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Jena
University
Language &
Information
Engineering
Lab

Emotional Enterprises?

Measuring Affective Language on and by Organizations

Sven Buechel

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<https://julielab.de>

Short Bio

- Studied physics, sociology and German at University of Jena
- Bachelor's degree in 2016
Automatische Analyse von Emotionen in Geschäfts- und Nachhaltigkeitsberichten
- Pursuing “Fast-Track” PhD in computational linguistics
(Prof. Udo Hahn)
 - Methodological foundations to measure emotion in language
 - Applications to social science, economics, and humanities
 - Expected graduation by end of 2020
- Research visit at University of Pennsylvania in summer 2018
(Prof. Lyle Ungar (School of Engineering / Wharton School))
- Research intern at Amazon in summer 2019
(Berlin office; working on *Alexa*)

Structure of Talk

- Sentiment and emotion analysis
 - Task description and linguistic levels
 - Representing emotion
 - Application domains
- Emotional profiling of organizations
 - A corpus of annual and corporate social responsibility reports
 - A simple unsupervised approach
 - Results
- Recent methodologies in natural language processing

Sentiment and Emotion Analysis

Natural Language Understanding in the 90s

John Doe , the founder of *XY Inc* ,

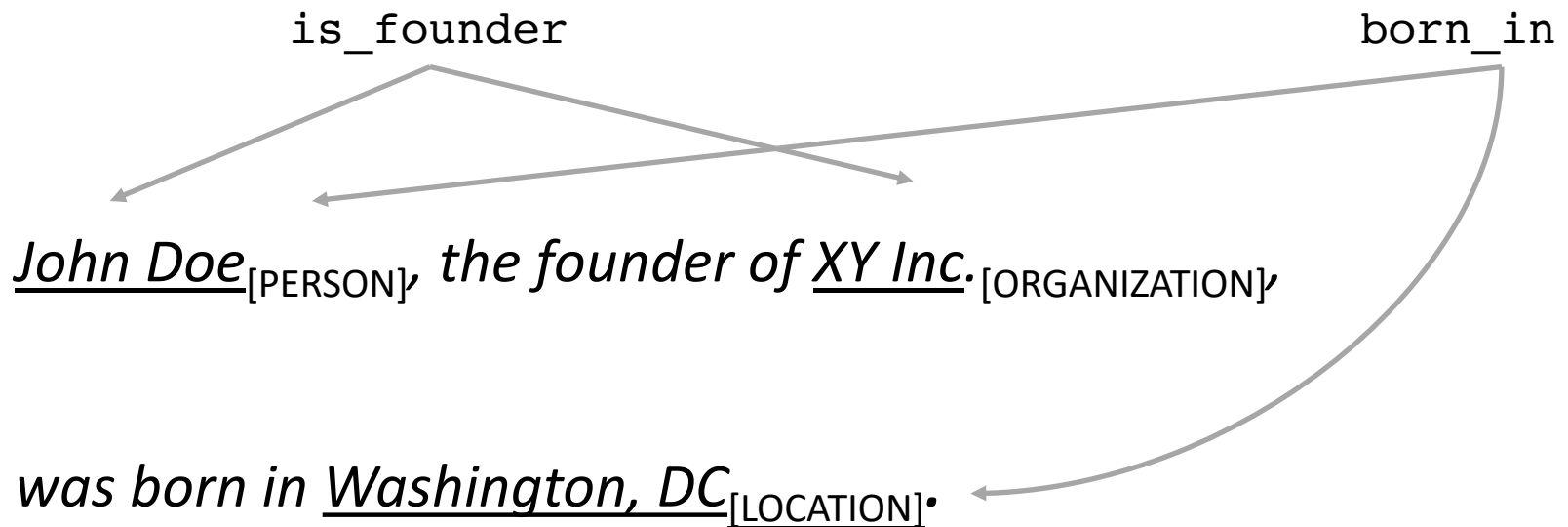
was born in Washington, DC .

Natural Language Understanding in the 90s

John Doe_[PERSON], the founder of XY Inc._[ORGANIZATION],

was born in Washington, DC_[LOCATION].

Natural Language Understanding in the 90s



Growing Interest in *Subjective* Language

semantic polarity of words

(Hatzivassiloglou & McKeown, 1997)

good fantastic
great mediocre
boring poor

evaluative statements

(Pang et al., 2002)

The pizza was great!

The service was awful...

subjectivity

(Wiebe et al., 2004)

John Doe, the founder of XY Inc., was born in Washington, DC.

I hate John Doe, he has a terrible sense of humor.

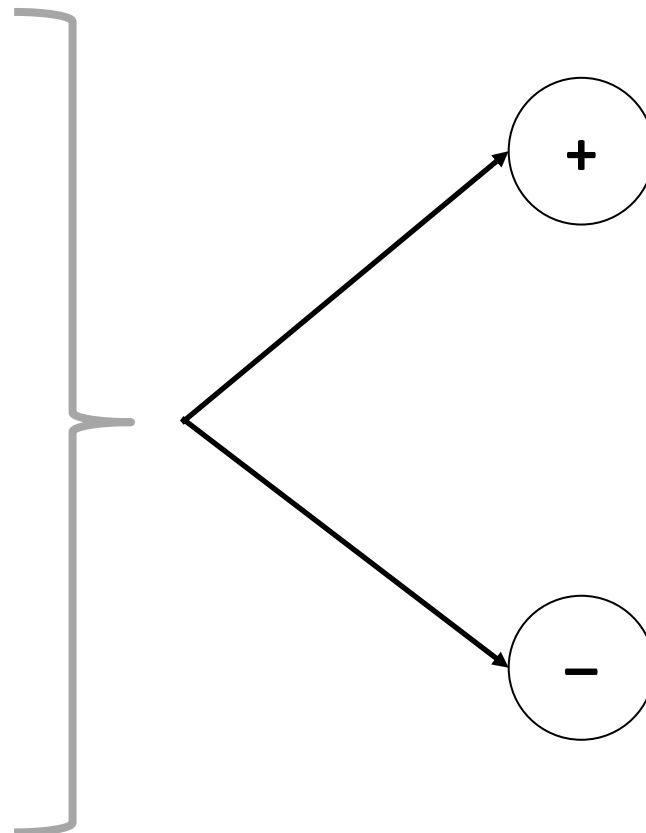
Sentiment Analysis — Task Description(s)

Trends were bundled in the emerging area of sentiment analysis

sunshine

I hate John Doe, he has a
terrible sense of humor.

*XY Inc.
Annual
Report*



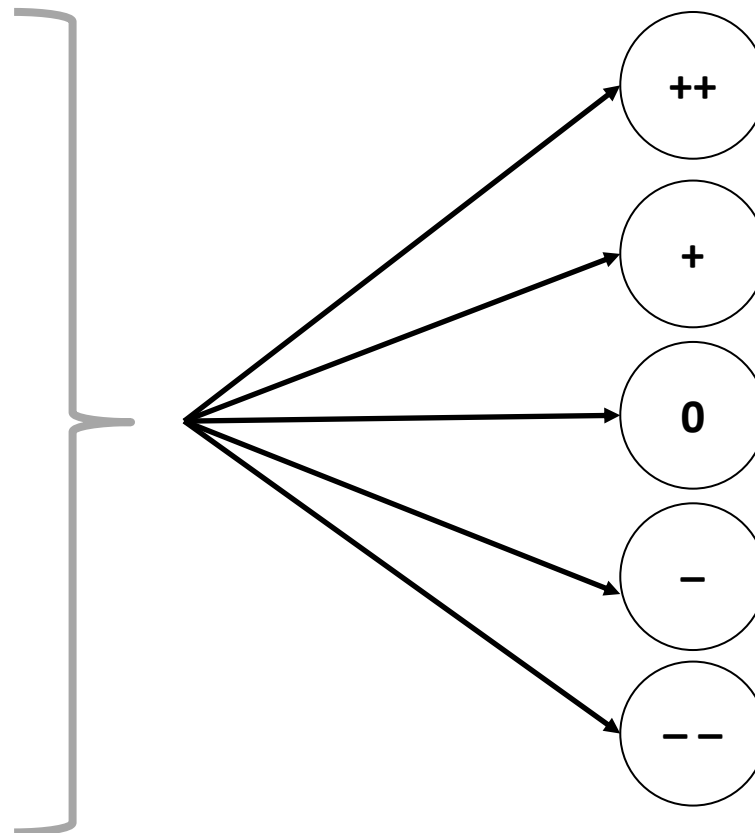
Sentiment Analysis — Task Description(s)

Need for a more fine-grained target representation

sunshine

I hate John Doe, he has a
terrible sense of humor.

*XY Inc.
Annual
Report*



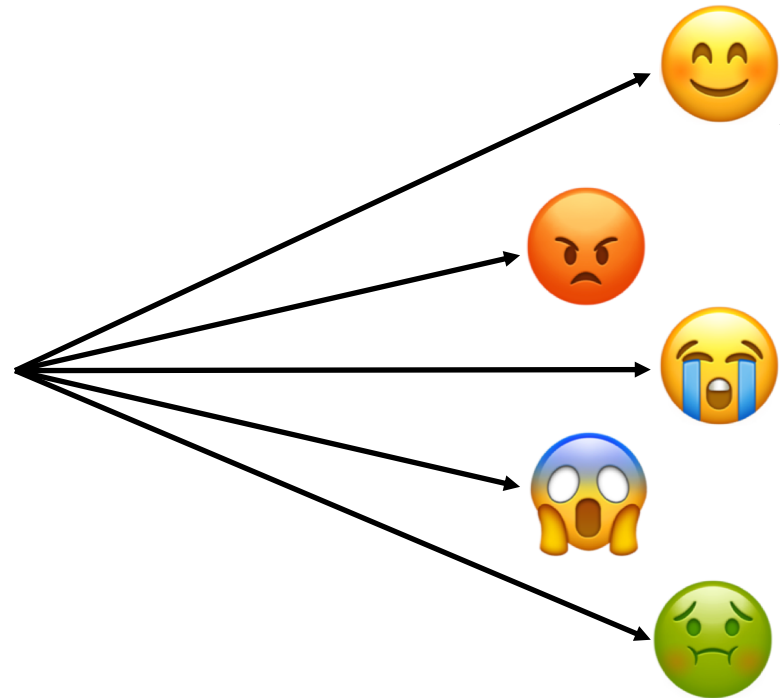
Emotion Analysis — Task Description(s)

Need for a more fine-grained target representation

sunshine

I hate John Doe, he has a
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Report*



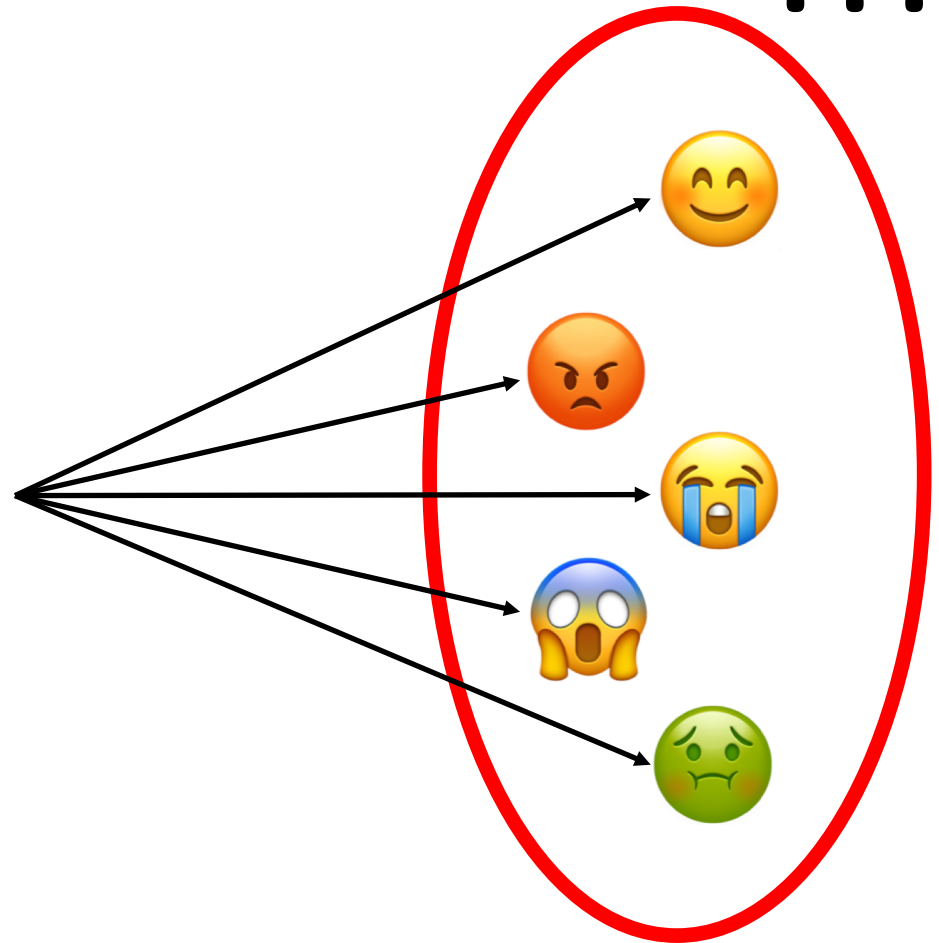
Emotion Analysis — Task Description(s)

Need for a more fine-grained target representation ???

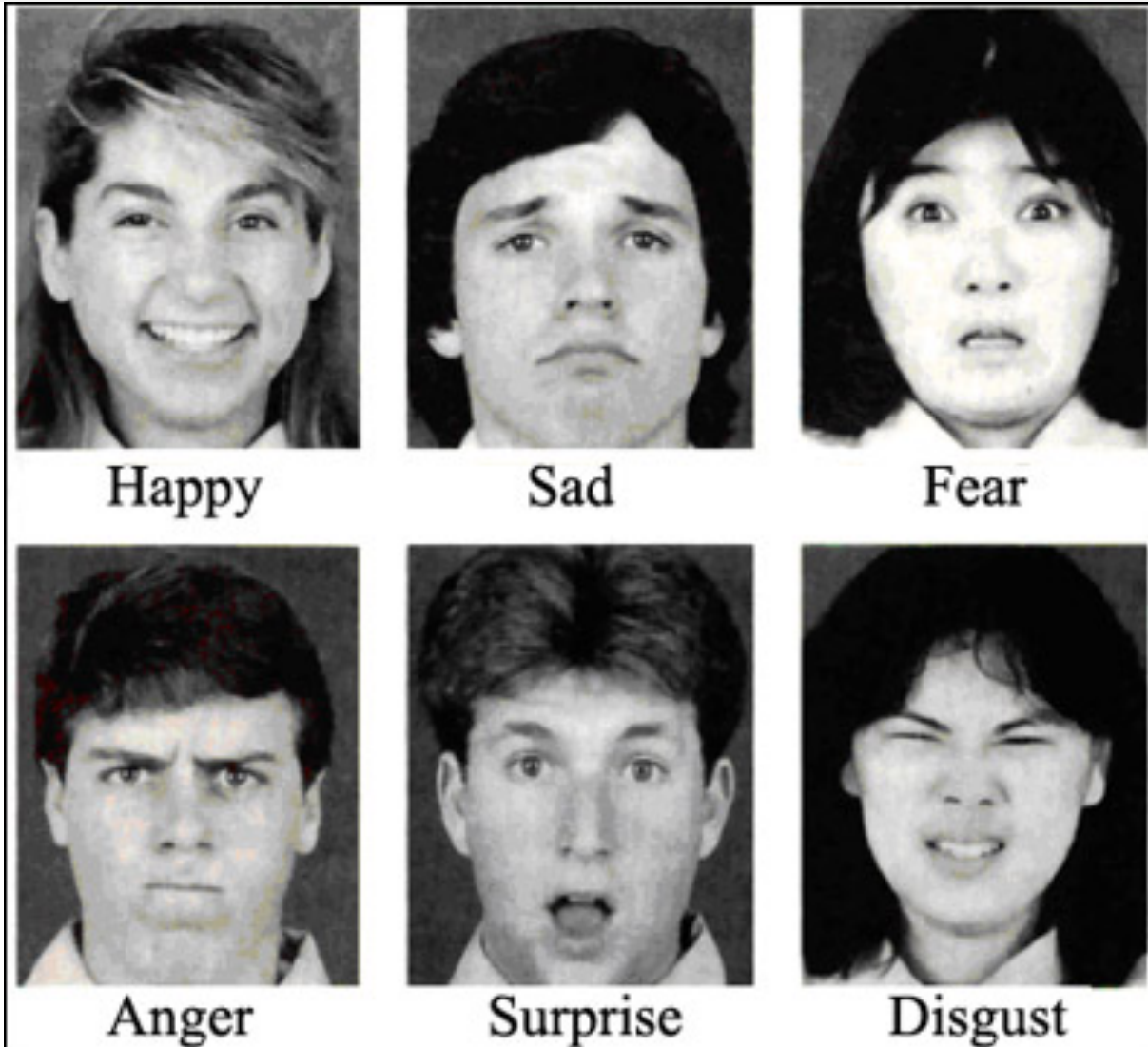
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Annual
Report*

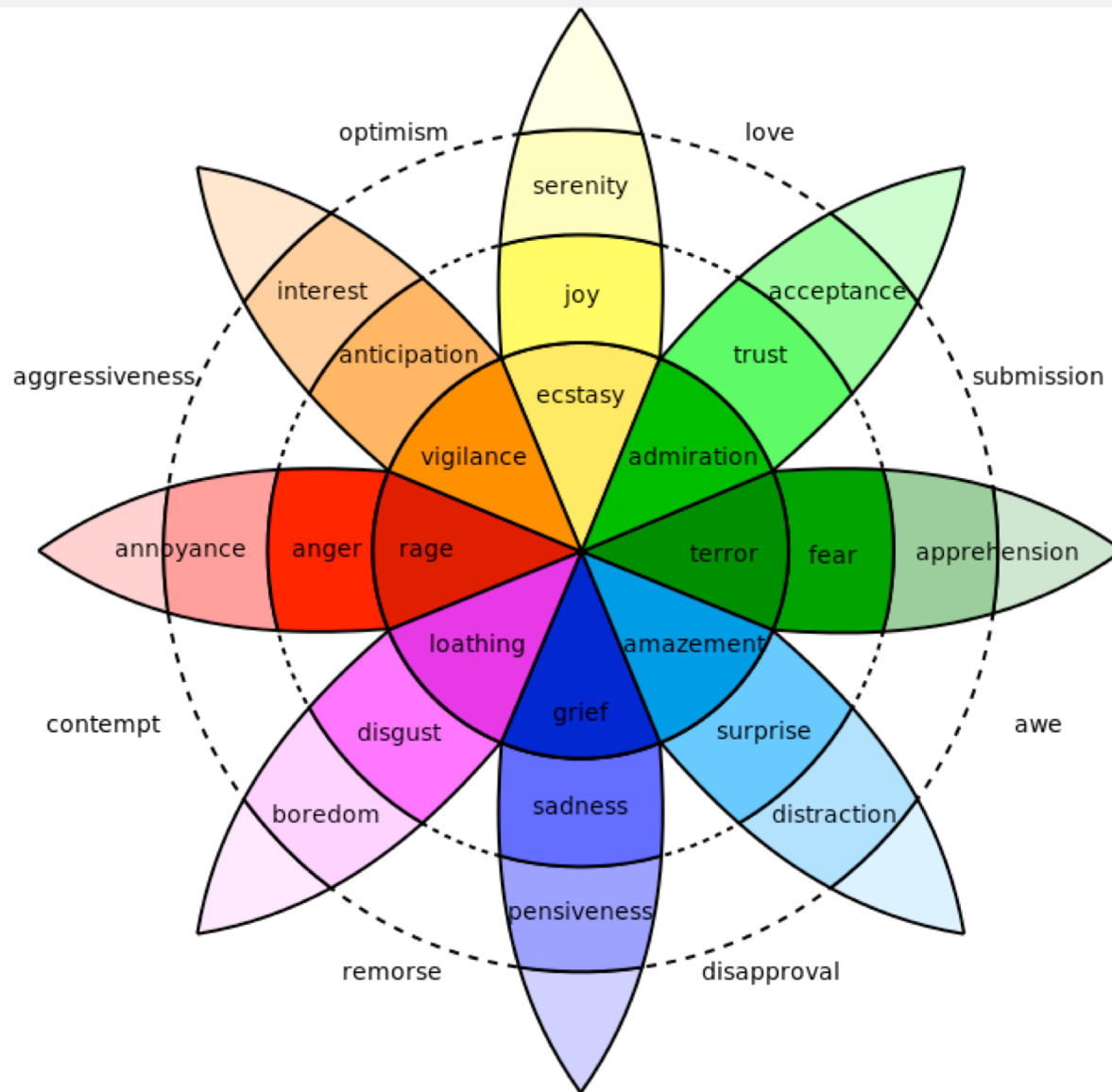


Representing Emotion — Ekman's Basic Emotions



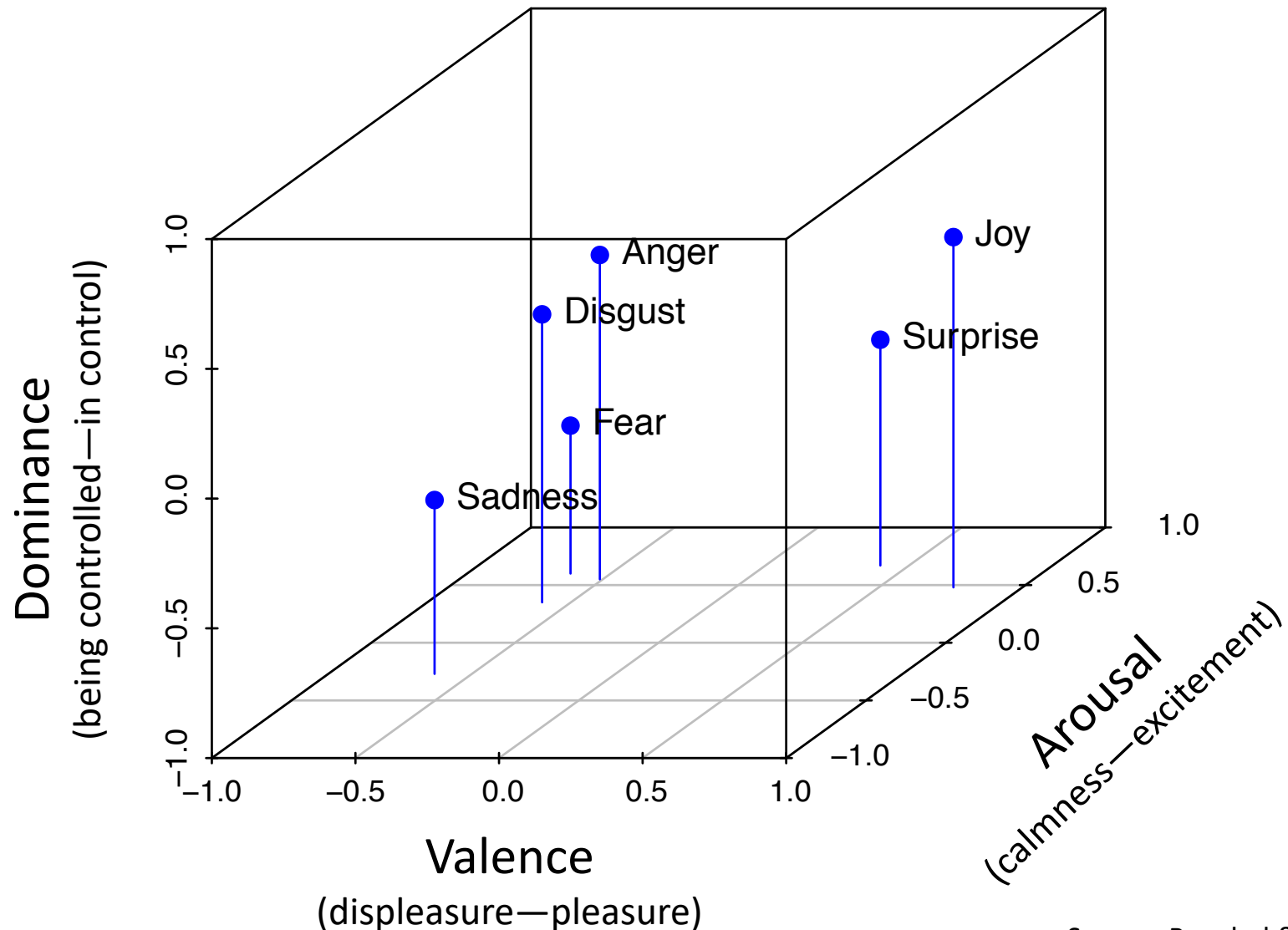
Source: <http://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-00sc-introduction-to-psychology-fall-2011/emotion-motivation/discussion-emotion/>

Representing Emotion — Plutchik's Wheel of Emotion



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

Representing Emotion — Dimensional Models



Source: Buechel & Hahn (2016)

Application Domains

- Product reviews / analytics
 - Restaurant (Yelp)
 - Online retailers (Amazon)
 - Movies (RottenTomatoes, IMDB)
- Social media (esp. Twitter)
 - Political science
 - Public relations
 - Stock market prediction



All in all, I prefer a Marvel movie that doesn't take itself seriously, but the nonstop unseriousness of Deadpool 2 can wear you down, too.

May 18, 2018 | Rating: B- | [Full Review...](#)

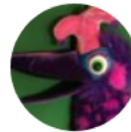


Peter Rainer

Christian Science Monitor

★ Top Critic

rottentomatoes.com



Xavidub @jimdoherty09 · 2 Min.

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

twitter.com



Tiffany Couch @TheTiffanyCouch · 22 Std.

Audi CEO arrested over **diesel** cheating scandal. [#fraud](#) [#audi](#) @FinancialTimes @FCPA

twitter.com

Subjective Language *by* Companies

- Sentiment and subjectivity in annual reports for
 - Stock market prediction
(Hajék et al., 2014)
 - Bankruptcy prediction
(Hajkék & Olej, 2015)
 - Fraud detection
(Goel & Uzuner, 2016)
 - Risk prediction
(Tsai & Wang, 2017)
- 2nd Workshop on Economics and Natural Language Processing
(ECONLP @ EMNLP 2019 in Hong Kong)

Emotional Profiling of Organizations

Motivation

- Collaboration with management and organization researchers
- Interest in anthropomorphic communication behavior of organizations (esp. targets, virtues, cognitive processes)
- Is this framework also applicable to emotions?
- Do enterprises communicate with a distinctive and persistent emotional profile?

Publications

- Sebastian G.M. Händschke*, **Sven Buechel***, Jan Goldenstein, Philipp Poschmann, Tinghui Duan, Peter Walgenbach and Udo Hahn. 2018. A corpus of business and corporate social responsibility reports: 280 million tokens of balanced organizational writing. In ***ECONLP @ ACL 2018***.
- **Sven Buechel** and Udo Hahn. 2016. Emotion analysis as a regression problem — Dimensional models and their implications on emotion representation and metrical evaluation. In ***ECAI 2016***.
- **Sven Buechel**, Udo Hahn, Jan Goldenstein, Sebastian G. M. Händschke, and Peter Walgenbach. 2016. Do enterprises have emotions? In ***WASSA @ NAACL 2016***.

Related Work — 10-K Corpus (Kogan et al., 2010)

- Consists of Form 10-K reports
- 10K companies
- 54K reports
- Covers 1996 – 2006
- Much larger than our corpus yet
 - unbalanced
 - no cross-country comparisons
 - outdated

Selection of Raw Data

- Three countries: US, UK, Germany
- Annual reports and corporate social responsibility (CSR) reports
- Stepwise selection of companies:
 1. 30 large companies DJIA, FTSE 100, and DAX
 2. 30 middle-sized companies from S&P500, FTSE 250, and MDAX
 3. 30 tech companies from NASDAQ, FTSE AIM 100 and TECDAX
- US and UK enterprises chosen to match the German ones
- Companies were selected as of 2015, all available reports were collected back to 2000

Data Acquisition and Cleansing

- Reports were downloaded from company website
(email as fallback)
- PDF-to-text conversion
- Handwritten rules to
 - Filter conversion errors
 - Remove remnants of print layout and structured information
(page numbers, tables, ...)
 - Making it as much of a plain text as possible

Annual Reports

The most important new model in 2002 was the Actros, which had its premiere at the International Auto Show (IAA) in Hanover and was well received by customers and automotive journalists. Its distinctive characteristics are its more powerful engines, a new axle and suspension concept, improved aerodynamics and a redesigned driver's cab.

Mercedes-Benz Vans still leads the field

The Mercedes-Benz Vans business unit sold 236,600 vehicles worldwide in 2002, nearly matching the figure for 2001. With a market share of 18% (2001: 19%) in the segment of 2 to 6 metric tons, Mercedes-Benz Vans is still the market leader in Western Europe. Whereas the Sprinter was able to maintain its strong market position in the heavy vans segment, in the segment of mid-size vans the market share of the Vito decreased due to the model changeover scheduled for 2003.

In the spring of 2002, DaimlerChrysler introduced the new Vaneo, which is positioned as a premium product in this segment.

The updated Sprinter model was introduced at the International Auto Show (IAA) in Hanover in September 2002. This new model is more attractive and, thanks to longer service intervals, more economical. Another new feature is the Electronic Stability Program (ESP). DaimlerChrysler is the first vehicle manufacturer to offer this system in this van segment. To strengthen its presence in the US van market in early 2003, DaimlerChrysler plans to offer the Sprinter, which has been sold successfully in the US under the Freightliner brand name since the middle of 2001, as a Dodge brand vehicle as well. We also plan to launch the Sprinter in Canada and Mexico.

The licensing agreement with Volkswagen AG for the production of the Sprinter van by Volkswagen was renewed to cover successor models as well.



The updated Mercedes-Benz Sprinter appeals with a new design and a world first. The Sprinter is the first van series worldwide for which all models can be supplied with the ESP electronic stability program.

Unit Sales 2002 ¹

	1,000 Units	02/01 in %
World	485	- 2
of which: Vans ²	246	- 5
Trucks ³	212	+ 3
Buses	25	- 8
Unimogs	2	- 23
Europe	287	- 2
of which: Germany	103	- 3
Western Europe (excluding Germany)	162	- 5
of which: France	32	- 10
United Kingdom	33	+ 14
Italy	23	+ 4
NAFTA	118	+ 11
of which: United States	100	+ 12
South America (excluding Mexico)	37	- 14
of which: Brazil	30	- 12
Asia	24	- 8

¹ Wholesale figures (including leased vehicles)

² Including the Mitsubishi L200 pickup and the Mitsubishi Pajero in South Africa

³ Including schoolbuses by Thomas Built Buses and bus chassis by Freightliner

DaimlerChrysler, 2002

Annual Reports

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3 Including schoolbuses by Thomas Built Buses and bus chassis by Freightliner

DaimlerChrysler, 2002

CSR Reports

BE BOLD. BE TRANSPARENT. BE A LEADER.

Our stakeholder engagement process has identified a number of issues that are important to society and our business, including several over-arching priorities for the future.

WHAT OUR STAKEHOLDER ADVISORY TEAM TOLD US	HOW IT IS INFLUENCING OUR JOURNEY
 <p>GOALS: SET LONG-TERM, MEASURABLE, AMBITIOUS GOALS.</p>	 <ul style="list-style-type: none"> • ESTABLISHED GOALS FOR THREE OF OUR CSR & SUSTAINABILITY PILLARS • DEVELOPING IMPROVED COLLECTION, CONSOLIDATION, AND REPORTING PROCESSES
 <p>FOOD: FOCUS ON FOOD AS THE PRIORITY.</p>	<ul style="list-style-type: none"> • PARTNERED WITH THE ALLIANCE FOR A HEALTHIER GENERATION IN CONNECTION WITH THE CLINTON GLOBAL INITIATIVE TO COMMIT TO INCREASING CUSTOMERS' ACCESS TO FRUIT AND VEGETABLES AND HELPING FAMILIES MAKE INFORMED FOOD CHOICES • WORKING TO IMPROVE PRODUCT NUTRITIONALS • PROVIDING EASY ACCESS TO NUTRITION INFORMATION AND MORE CUSTOMER CHOICE
 <p>SOURCING: LEVERAGE McDONALD'S SCALE AND MARKET LEADERSHIP TO INFLUENCE CHANGE ON KEY ISSUES.</p>	<ul style="list-style-type: none"> • WORKING THROUGH GLOBAL ORGANIZATIONS TO ADVANCE COLLECTIVE IMPROVEMENTS, SUCH AS SUSTAINABLE BEEF PRODUCTION • COLLABORATING WITH SUPPLIERS TO SUPPORT MORE SUSTAINABLE AGRICULTURE
<p>PLANET: INCORPORATE CLIMATE CHANGE AND WATER RISK AVOIDANCE IN OUR STRATEGY.</p>	 <ul style="list-style-type: none"> • ESTIMATED SYSTEM-WIDE CARBON FOOTPRINT • DEVELOPED CLIMATE AND ENERGY CHANGE POSITION STATEMENT • INCLUDED WATER RISK IN ENVIRONMENTAL SCORECARD FOR SUPPLIERS • COMPLETED WATER STRESS MAPPING FOR ALL RESTAURANTS • DEVELOPING ENTERPRISE-WIDE WATER STRATEGY AND BEGINNING WATERSHED-LEVEL INVESTIGATIONS
<p>PEOPLE: BE BOLDER IN OUR COMMUNICATIONS, BOTH INTERNALLY AND EXTERNALLY.</p>	<ul style="list-style-type: none"> • CREATED A CSR & SUSTAINABILITY COMMUNICATIONS TEAM • ALIGNING WITH REGIONAL McDONALD'S COMMUNICATIONS PERSONNEL
<p>COMMUNITY: LEVERAGE EMPLOYEES AS A KEY DRIVER OF COMMUNITY STRATEGY.</p>	<ul style="list-style-type: none"> • PLANNING GLOBAL EMPLOYEE VOLUNTEER PROGRAM AND RECOGNITION INITIATIVE • CREATING COMMUNITY STRATEGY ALIGNED WITH BRAND AMBITION, CSR & SUSTAINABILITY FRAMEWORK

14

Corpus Statistics

- 280M Tokens (for comparison: German Wikipedia has 1.3B),
- 5K reports
- Equal distribution by country
- 250K tokens of annual vs. 35K tokens of CSR reports

Measuring Document Emotion

- Lexicon-based approach because of missing gold data
- Emotion lexicons store uncontextualized word emotions
- Lexicon by Warriner et al. (2013) comprises 14k entries

Lemma	Valence	Arousal	Dominance
sunshine	8.1	5.3	5.4
terrorism	1.6	7.4	2.7
calm	6.9	1.7	7.4

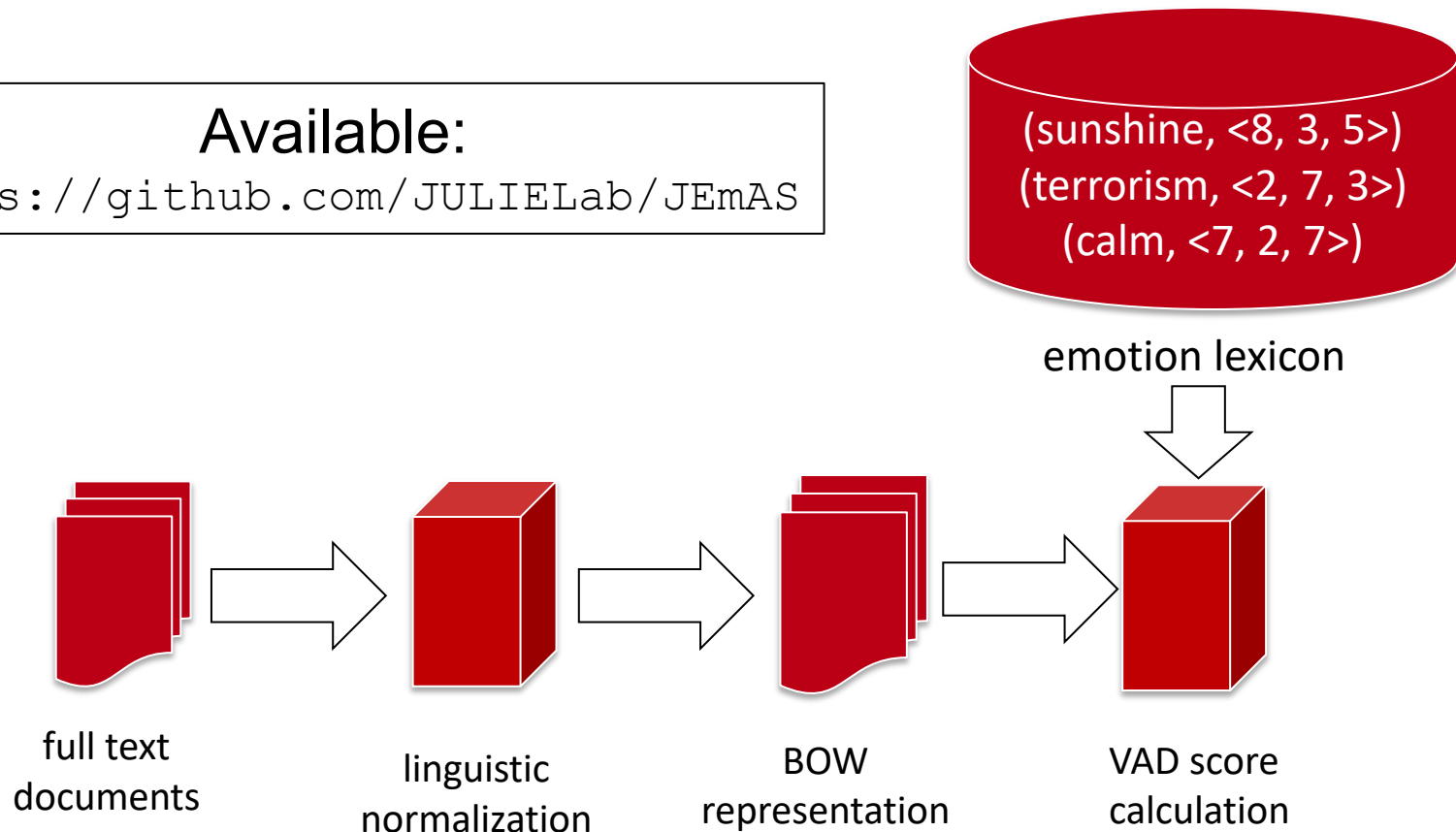
(1-to-9 scales)

Measuring Document Emotion: JEmAS

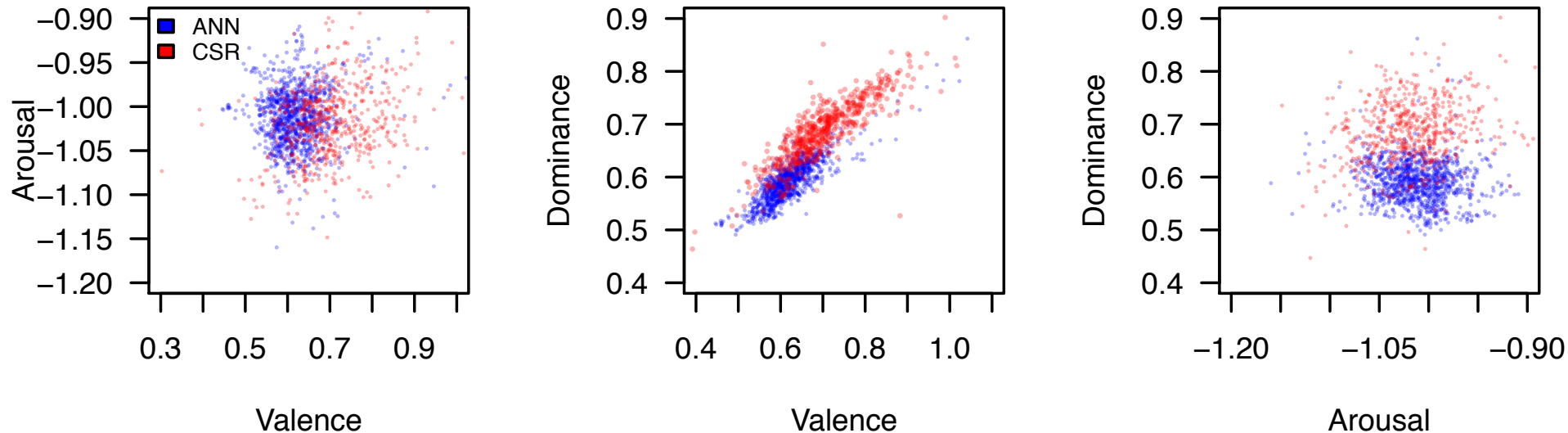
(Buechel & Hahn, ECAI 2016)

Available:

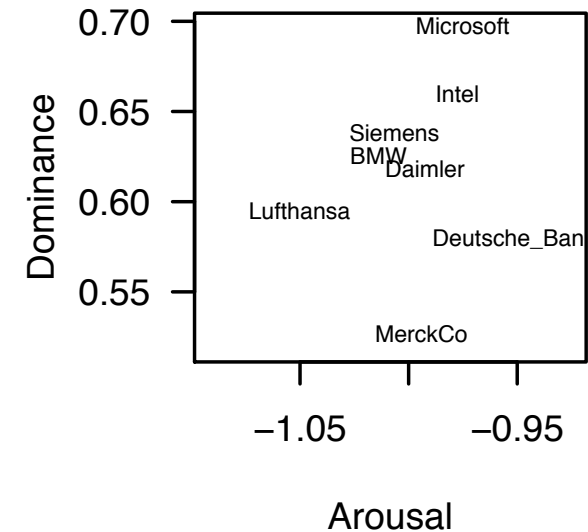
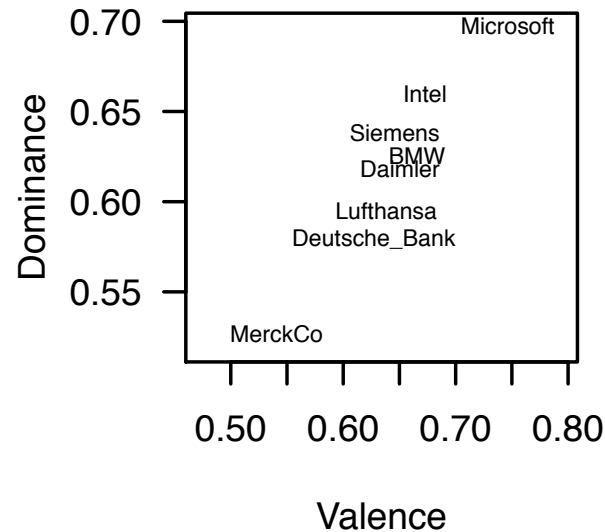
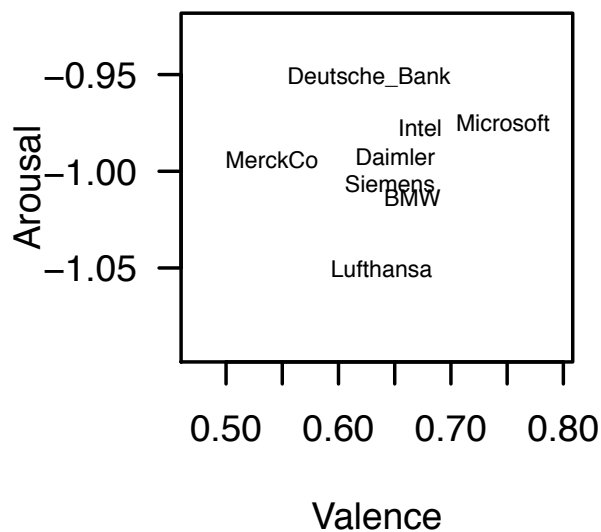
<https://github.com/JULIELab/JEmAS>



Results — Annual vs. CSR Reports



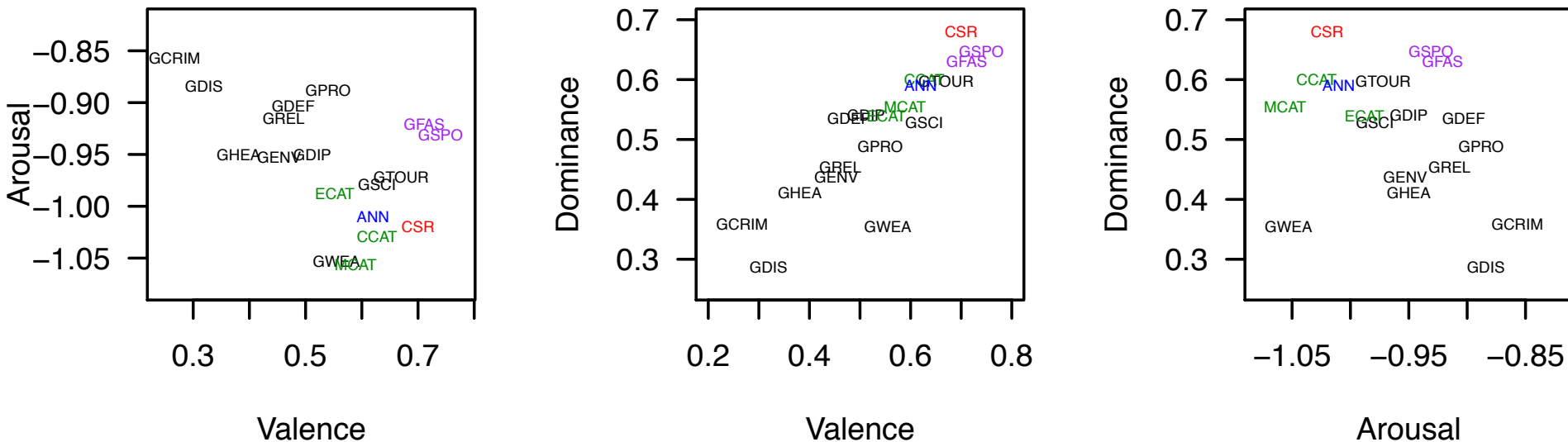
Results — Enterprise Mean Scores



Results — Influence of Company and Year

- Statistical analysis revealed that the company issuing a report accounts for most of the variance of VAD values
- Up to 70% for arousal when controlling for report type
- Yet reference year shows very little variance at all
- Corporations communicate with distinctive and persistent emotional profile

Results — Organizational Writing vs. News Topics



- Based on Reuters Corpus Volume 1 (RCV1)
- 800k newswire documents
- Hierarchy of 103 topic codes

Limitations of the Lexicon-Based Approach

Word usage is not always sufficient to infer sentiment

Everytime I read “Pride and Prejudice” I want to dig her [Jane Austen] up and beat her over the skull with her own shin-bone.

– Mark Twain

Problematic Linguistic Phenomena

Negation

good

not good

Modification

fine

almost fine

Composition

kill

kill cancer

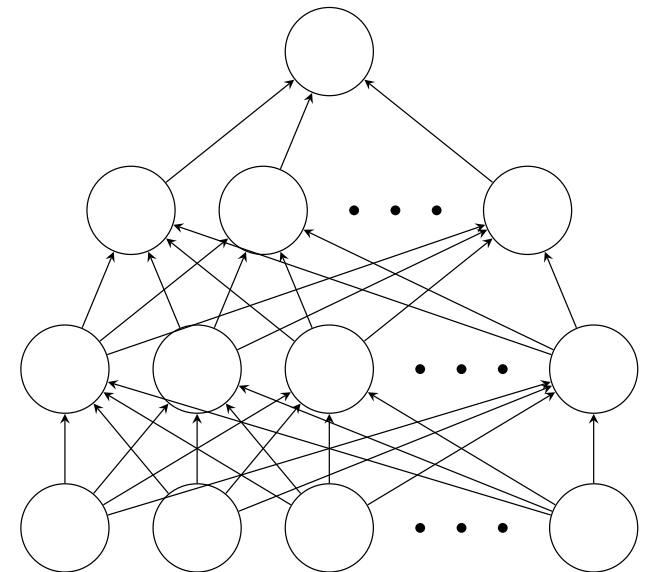
Ordering

The interior was charming, the service flawless, and the courses sounded delicious. However, it couldn't keep up to the expectations.

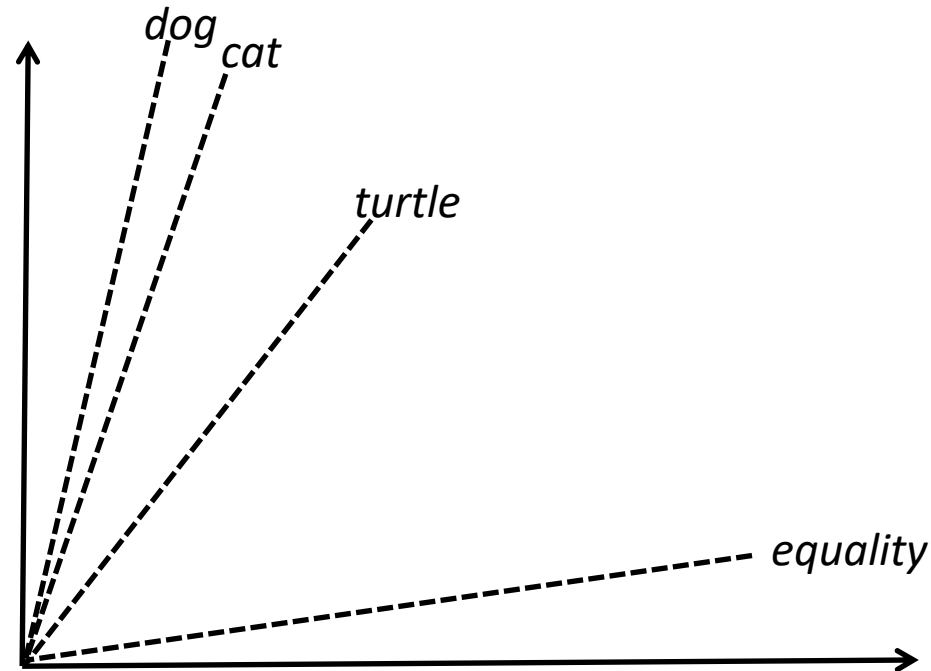
Recent Methodologies in Natural Language Processing

Recent Methodologies

- Most tasks in NLP approached as supervised machine learning
- In recent years: Deep Learning
- Neural network with multiple layers of non-linear transformations (stacked logistic regression models)
- Specific architecture depends on linguistic level (Word–Sentence–Text)



Word Embeddings I

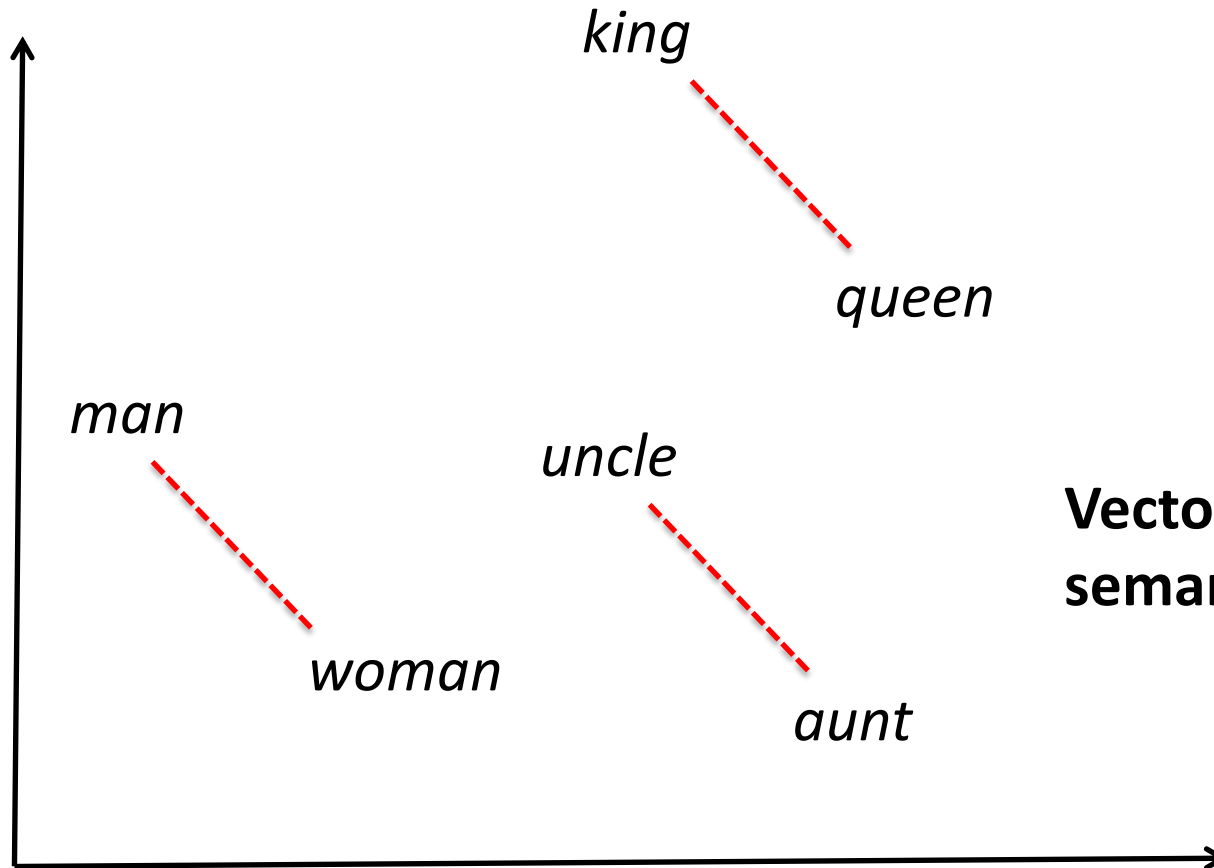


- Words represented as real valued vectors
- Angle between vectors encodes similarity
- Derived from raw text only
(factorization of cooccurrence matrix)

Specific Word Meaning in JOCo

<i>economy</i>		<i>growth</i>		<i>tax</i>		<i>leadership</i>	
recession	.70	grow	.66	taxes	.73	leaders	.66
economies	.69	double-digit	.64	taxation	.71	excellence	.57
upswing	.68	strong	.63	deferred	.65	reinforce	.56
upturn	.67	organic	.60	non-deductible	.61	leader	.55
gdp	.66	profitable	.60	carryforwards	.57	competencies	.55

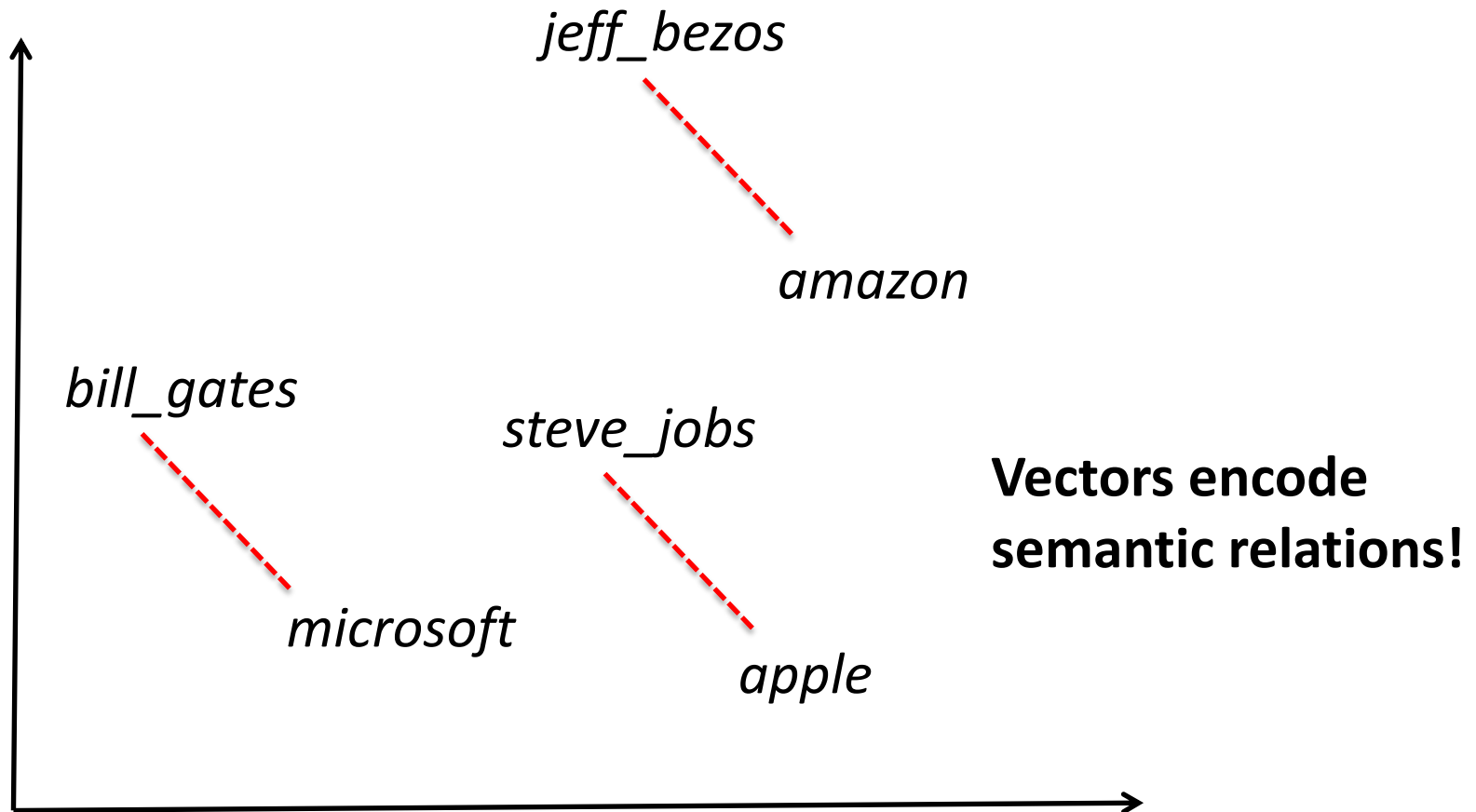
Word Embeddings II



**Vectors encode
semantic relations!**

$$\text{man} - \text{woman} + \text{queen} \approx \text{king}$$

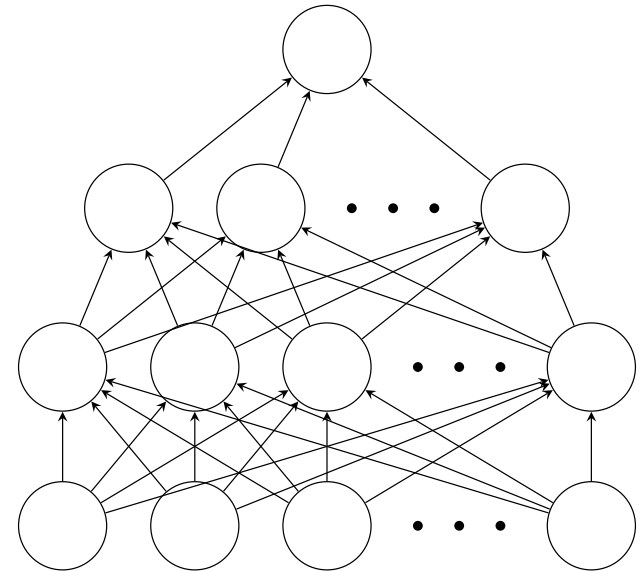
Word Embeddings II



$$\textit{bill_gates} - \textit{microsoft} + \textit{apple} \approx \textit{steve_jobs}$$

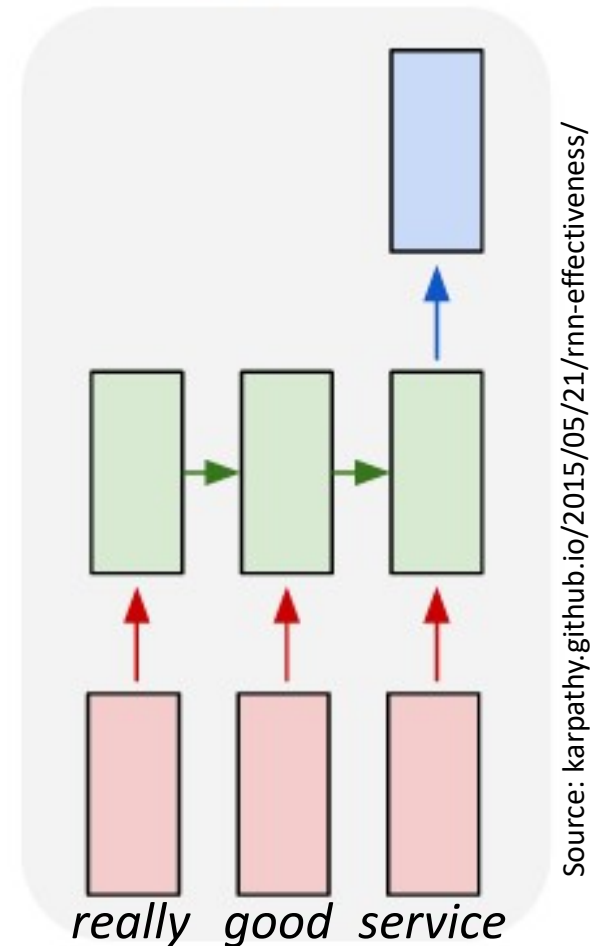
Current Methodologies — Word Level

- Emotion ratings can be directly inferred from word embeddings
- Simple feed-forward networks do very well (Du & Zhang, 2016)
- Close to human performance (Buechel & Hahn, NAACL 2018)



Current Methodologies — Sentence Level

- Recurrent neural networks (RNNs) as standard building block
- Input at multiple timesteps
- Hidden state “memorizes” context



Current Methodologies — Text Level

- Problem: RNNs can only memorize short sequences (≈ 100 time steps)
- RNNs work only for very short texts (paragraph, tweet)
- Best approach for long texts unclear
(news paper articles, movie transcript, novels, annual reports)
 - Averaging of sentence or even word scores as robust fallback
 - Unclear how to acquire ground truth

Conclusion

Conclusion

- Sentiment and emotion analysis are vibrant and relatively new areas within NLP
- Analysis of emotional language use by enterprises within corpus of annual and CSR reports
- Currently very fast methodological development in NLP opening up new possibilities for applied research



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Emotional Enterprises?

Measuring Affective Language on and by Organizations

Sven Buechel

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Jena, Germany

<https://julielab.de>