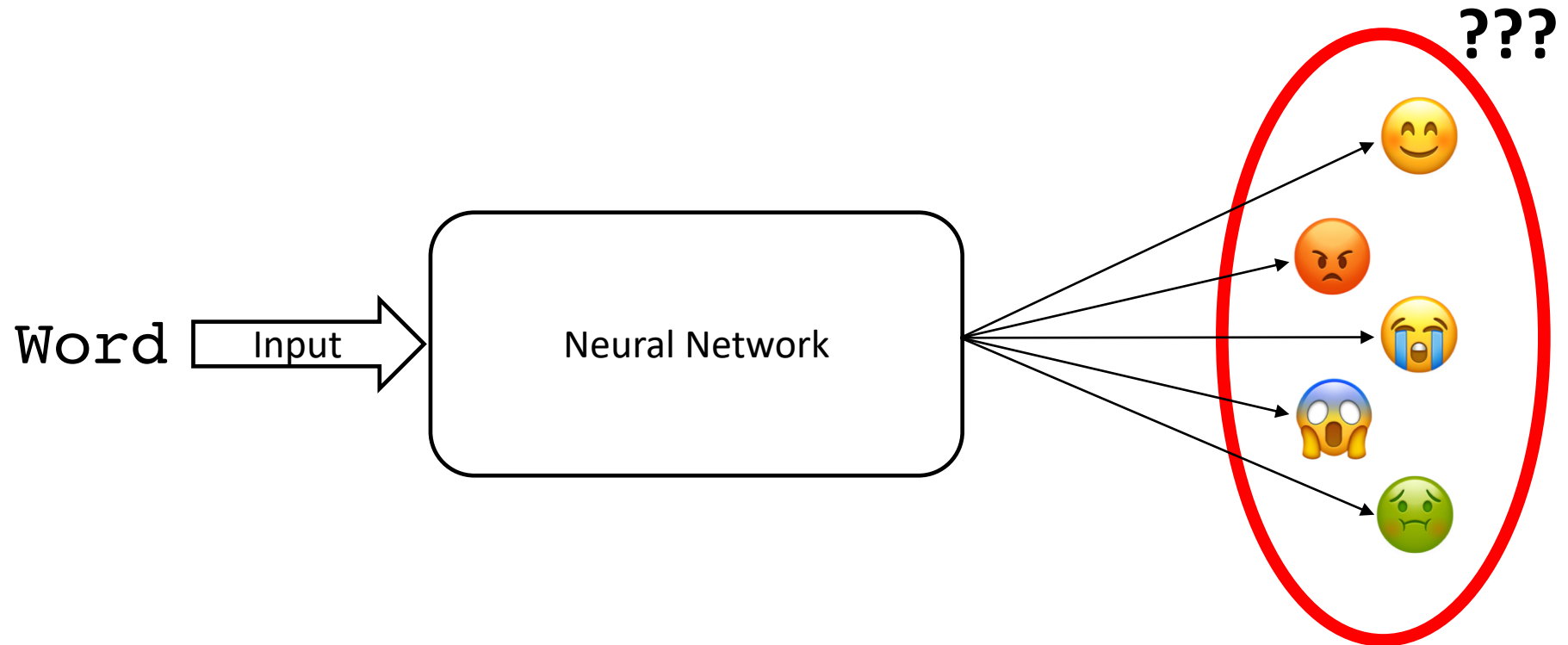
Application Domains

- Product and enterprise analytics
- Social sciences
 - voting behavior
 - happiness across geographic/socio-economic position
- Humanities
 - amelioration/pejoration of words
 - attitudes towards concepts and ideas
 - emotional relationships in character networks

Goal of This Work

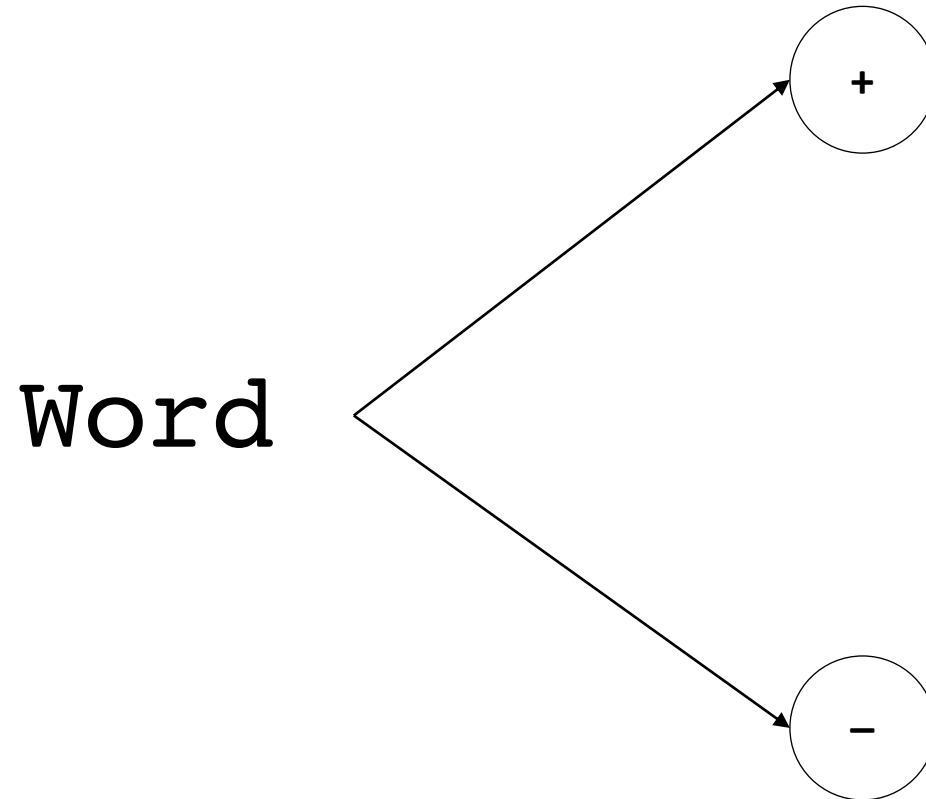


Goal of This Work

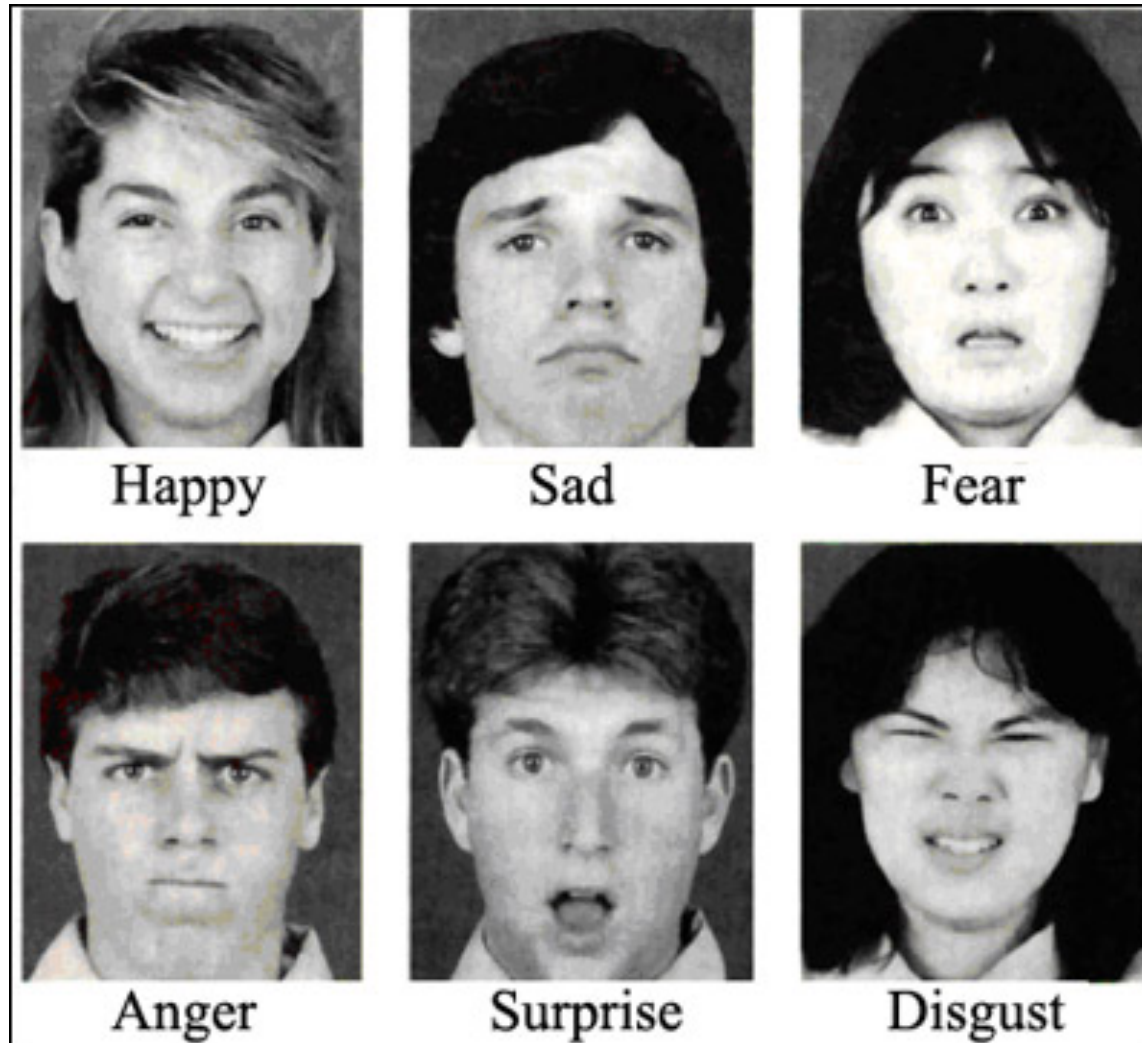


How to Represent Affective Word Meaning?

Semantic Orientation / Polarity

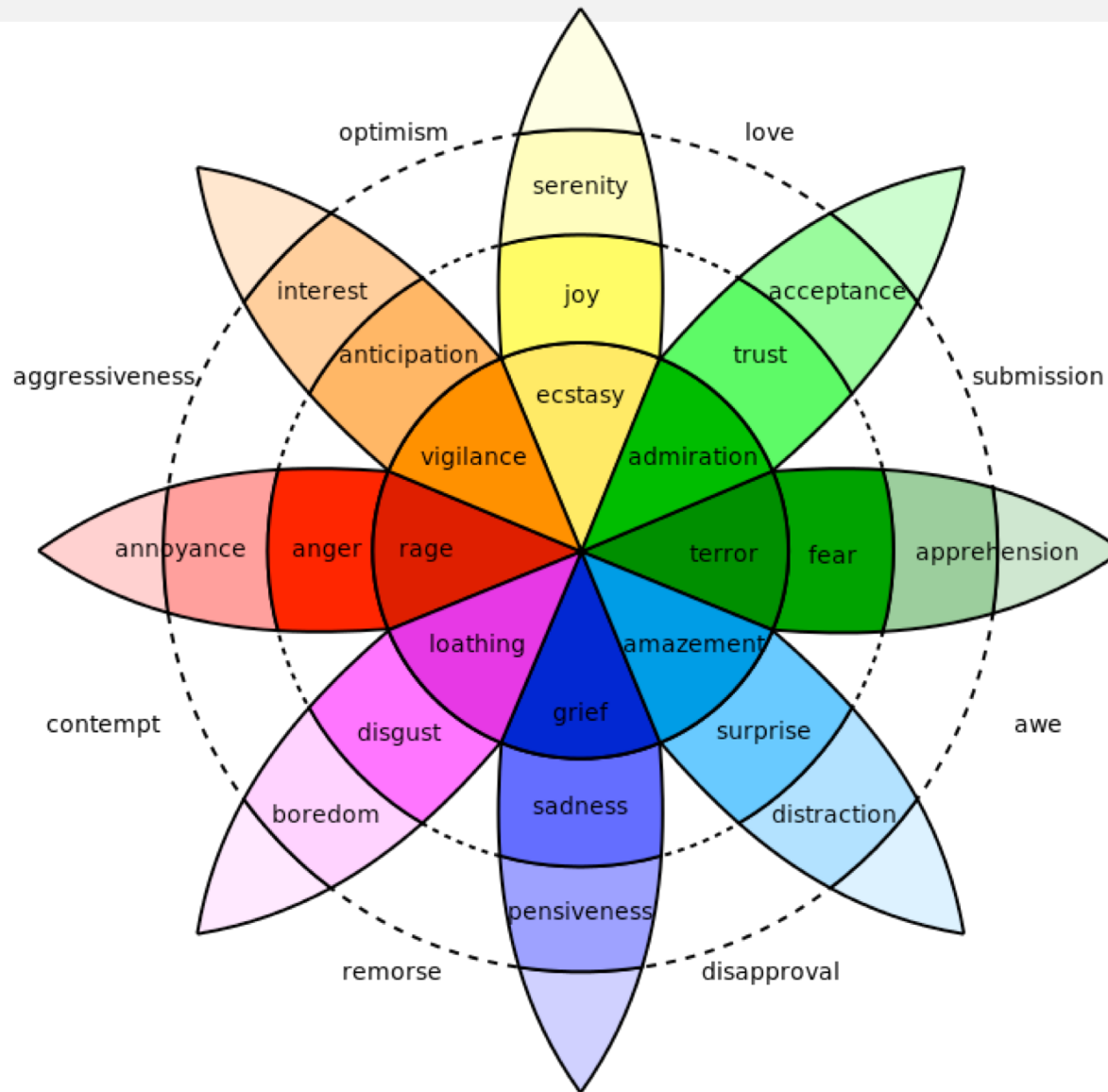


Ekman's Basic Emotions



Source: <http://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-00sc-introduction-to-psychology-fall-2011/emotion-motivation/discussion-emotion/>

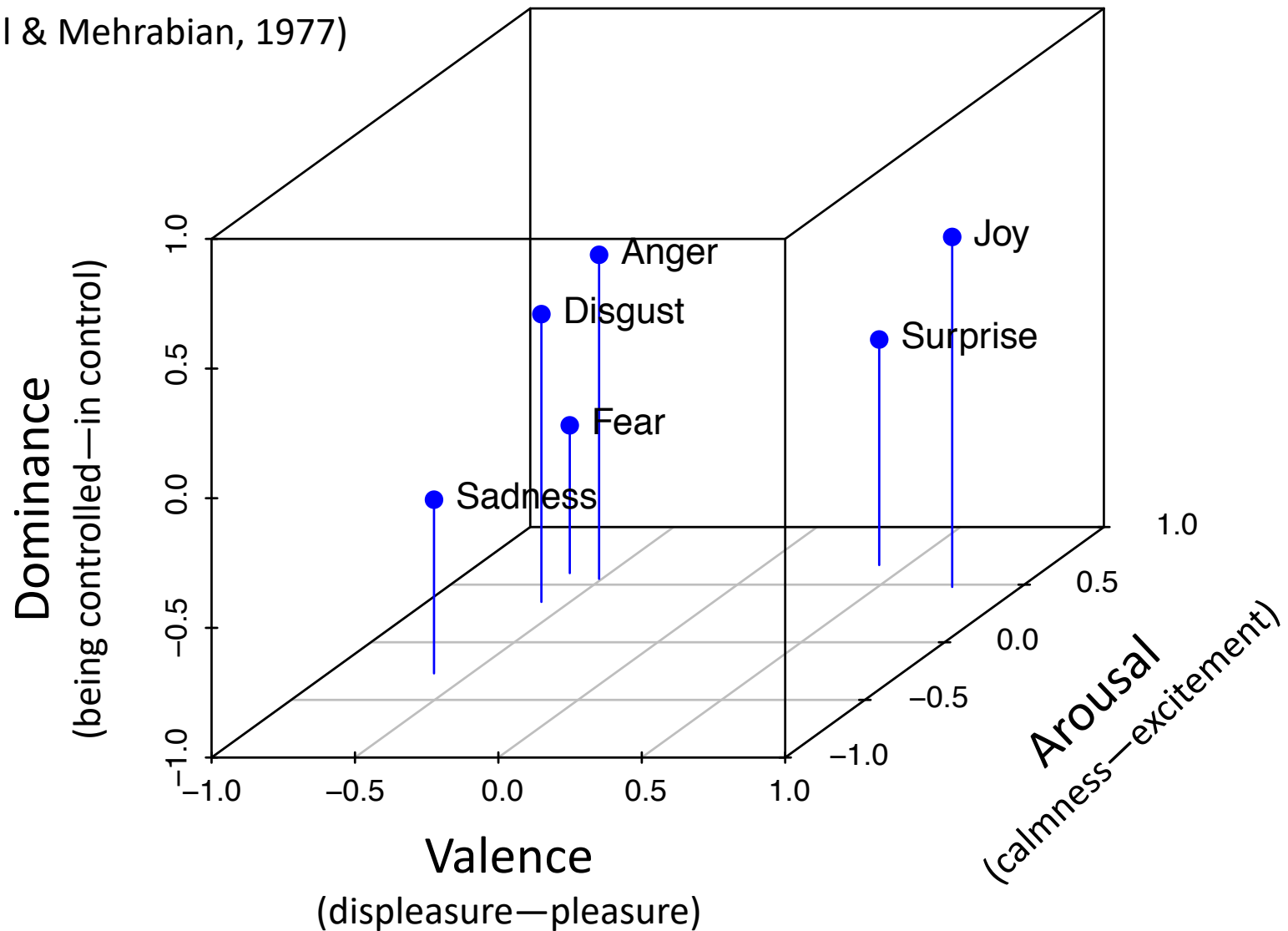
Representing Emotion — Wheel of Emotion



Source: https://en.wikipedia.org/wiki/Contrasting_and_categorization_of_emotions#/media/File:Plutchik-wheel.svg

Valence-Arousal-Dominance

(Russell & Mehrabian, 1977)



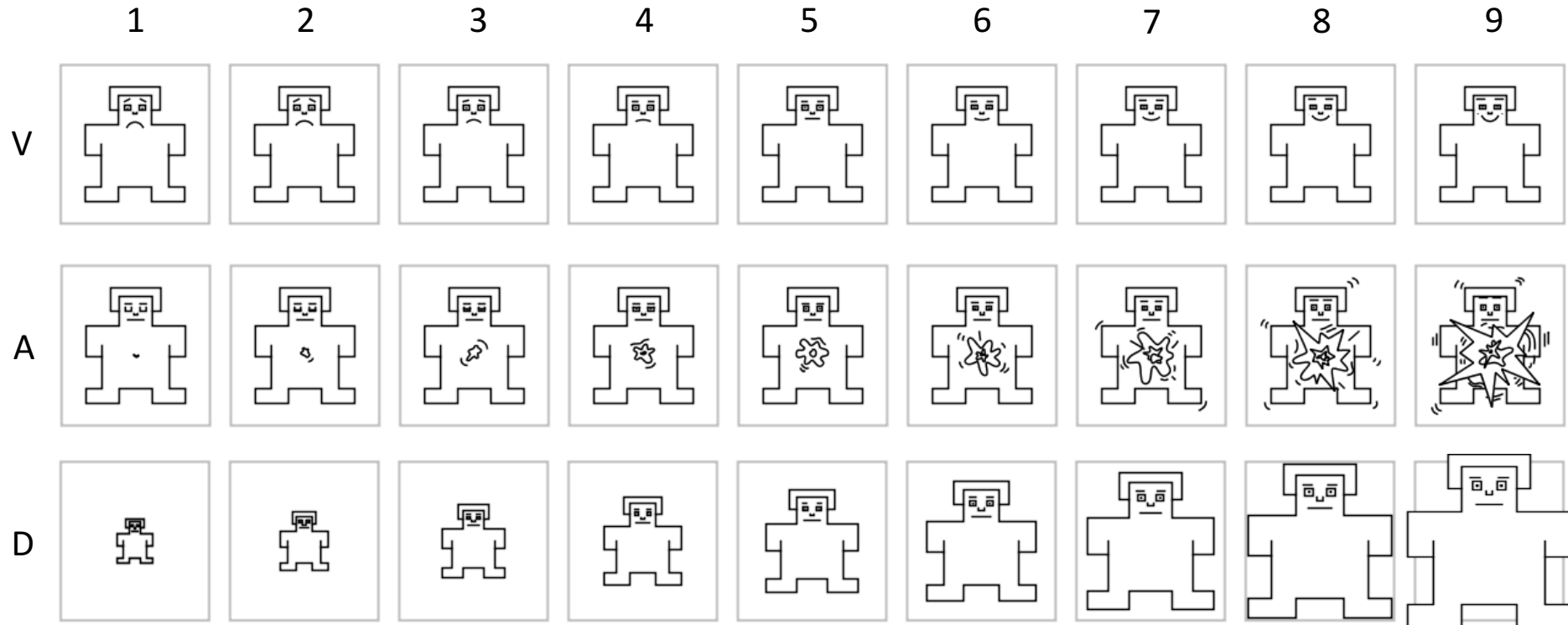
Empirically Measured VAD Ratings

- Psychologists and Psycholinguists need VAD ratings

(e.g., experiments on word processing and memory)

- Experimental set-up of gathering those
 - questionnaire study
 - >20 raters per word

Self-Assessment Manikin

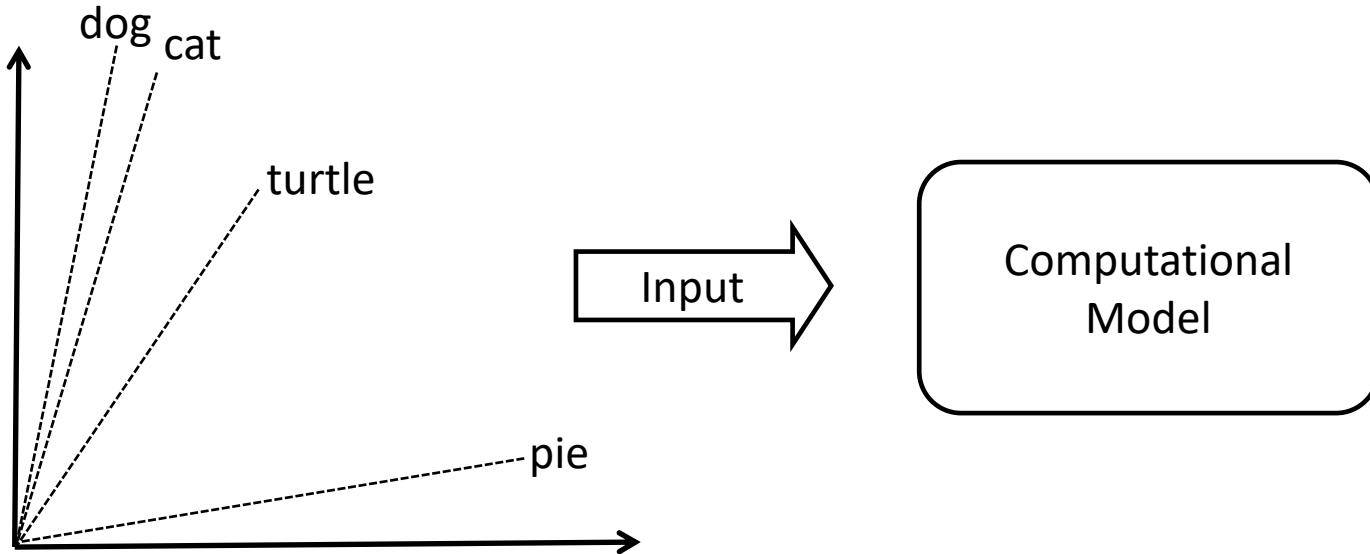


Averaged Individual Ratings: Emotion Lexicons

	Valence	Arousal	Dominance
sunshine	7.6	4.9	5.2
calm	6.3	1.9	5.9
terrorism	1.5	8.4	3.2

How to Model Affective Word Meaning?

Input Representation: Word Embeddings



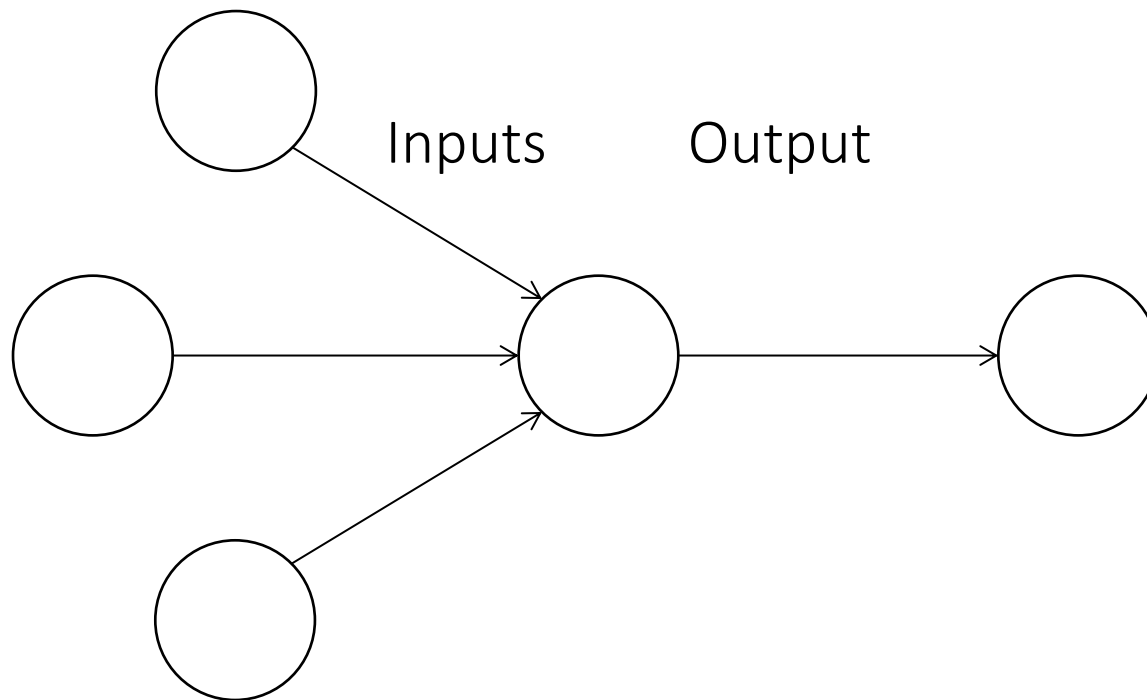
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0.42662 -0.071747 0.25112 0.12082 -0.33192 -0.4728 -0.0090568 0.0030266 0.032861 0.074323 -0.38017 0.091399
-0.16034 -0.050232 -0.094194 0.16656 0.40901 0.069625 0.059306 0.01991 -0.35846 -0.14549 0.24894 0.50184 -
0.0073098 -0.4589 -0.10073 -0.099315 0.30583 -0.40577 0.16586 0.055741 0.26776 -0.13515 0.28127 0.069221 -
0.20907 0.092053 0.39419 -0.2412 0.01173 -0.16856 -0.0053851 0.14282 0.17513 0.34775 0.178 0.35883 -0.17684
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(*sunshine*)

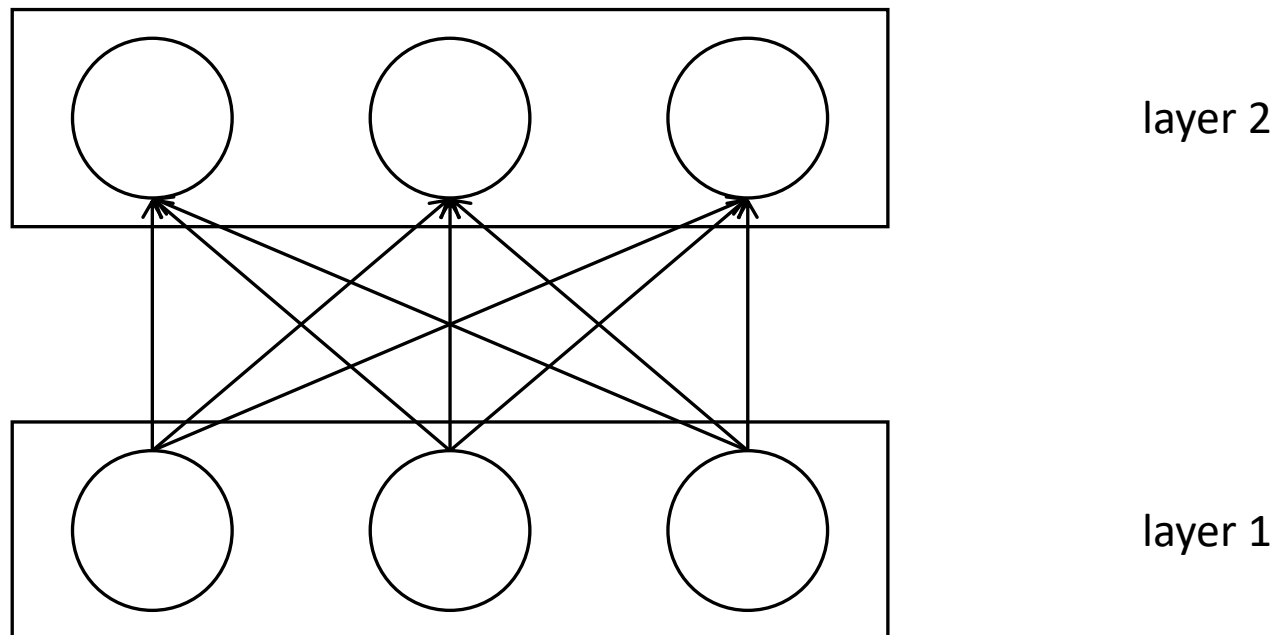
Artificial Neural Networks: Biological Inspiration

- Family of machine learning techniques (\approx Deep Learning)
- Inspired by signal processing of biological neurons

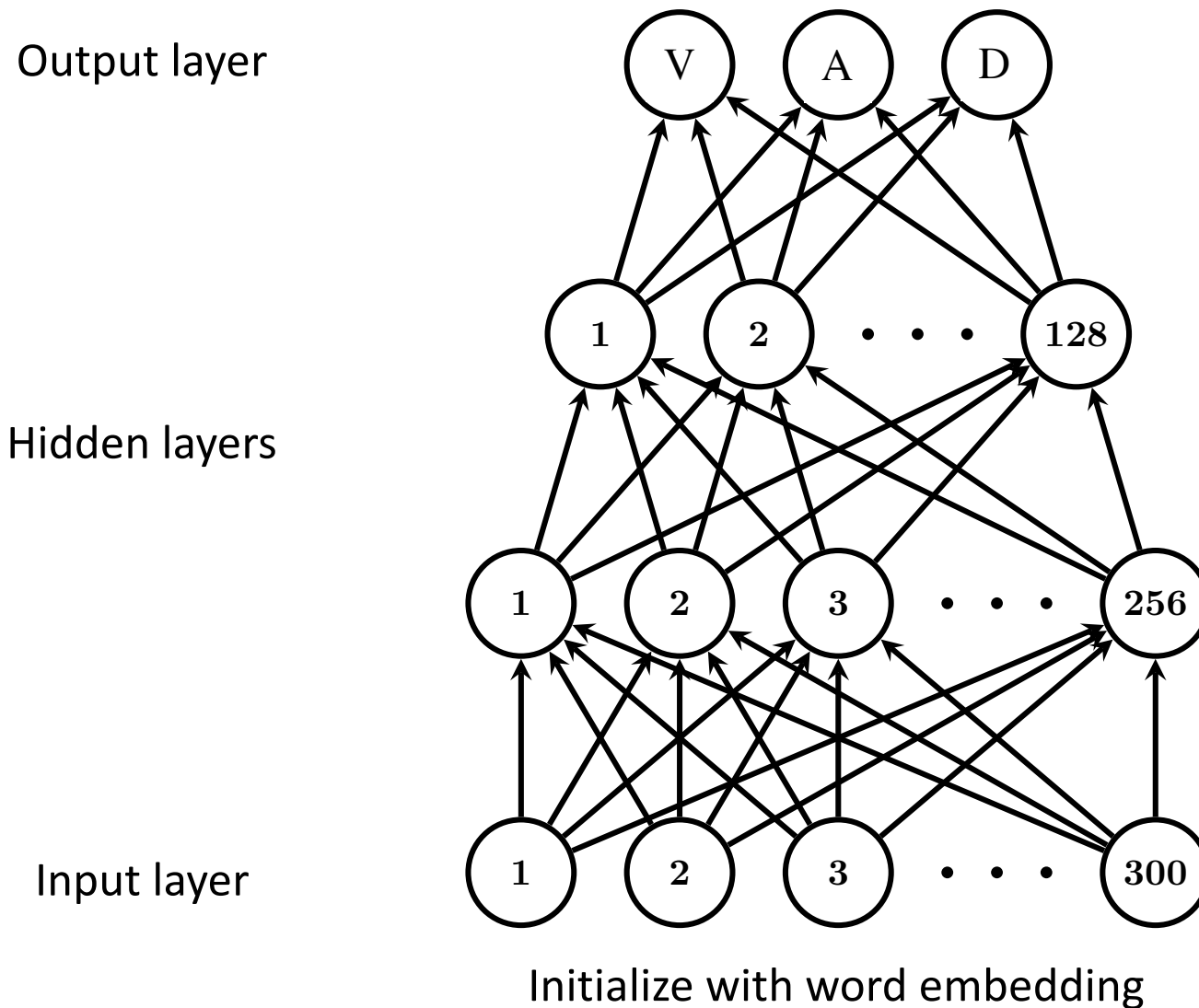


Artificial Neural Networks: Layer-Based Arrangement

- Organized in layers for efficient computation
- Signal flows in one direction only
- Signal gets transformed by passing it to next layer



Artificial Neural Networks: Modeling Word Emotion

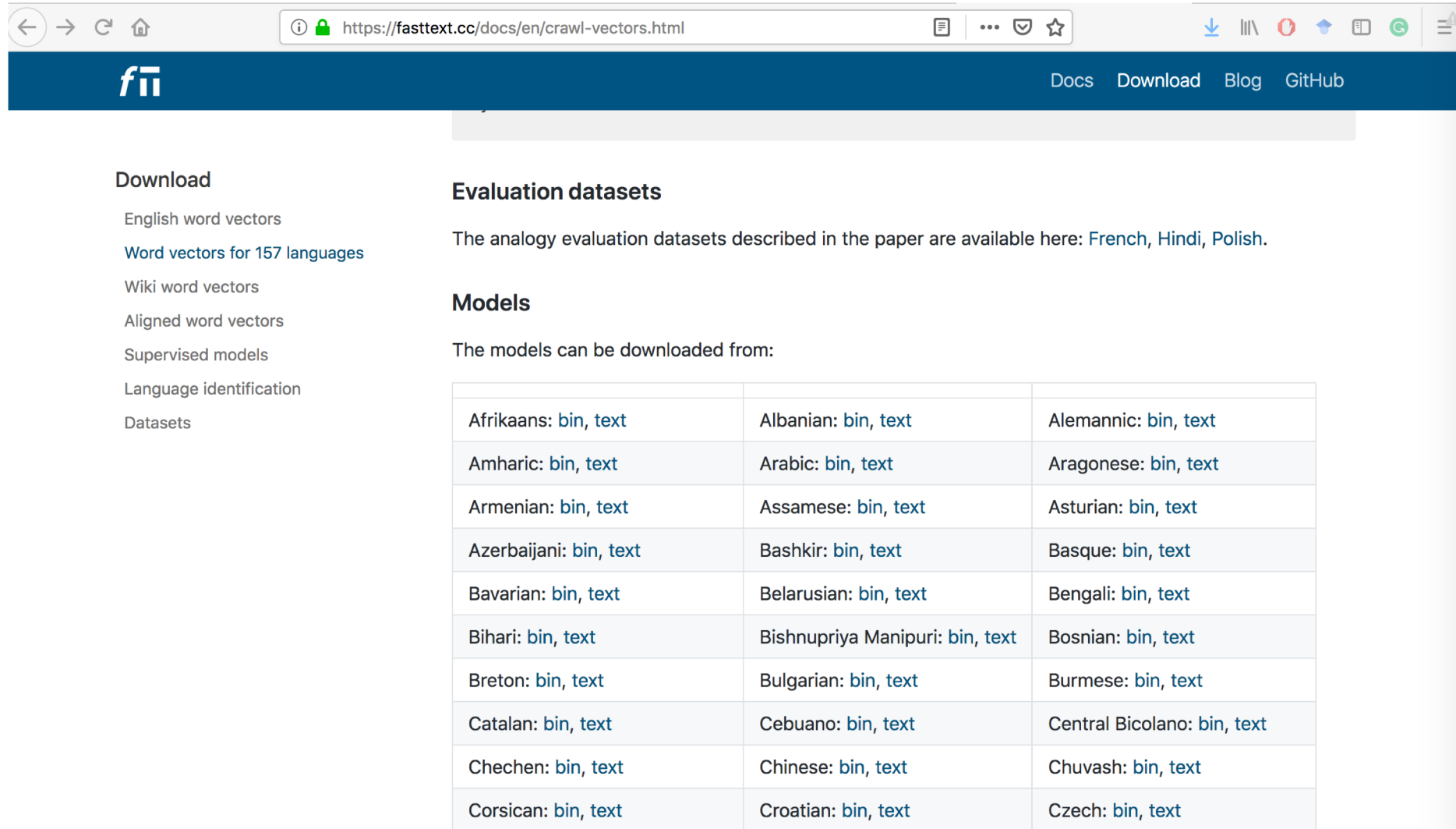


How to Evaluate the Model?

What Datasets to Evaluate on?

Source	ID	Language	Format	# Entries
Bradley and Lang (1999)	EN	English	VAD	1,034
Warriner et al. (2013)	EN+	English	VAD	13,915
Redondo et al. (2007)	ES	Spanish	VAD	1,034
Stadthagen-Gonzalez et al. (2017)	ES+	Spanish	VA	14,031
Schmidtke et al. (2014)	DE	German	VAD	1,003
Yu et al. (2016a)	ZH	Chinese	VA	2,802
Imbir (2016)	PL	Polish	VAD	4,905
Montefinese et al. (2014)	IT	Italian	VAD	1,121
Soares et al. (2012)	PT	Portuguese	VAD	1,034
Moors et al. (2013)	NL	Dutch	VAD	4,299
Sianipar et al. (2016)	ID	Indonesian	VAD	1,490

Where to Get the Word Embeddings?



The screenshot shows the fasttext.cc website. The browser address bar displays <https://fasttext.cc/docs/en/crawl-vectors.html>. The website has a dark blue header with the 'fii' logo on the left and navigation links 'Docs', 'Download', 'Blog', and 'GitHub' on the right. On the left side of the page, under the heading 'Download', there is a list of links: 'English word vectors', 'Word vectors for 157 languages' (highlighted in blue), 'Wiki word vectors', 'Aligned word vectors', 'Supervised models', 'Language identification', and 'Datasets'. The main content area features a section titled 'Evaluation datasets' with the text 'The analogy evaluation datasets described in the paper are available here: [French](#), [Hindi](#), [Polish](#).' Below this is a section titled 'Models' with the text 'The models can be downloaded from:'. A table follows, listing 24 languages and their corresponding binary and text file formats for download.

Download

- English word vectors
- [Word vectors for 157 languages](#)
- Wiki word vectors
- Aligned word vectors
- Supervised models
- Language identification
- Datasets

Evaluation datasets

The analogy evaluation datasets described in the paper are available here: [French](#), [Hindi](#), [Polish](#).

Models

The models can be downloaded from:

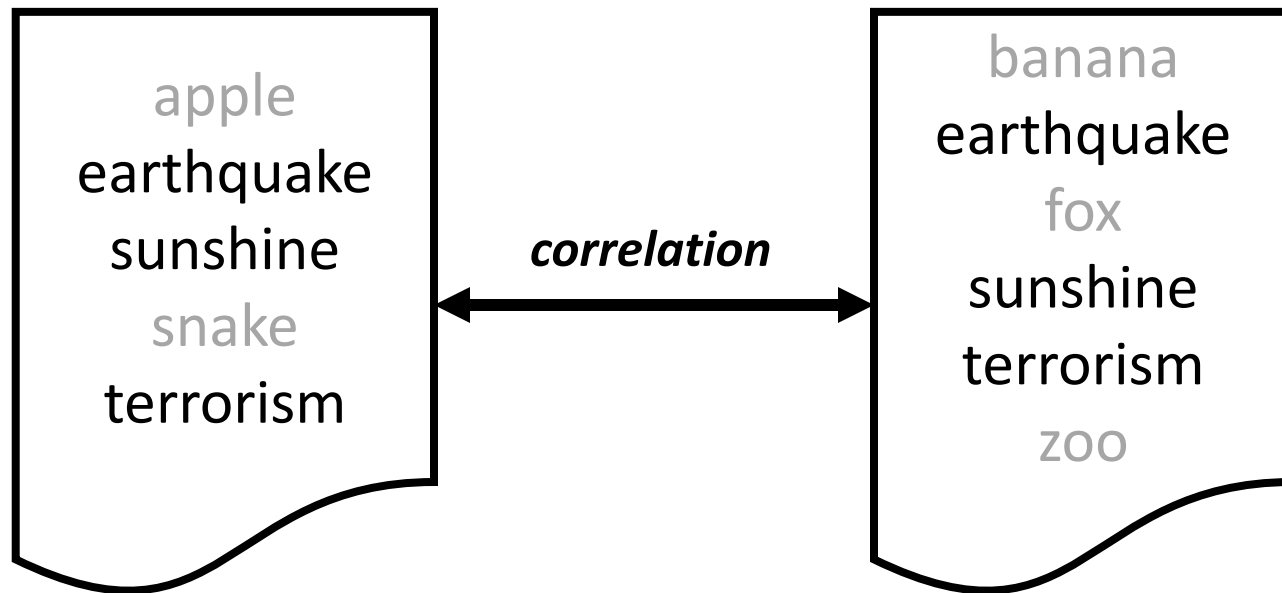
Afrikaans: bin , text	Albanian: bin , text	Alemannic: bin , text
Amharic: bin , text	Arabic: bin , text	Aragonese: bin , text
Armenian: bin , text	Assamese: bin , text	Asturian: bin , text
Azerbaijani: bin , text	Bashkir: bin , text	Basque: bin , text
Bavarian: bin , text	Belarusian: bin , text	Bengali: bin , text
Bihari: bin , text	Bishnupriya Manipuri: bin , text	Bosnian: bin , text
Breton: bin , text	Bulgarian: bin , text	Burmese: bin , text
Catalan: bin , text	Cebuano: bin , text	Central Bicolano: bin , text
Chechen: bin , text	Chinese: bin , text	Chuvash: bin , text
Corsican: bin , text	Croatian: bin , text	Czech: bin , text

Evaluation Set-Up

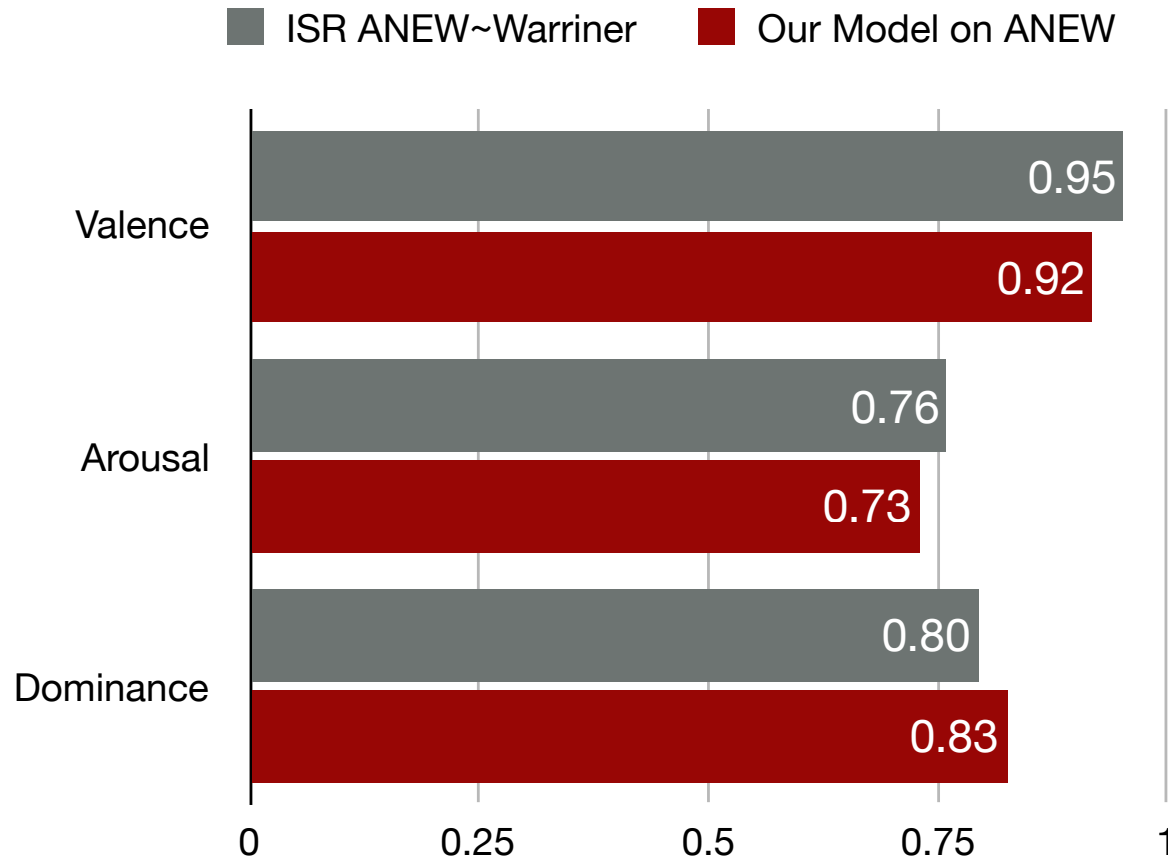
- 9 languages
- Compare our model against 5 reference methods
- Performance measured in Pearson's r
- *Best current approach for predicting word emotion*

Comparison against Human Reliability

- How does our model compare against Inter-Study Reliability (ISR)
- Correlation between Ratings in $ANEW \cap Warriner$



Competitive against Human Reliability



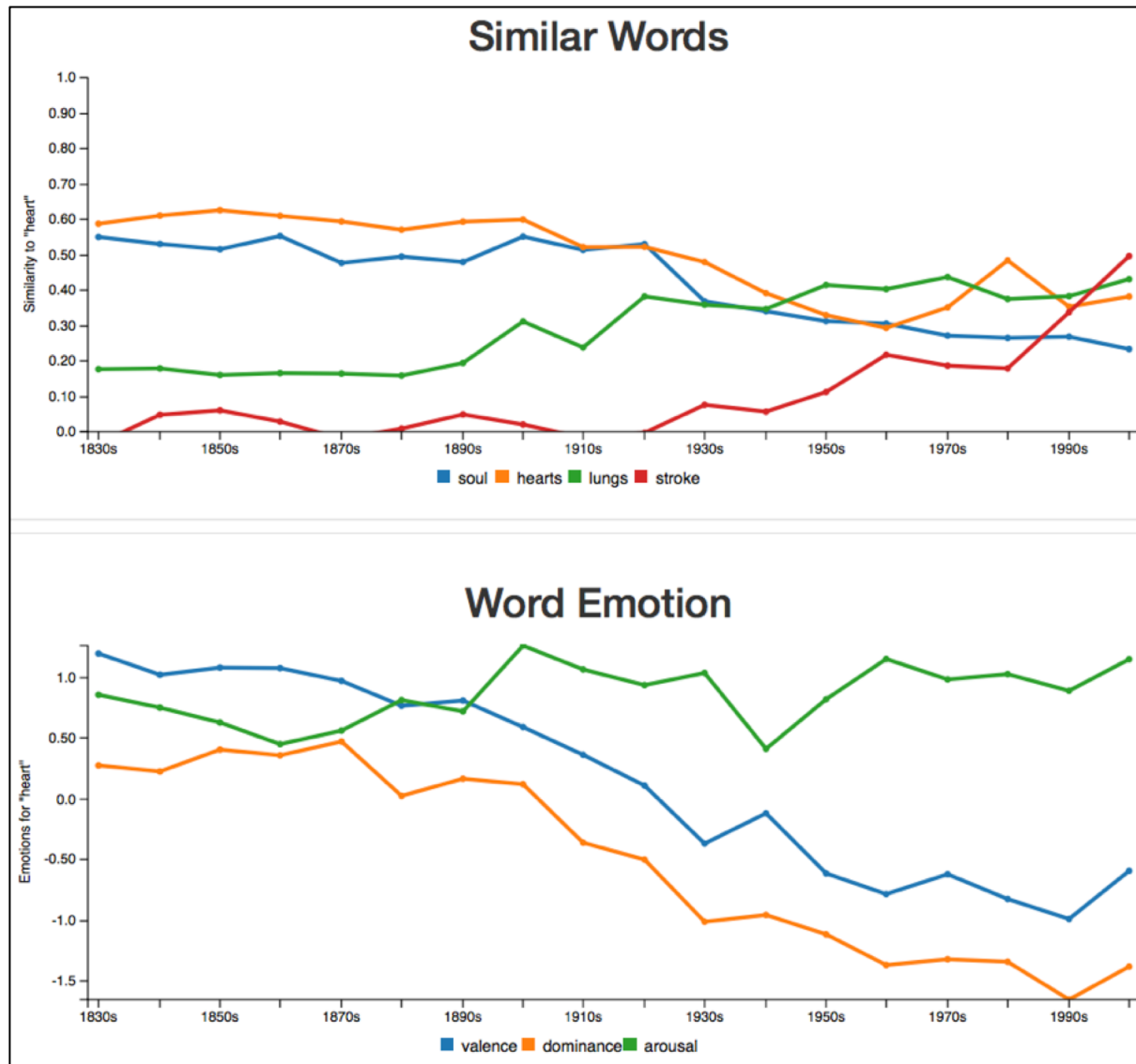
- Consistent with results from split-half reliability

Conclusion

Conclusion

- Affective word meaning: Emotion evoked in recipients
- Introduced VAD approaches to emotion representation
- Described how word embeddings and ANNs can be used for modeling affective word meaning
- Reported on experiments involving many different languages and prior computational approaches
- Our model is current state-of-the-art and performs competitive to human reliability

Bonus: Diachronic Word Emotions — *heart*



JeSemE.org

(Hellrich et al., COLING 2018)



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Using Artificial Neural Networks to Model Affective Word Meaning

Sven Buechel

Jena University Language and Information Engineering (JULIE) Lab
Friedrich-Schiller-Universität Jena,
Jena, Germany

<https://julielab.de>