Sentiment Analysis

ÖAW AI Winter School 2023

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Introduction

Nehammer
(politician)

Introduction (cont.)

Nehammer
(politician)

©Twitter/@NoeWehrtSich

polarizing action

Introduction (cont.)

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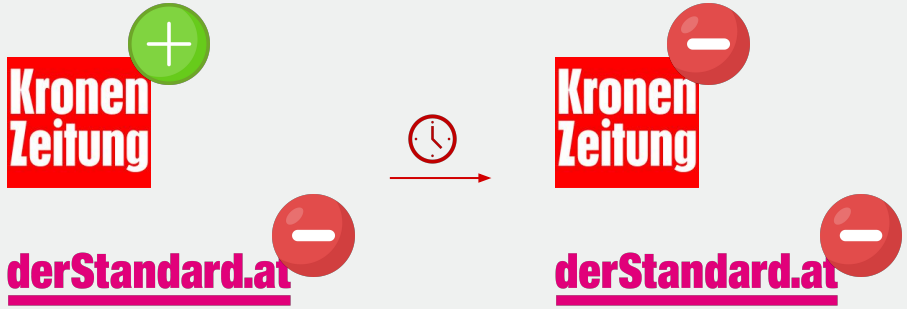
polarizing action



possible connection between polarizing action and change in media reporting

Introduction (cont.)

Nehammer
(politician)

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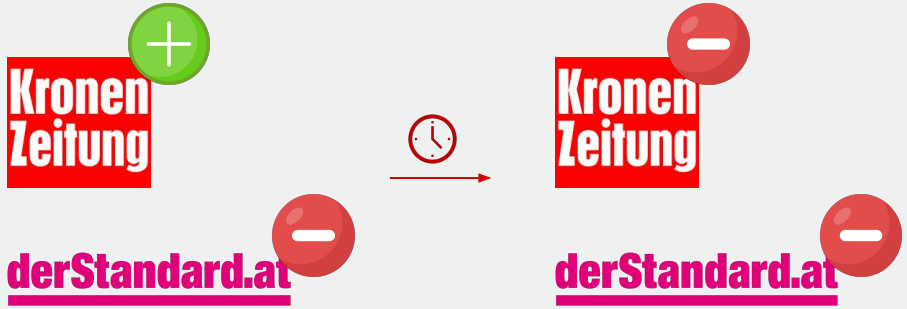
polarizing action



possible connection between polarizing action and change in media reporting

Example of a research question (RQ) requiring sentiment analysis:

RQ: To what extent is it possible to predict the polarization* of politicians over time in different news media outlets?

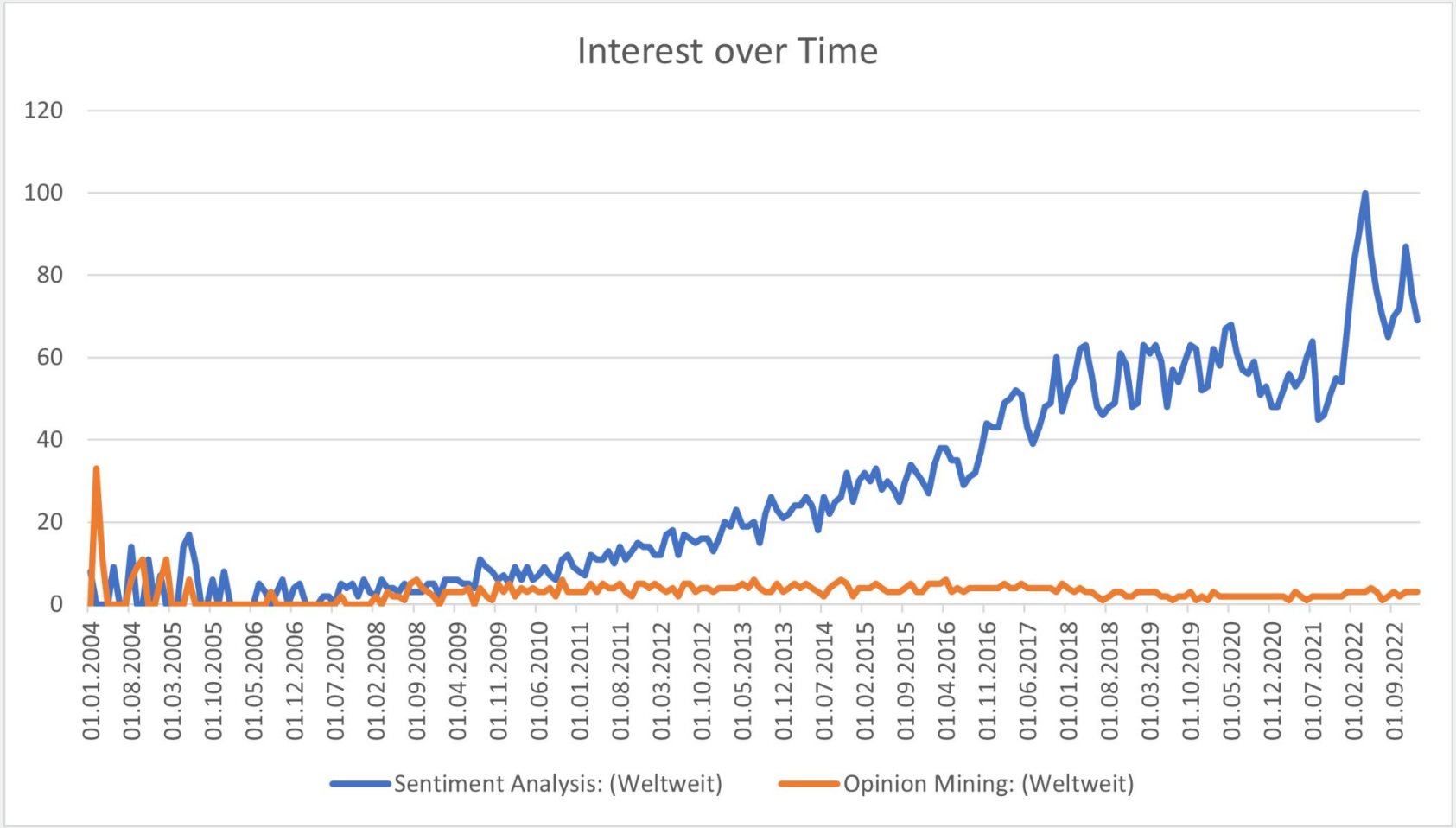
*by analysing their corresponding sentiment

Introduction to Sentiment Analysis

"Sentiment analysis (SA), also called Opinion Mining (OM) is the task of extracting and analyzing people's opinions, sentiments, attitudes, perceptions, etc., toward different entities such as topics, products, and services." [1]

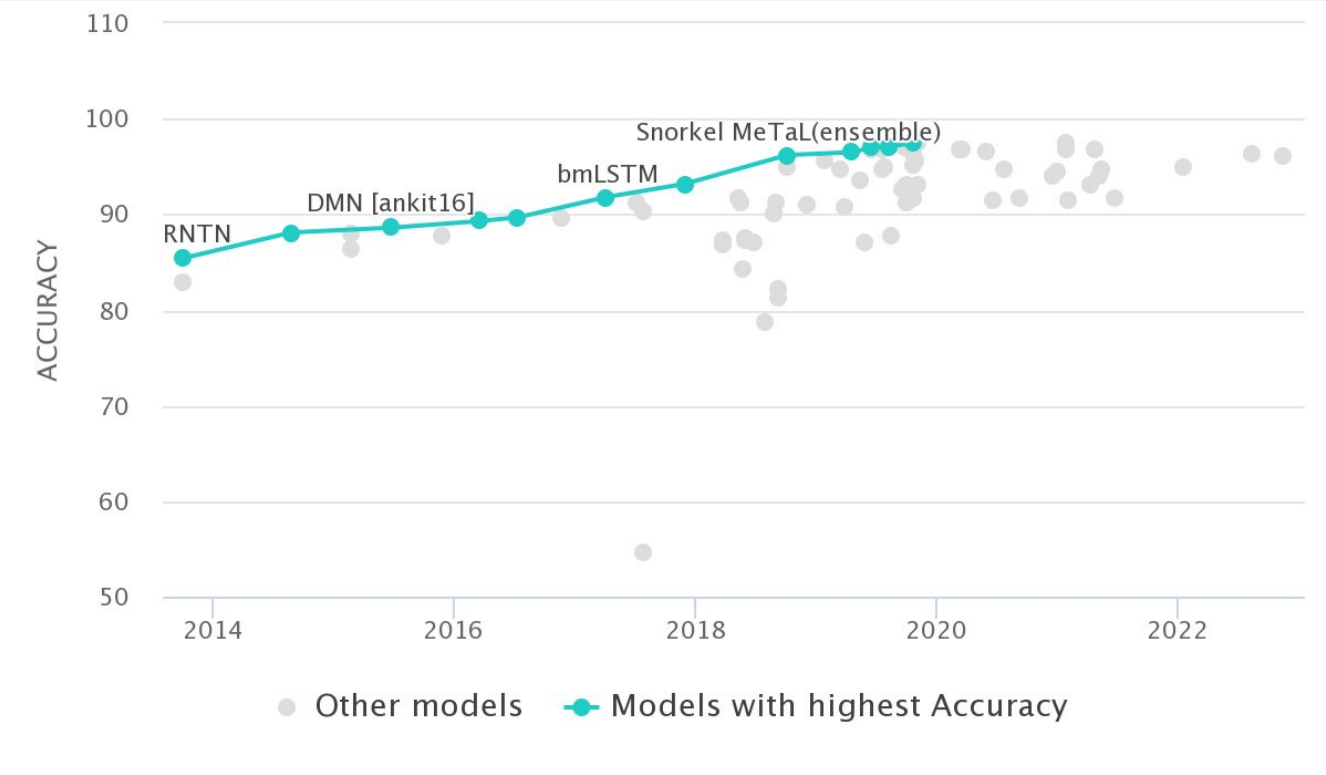
[1] Marouane Birjali, Mohammed Kasri, & Abderrahim Beni-Hssane (2021). A comprehensive survey on sentiment analysis: Approaches, challenges and trends. Knowledge-Based Systems, 226, 107134.

Still Interesting?



According to Google Trends (https://trends.google.com/trends/)

Towards the State of the Art



Sentiment Analysis on SST-2 Binary classification (https://paperswithcode.com/sota/sentiment-analysis-on-sst-2-binary)

Dataset: SST (Stanford Sentiment Treebank) = benchmark dataset

- 8 out of the top 10 performing algorithms are transformer based approaches (e.g. BERT)
- Previous approaches often based on CNN / LSTM
- Early approaches were often based on dictionaries

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Applications of Sentiment Analysis

- User reviews (products, movies, music, …)
- News domain (comments section, forum, …)
- Analysis of user generated content (social media e.g. Twitter)
- …

The results can be used to create recommendations for users or to analyse public opinion on a specific event (COVID-19, elections, ...).

Pre-Processing Based on the Example of fastText

Pre-processing always depends on the planned application and the method used!

“FastText is an open-source, free, lightweight library that allows users to learn text representations and text classifiers. It works on standard, generic hardware. Models can later be reduced in size to even fit on mobile devices.” [2]

[2] https://fasttext.cc/

Pre-Processing Based on the Example of fastText (cont.)

- *Data Cleanup (punctuation, upper to lowercase, emoticons, stopwords, spell checking, …)*
- *Splitting up the data set into train-, test- and validation data set*
- *epochs, learning rate*
- *word n-grams*

https://fasttext.cc/docs/en/supervised-tutorial.html#making-the-model-better

Pre-Processing Based on the Example of fastText (cont.)

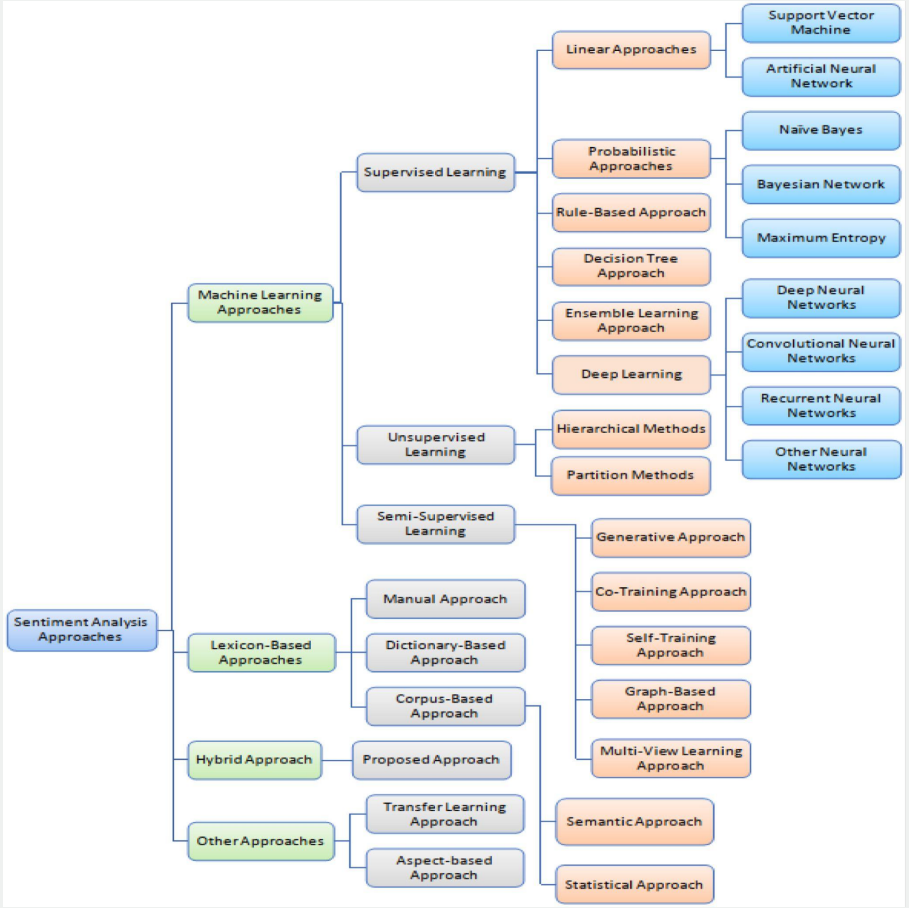
Frameworks

- *Natural Language Toolkit (NLTK) (https://www.nltk.org/)*
- *spaCy (https://spacy.io/)*

But often basic approaches like “sed”, “awk”, “sort” (= Linux packages) can help a lot if the data set is very big.

Sentiment Analysis Techniques

- Machine Learning Approaches
- Lexicon Based Approaches
- Hybrid Approaches
- Other Approaches



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Sentiment Ar

- Machine Lear
- Lexicon Base
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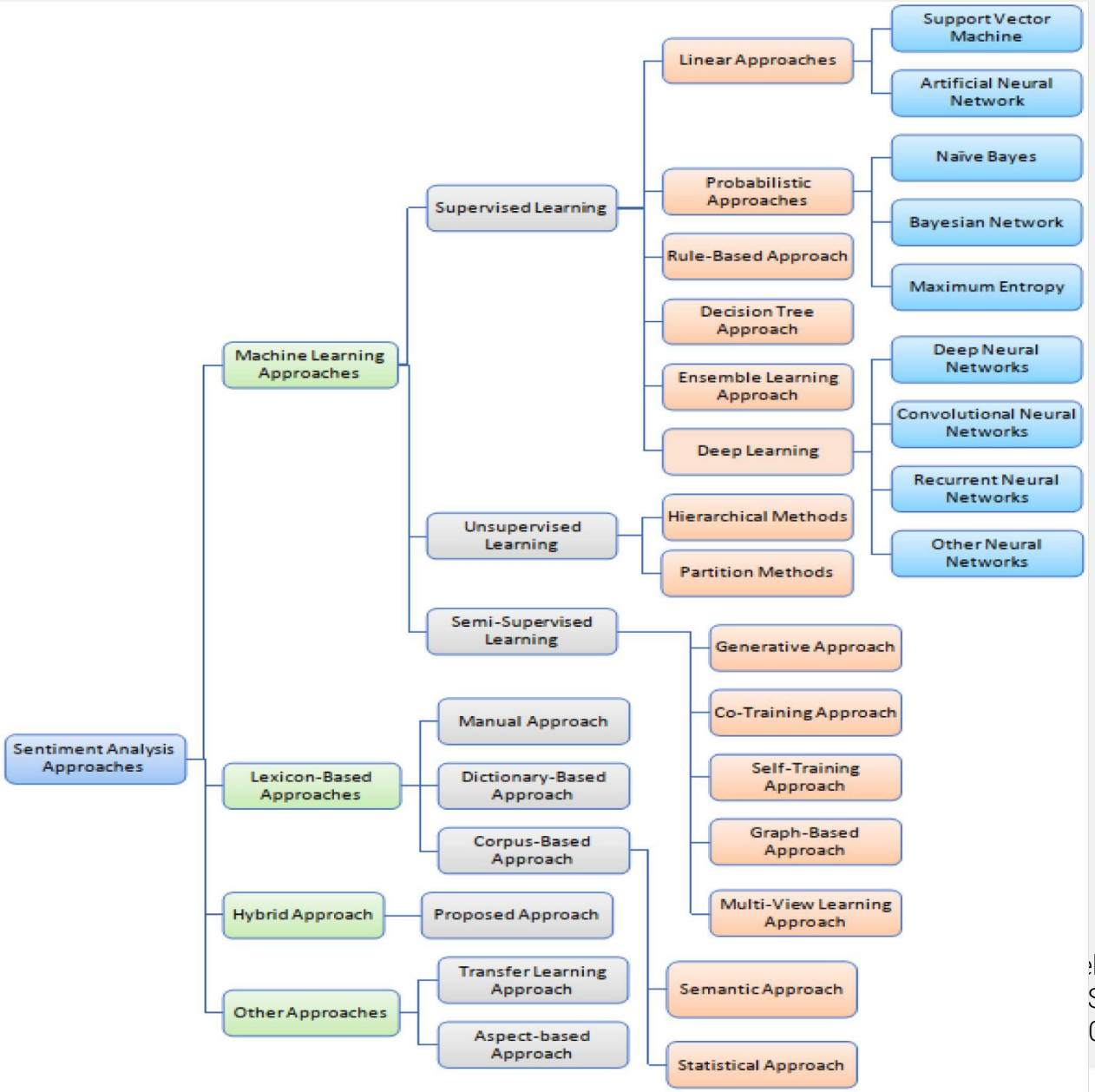

ehensive survey on sentiment analysis:
Systems, 226, 107134.
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Levels of Sentiment Analysis

- Document level
- Sentence level
- Phrase level (e.g. aspect based sentiment analysis)

Phrase level extraction often requires named entity recognition to get a specific phrase around a target e.g. a politician name.

Which level to use is always domain and task dependent!

P. Balaji, O. Nagaraju and D. Haritha, "Levels of sentiment analysis and its challenges: A literature review," *2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC)*, Chirala, Andhra Pradesh, India, 2017, pp. 436-439, doi: 10.1109/ICBDACI.2017.8070879.

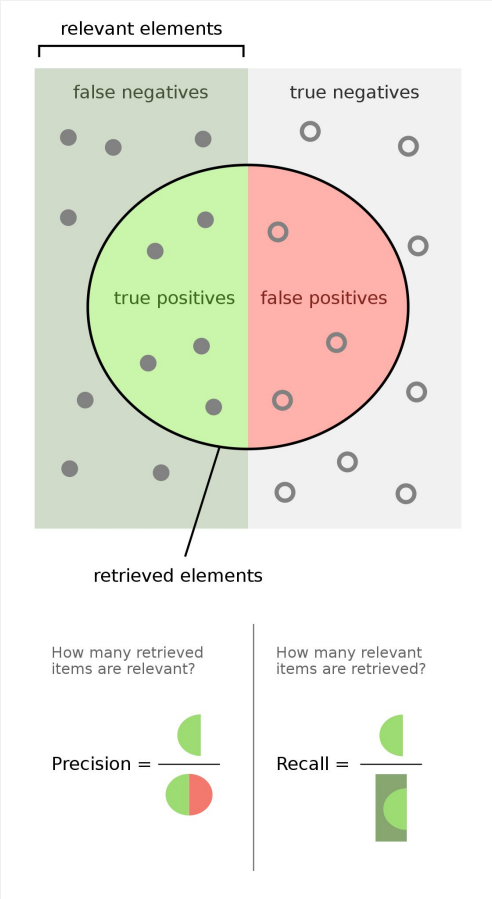
Evaluation Metrics

Accuracy $$Accuracy = \frac{TN + TP}{TN + TP + FP + FN}$$

Precision $$Precision = \frac{TP}{TP + FP}$$

Recall $$Recall = \frac{TP}{TP + FN}$$

F1 $$F1 = \frac{2 * Precision * Recall}{Precision + Recall}$$



Walber, CC BY-SA 4.0, via Wikimedia Commons

Saxena, A., Reddy, H., Saxena, P. (2022). Introduction to Sentiment Analysis Covering Basics, Tools, Evaluation Metrics, Challenges, and Applications. In: Biswas, A., Patgiri, R., Biswas, B. (eds) Principles of Social Networking. Smart Innovation, Systems and Technologies, vol 246. Springer, Singapore. https://doi.org/10.1007/978-981-16-3398-0_12

Evaluation Metrics (cont.)

There are many more relevant metrics in this area e.g.:

- Cohen's Kappa: measure inter-rater reliability (two raters)
- Fleiss Kappa: measure inter-rater reliability (any number of raters)
- …

https://en.wikipedia.org/wiki/Fleiss%27_kappa
https://en.wikipedia.org/wiki/Cohen%27s_kappa

Application in Research

DYSEN Project

Dynamic Sentiment Analysis as Emotional Compass for the Digital Media Landscape

RQ: How do print media report about the Viennese politicians?

Aim of the project: Develop a tool that can detect change of emotional polarization of politicians in Austrian Newspapers

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

ÖAW AUSTRIAN ACADEMY OF SCIENCES

universität wien

Funded by (DigHum Call):
Stadt Wien
Grant number: MA7-737909/19

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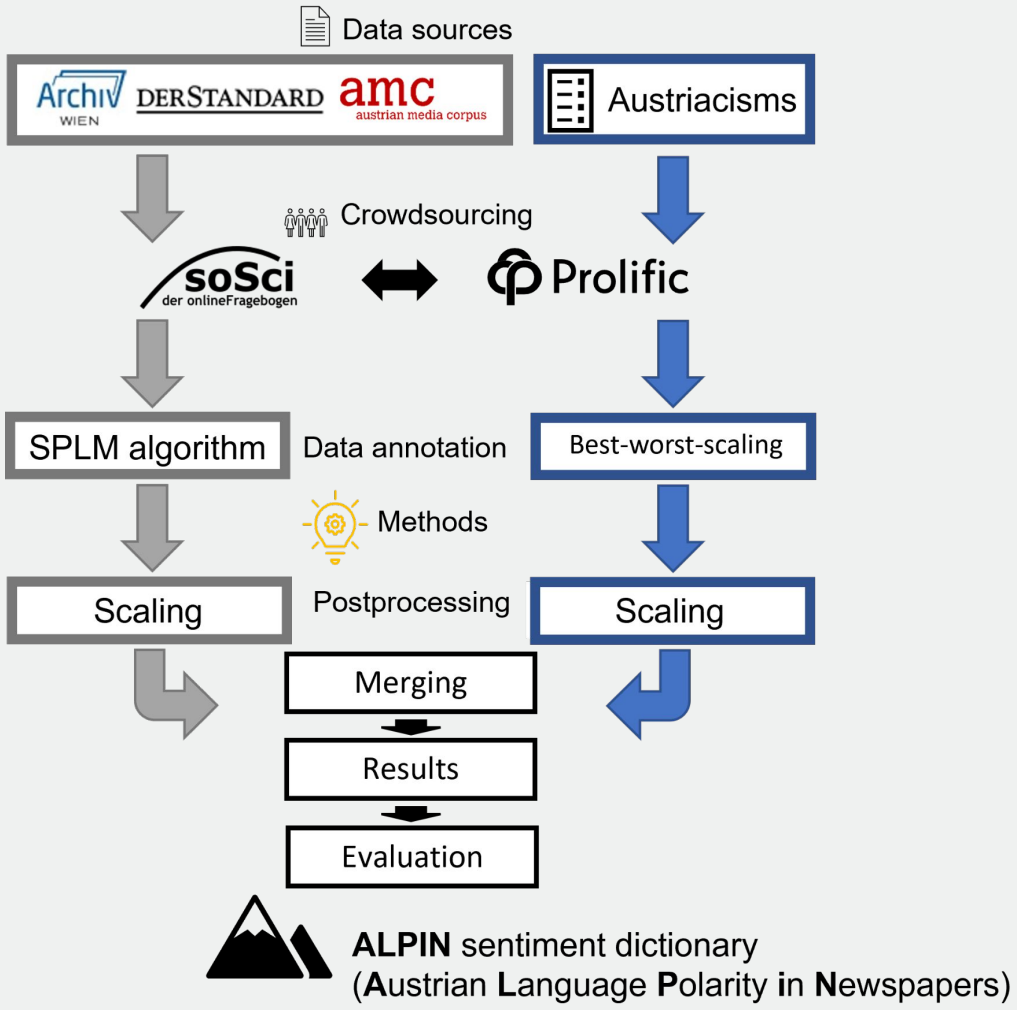
https://dylen.acdh.oeaw.ac.at/dysen/

DYSEN Project (cont.)



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https://dylen.acdh.oeaw.ac.at/dysen/

Data Collection & Preprocessing

amc austrian media corpus

Linguistic annotated Austrian Media Corpus (Ransmayr et al., 2017); contains around 45 million articles by covering the print media landscape of Austria

Extraction criteria:

- National & regional print media related to Vienna between 1996 and 2017
- Text areas limited to area extraction around politician names with around 60 tokens (legal limitation / copyright of the amc corpora)

Archiv WIEN

Politician archive of Vienna (*POLAR*) of the Vienna City and State Archives[1]

- Politicians which were active between the 13th and 20th parliamentary term (1983 to 2020)

AMC and POLAR are combined to extract text areas around Viennese politicians

[1] https://polar.wien.at

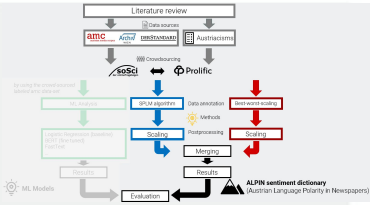
Crowd Sourcing: amc austrian media corpus Austrian Media Corpus

- Each item labelled ≥ 3 times
- Majority vote (equal number per class = rated as neutral)
- Three classes: positive, neutral, negative
- Quality control (≥75% correct)
- Two annotation runs (1st 70 annotators; Fleiss-Kappa: 0,295,
  2nd 88 annotators; Fleiss-Kappa: 0,283)

Restricted annotators by:

- Current Country of Residence (Germany, Austria, Switzerland)
- Nationality (Germany, Austria, Switzerland)
- First Language (German)

Data Collection & Preprocessing



DERSTANDARD

1 Million Posts Corpus (Schabus et al., 2017)

- Posts from 2015 to 2016
- 3599 posts with sentiment annotated by employed forum annotators

Austriacisms

Based on:

- „Variantenwörterbuch des Deutschen“ (VWB; words specific to Austria) (Ammon et al., 2016)
- Austriacism list of Wikipedia[1]
- 1600 words checked by the whole project team

[1] https://de.wikipedia.org/wiki/Liste_von_austriacismen

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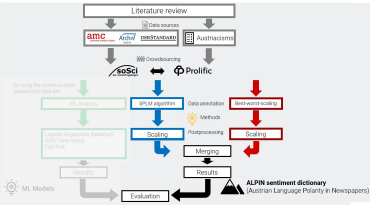
Crowd Sourcing: Austriacisms



Preselection survey
- 1600 words
- Quality control (≥75% correct)
- Four options (positive, neutral, negative, unknown)

Main survey
- Best-worst-scaling (BWS) method
- 1074 tuples
- Quality control (≥75% correct)
- 34 annotators

Restricted annotators by:
- Current Country of Residence (Austria)
- Nationality (Austria)
- First Language (German)

	Item1	Item2	Item3	Item4	BestItem	WorstItem
0	Rodel	Knödelakademie	Keiler	Gelenksbeschwerden	Rodel	Gelenksbeschwerden
1	brennheiß	Stornoversicherung	Scherz(e)l	sich ausgehen	sich ausgehen	brennheiß
2	Steireranzug	Causa	Pönale	Lokalaugenschein	Lokalaugenschein	Steireranzug
3	Alumnat	Beiwagerl	Servus	kiefeln	Servus	kiefeln
4	Patschenkino	Aufnahmestopp	Straßenerhalter	Marmeladinger	Straßenerhalter	Aufnahmestopp
...	...	...	...	...	...	...
4412	ferten	Ermäßigungsausweis	Halbpreispass	versumpern	Ermäßigungsausweis	versumpern
4413	Zuhaus	Bramburi	Mistbauer	Beiwagerl	Zuhaus	Mistbauer
4414	Oja!	ludeln	Rettung	gar	Oja!	ludeln
4415	Stützlehrer	Mascherl	Einspänner	grauslich	Mascherl	grauslich
4416	Jausenbrot	enthaften	versperren	Schubhaft	Jausenbrot	Schubhaft

4417 rows × 6 columns

Labeled dataset after main survey

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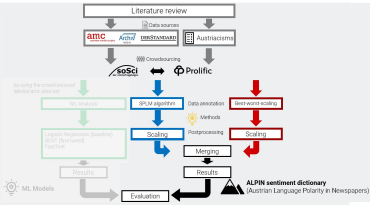
Methods (Dictionary Based)



…for <u>generating sentiment scores</u>

SPLM method
(Almatarneh & Gamallo, 2018)

Used for: amc austrian media corpus & DERSTANDARD datasets
… based on a labelled (positive, neutral, negative) dataset

Best-Worst-Scaling (BWS) method
(Kiritchenko & Mohammad, 2017)

Used for: Austriacism list
… based on tuple pairs (best, worst) of words

Spearman correlation:
0.9159 (+/- 0,0051) by applying split-half reliability

Sentiment score word lists based on…

… AMC & standard posts (SPLM)

	word	Tag	D
0	geben	v	0.001057
1	Frau	n	0.001028
2	Jahr	n	0.000979
3	neu	a	0.000957
4	Mann	n	0.000844
…	…	…	…
8924	Pilz	n	-0.000920
8925	Westenthaler	n	-0.000994
8926	ÖVP	n	-0.001003
8927	Peter	n	-0.001078
8928	Flüchtling	n	-0.001189

8929 rows × 4 columns

… Austriacisms (BWS)

	word	tag	short-tag	score	scaled
0	fesch	ADJ	a	0.882	0.910217
1	Zuckerl	NOUN	n	0.879	0.907121
2	Topfenpalatschinke	NOUN	n	0.857	0.884417
3	leiwand	ADJ	a	0.853	0.880289
4	Ersparnis	NOUN	n	0.844	0.871001
…	…	…	…	…	…
533	Schussattentat	NOUN	n	-0.844	-0.871001
534	Exekution	NOUN	n	-0.848	-0.875129
535	speiben	VERB	v	-0.875	-0.902993
536	Brandleger	NOUN	n	-0.879	-0.907121
537	Fotze	NOUN	n	-0.969	-1.000000

538 rows × 5 columns

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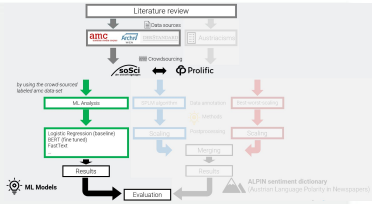
Evaluation



Model	Accuracy	Precision	Recall	F1
DummyClassifier v1 (stratified)	0,52	0,54	0,51	0,52
DummyClassifier v2 (uniformly gen. pred.)	0,52	0,54	0,57	0,56
BERT (dbmdz/bert-base-german-cased) Finetuned with the AMC dataset	0,78	0,82	0,76	0,79
ALPIN (dictionary based approach)	0.70	0.74	0.70	0.72

preprocessing:

- Model specific (stratified k-fold,train/test/validation)
- Different tokenization requirements
- Encoding
- ...

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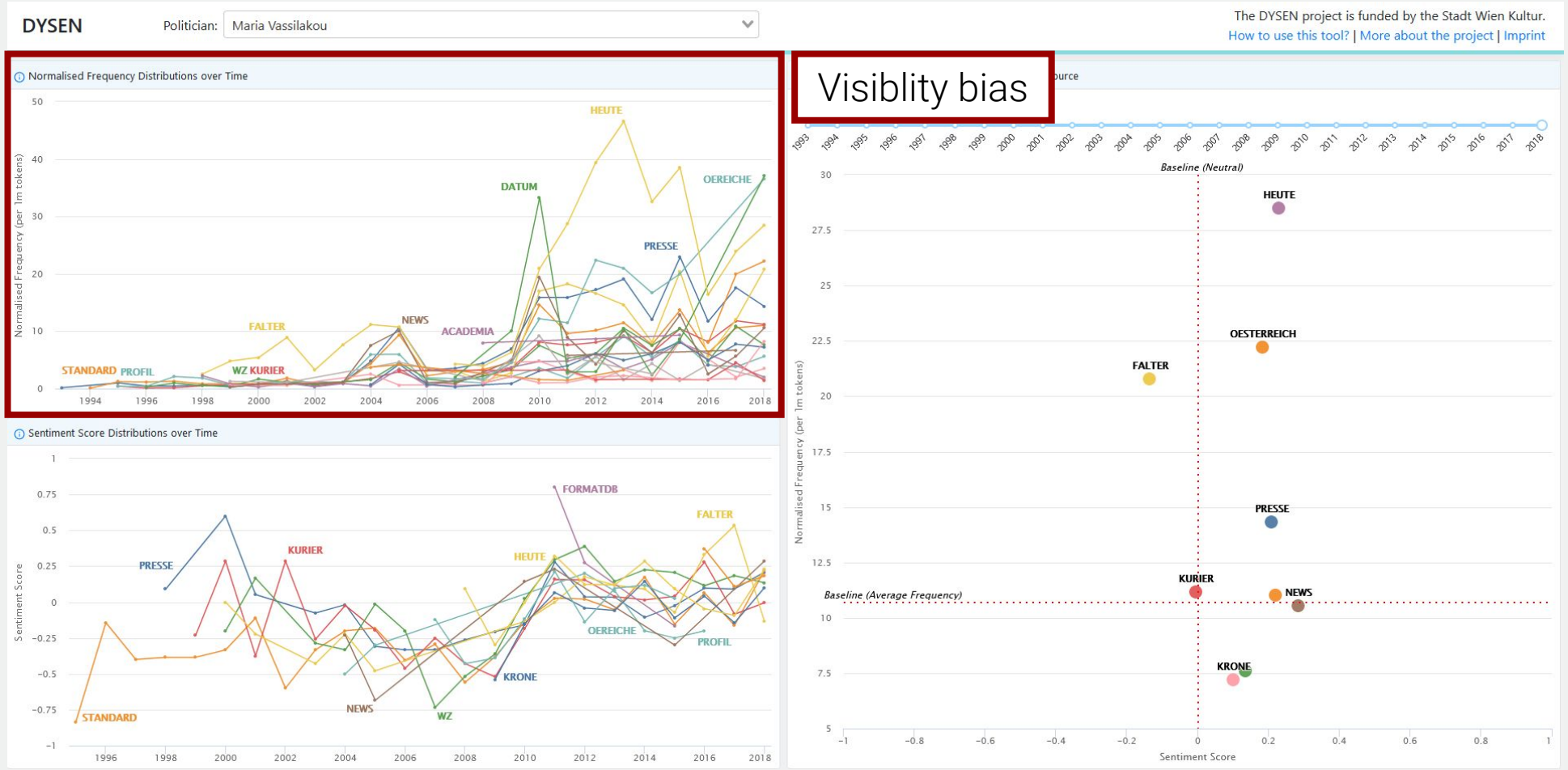
Web Application[1]

[1]data based on a master-thesis (Kolb, 2022), tool developed by the team of ÖAW; available at: https://dysen-tool.acdh.oeaw.ac.at/



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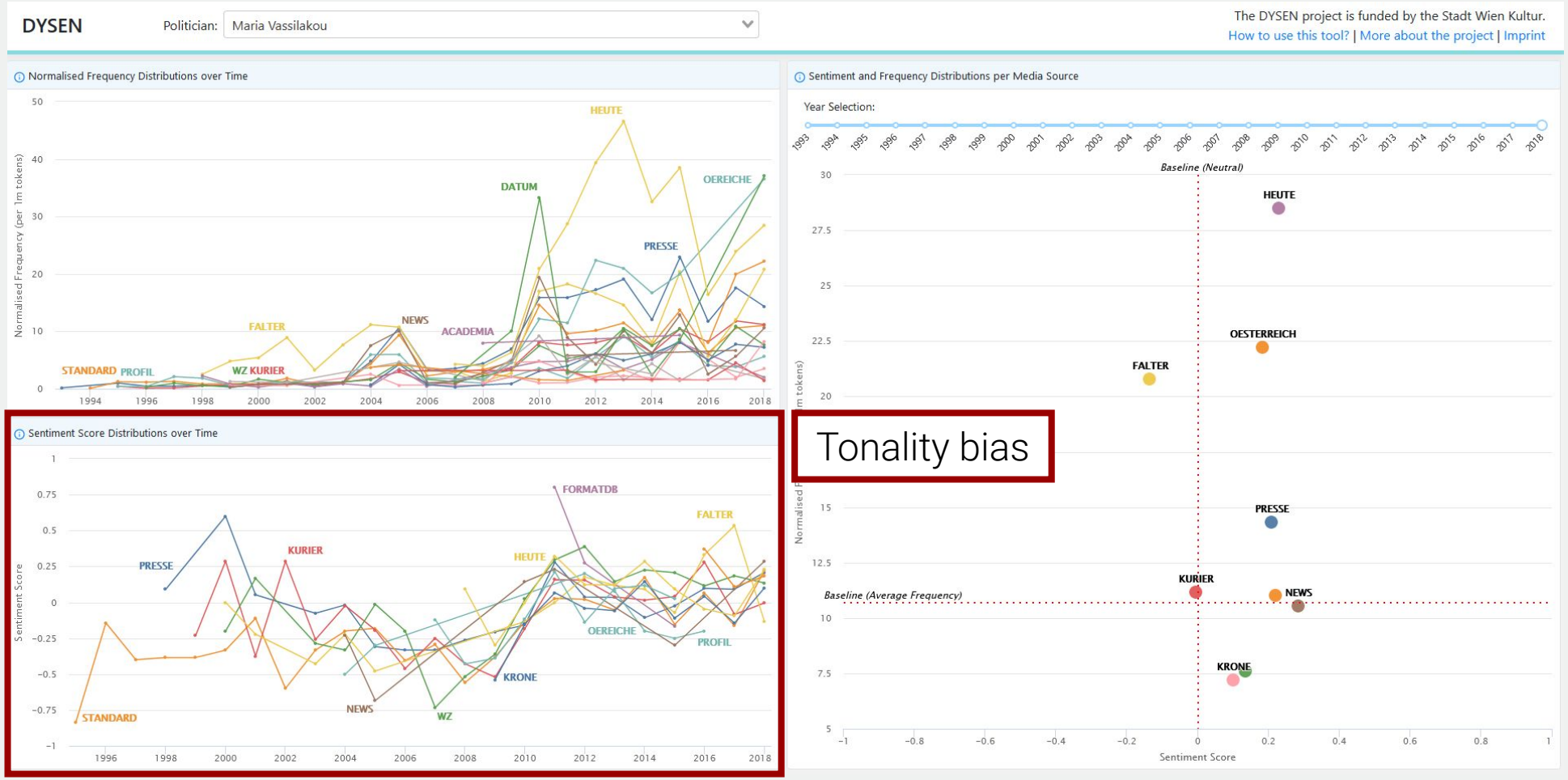

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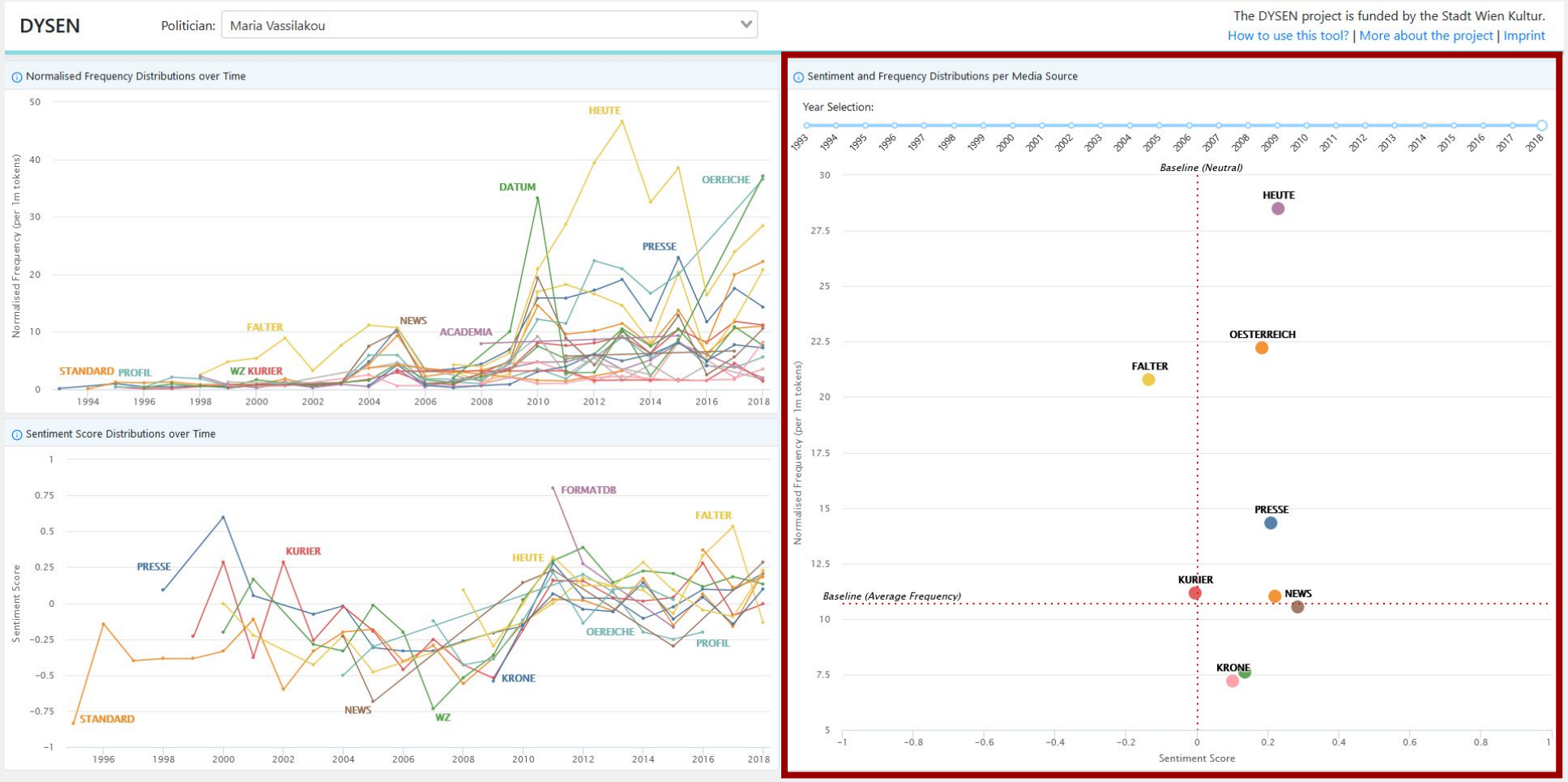

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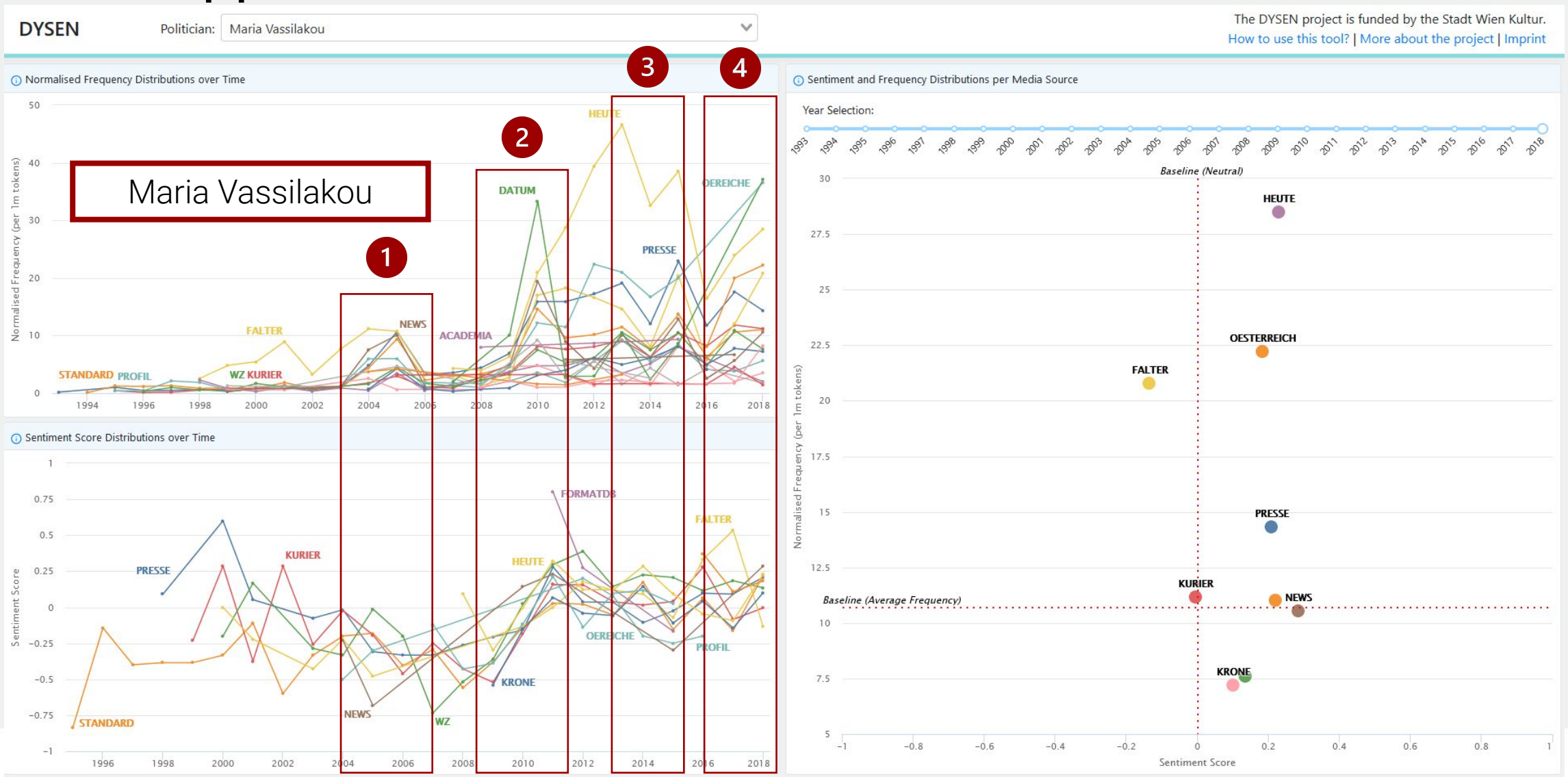

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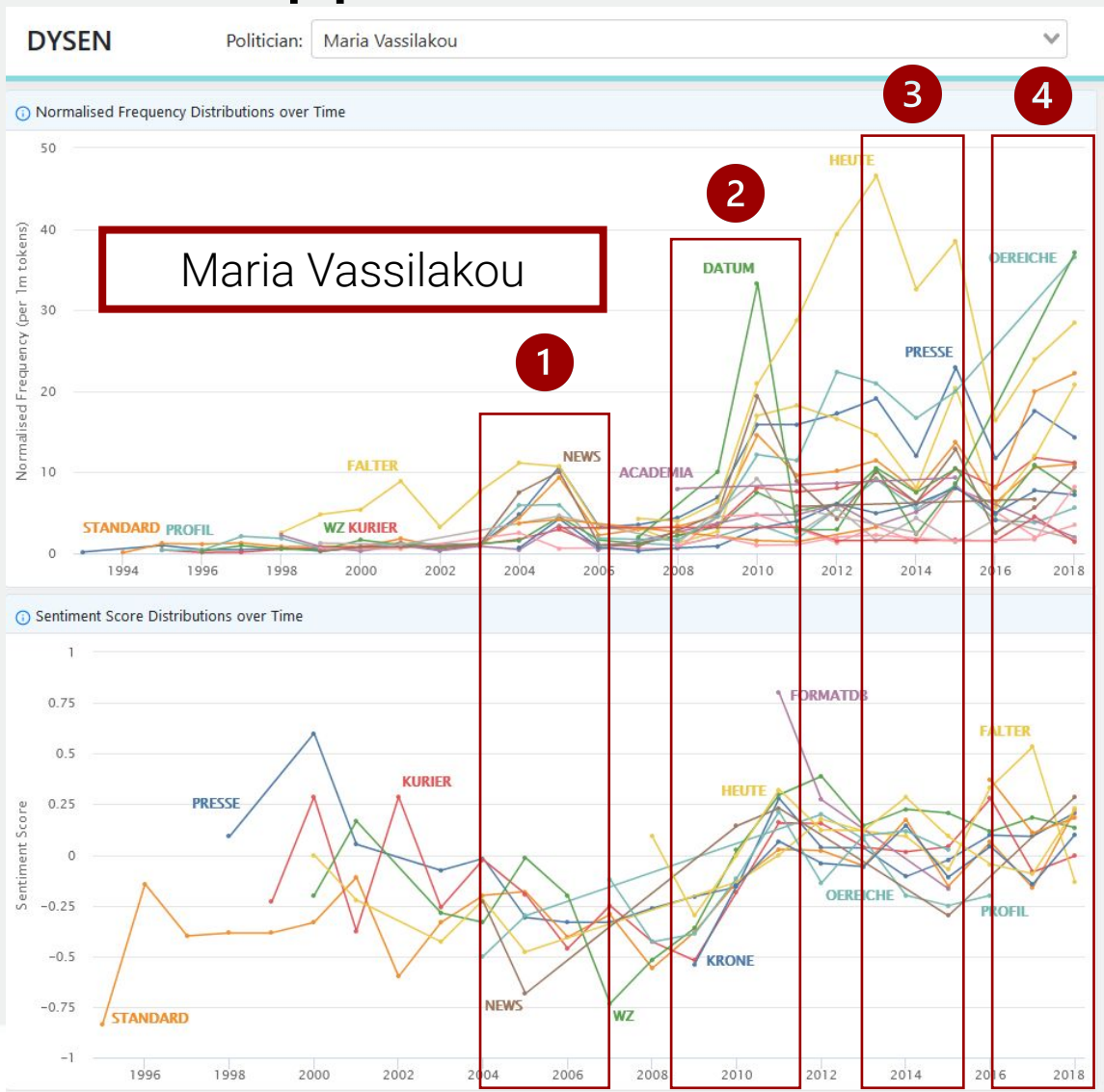
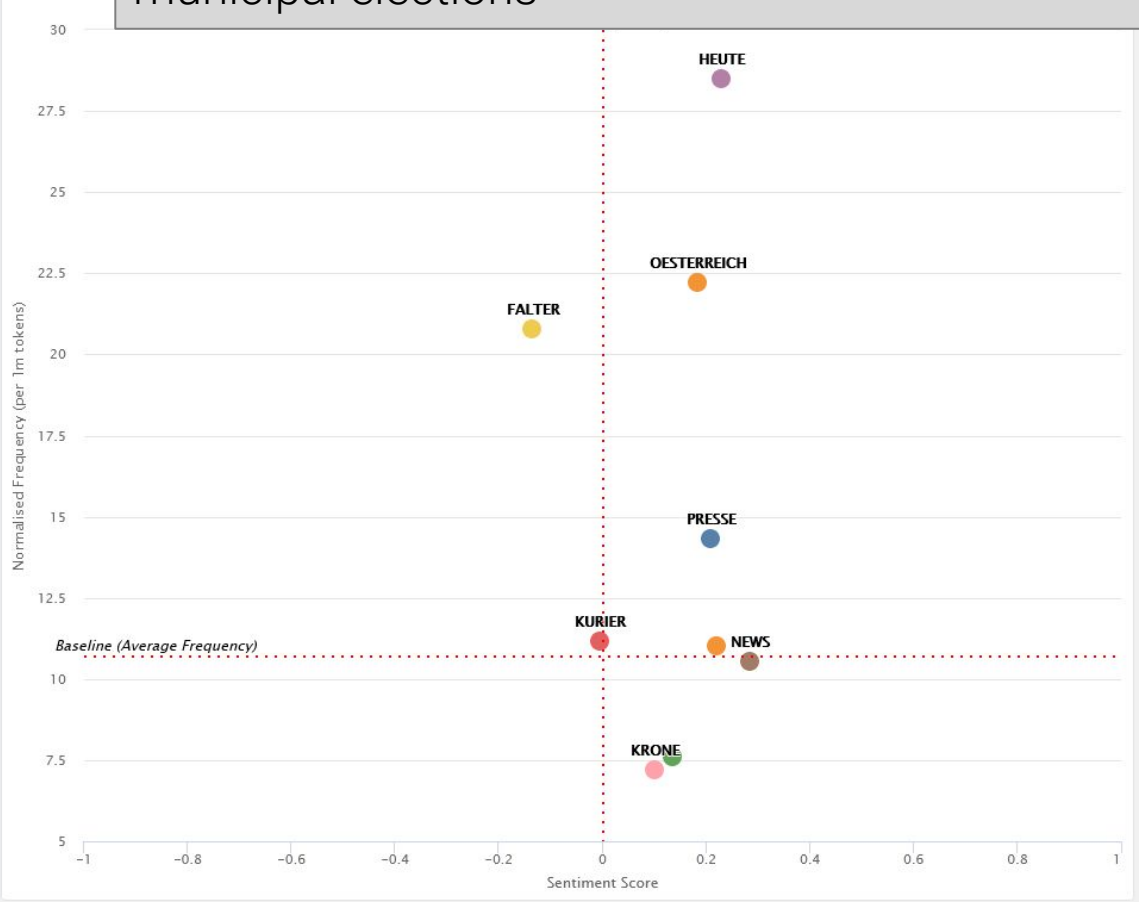


2004 elected to the federal executive committee of the Green Party
2005 top candidate of the Greens for the municipal elections



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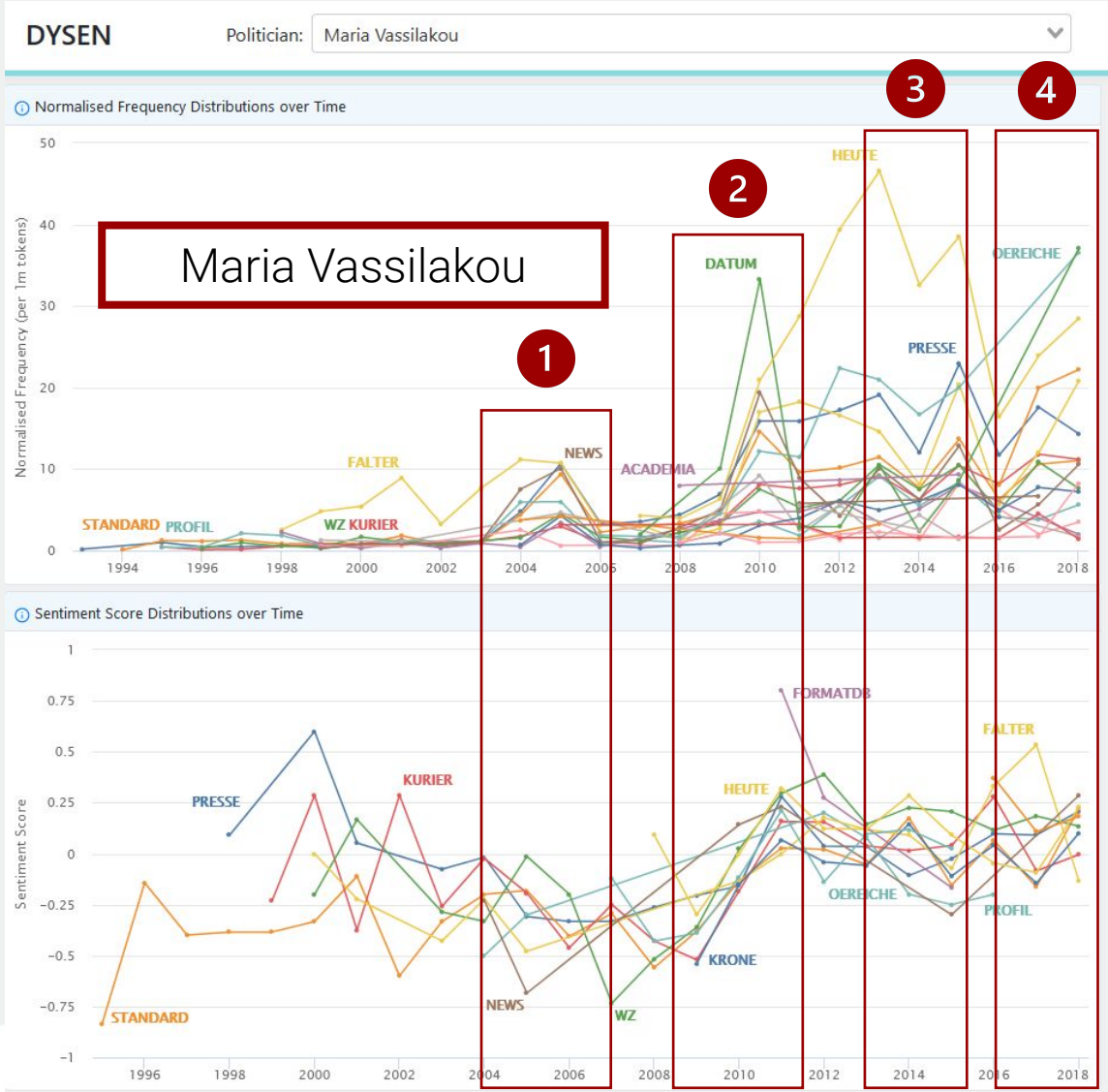

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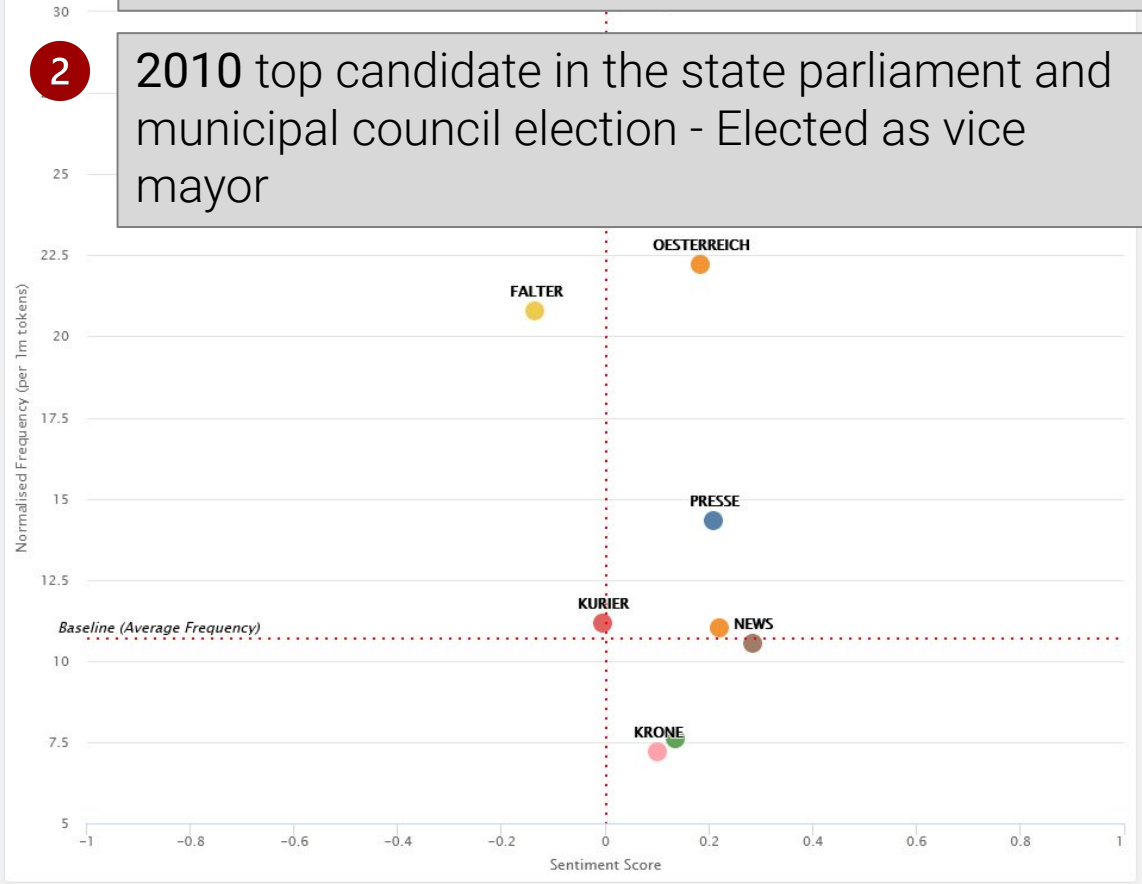

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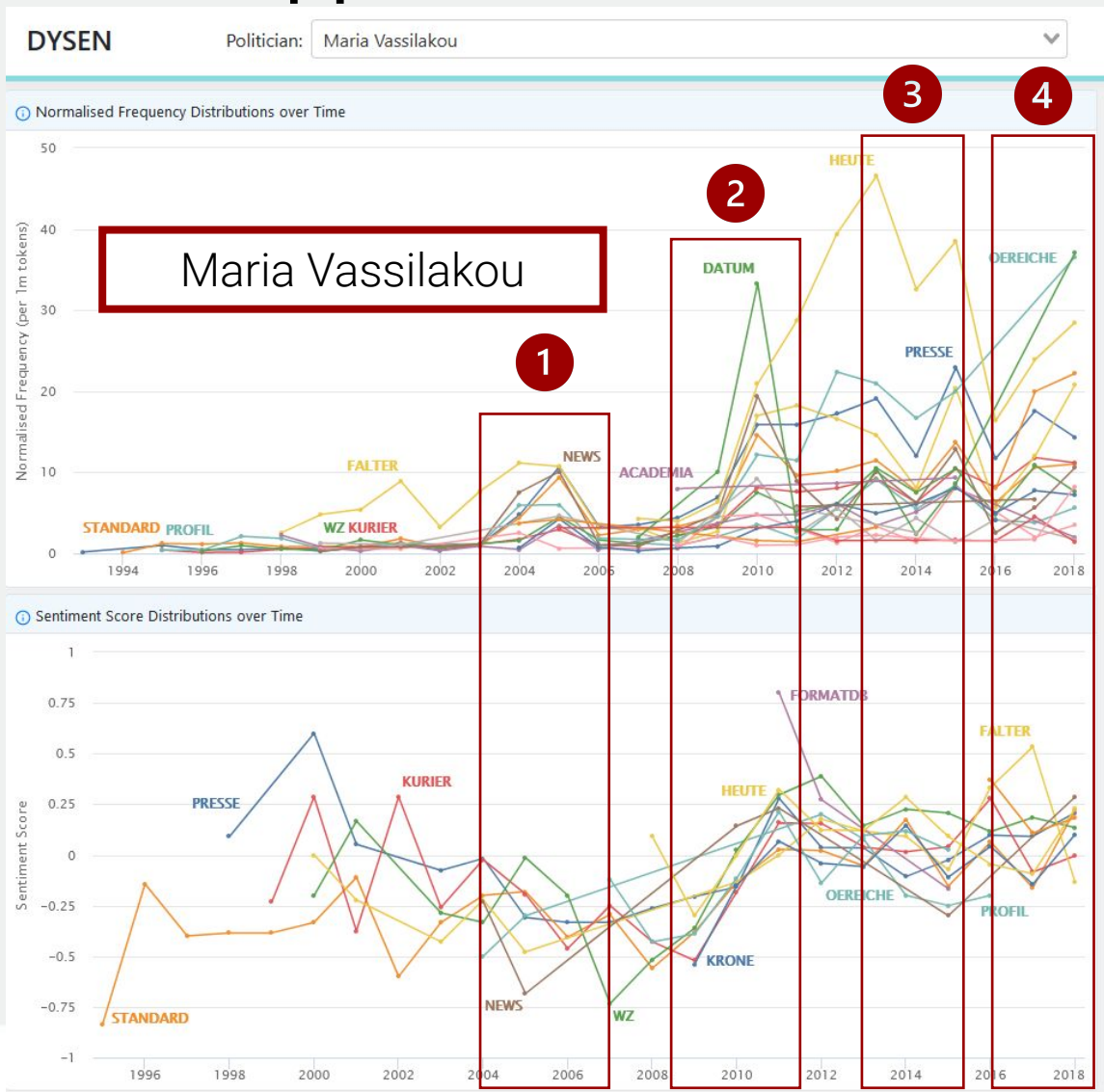

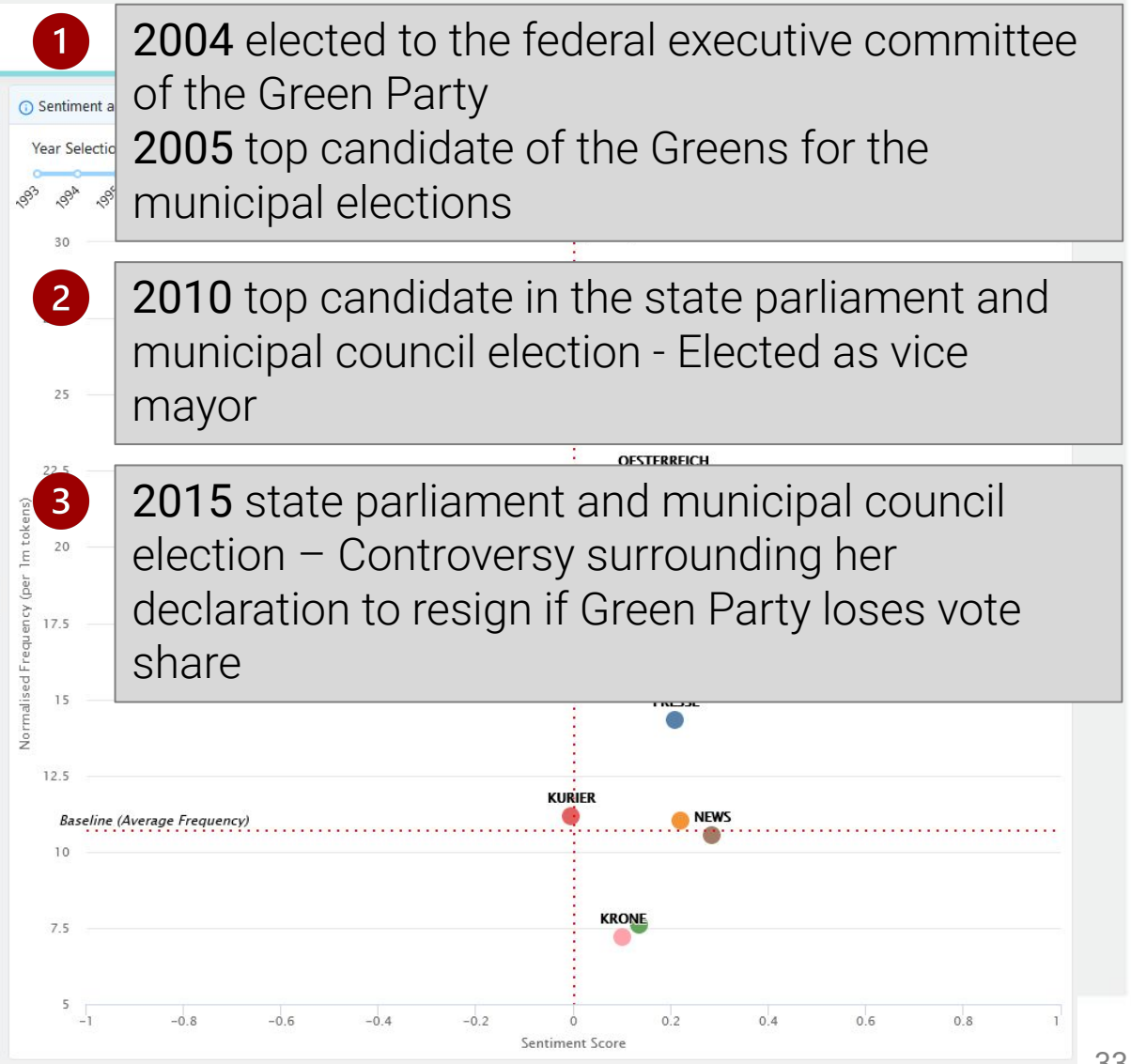

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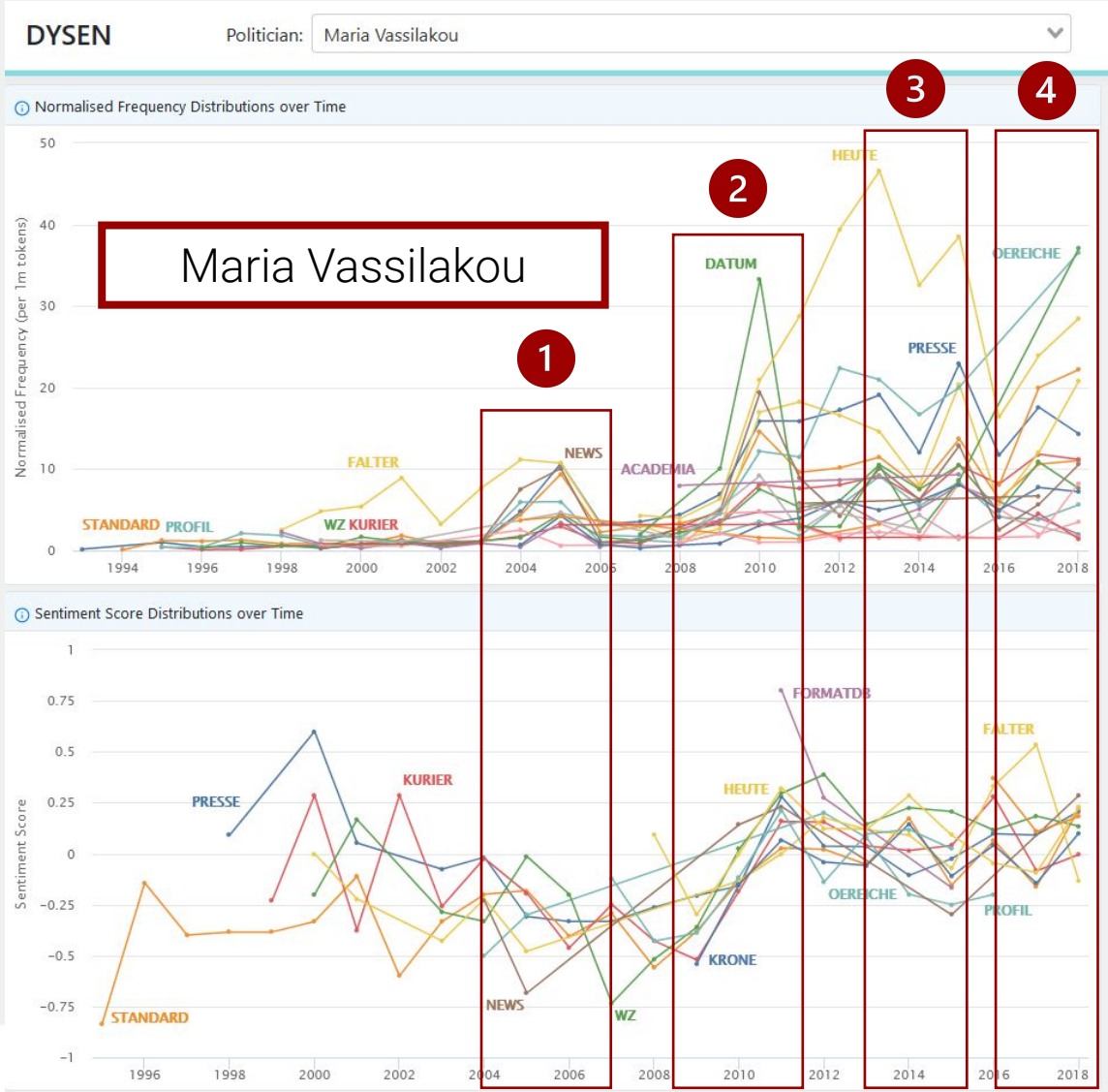

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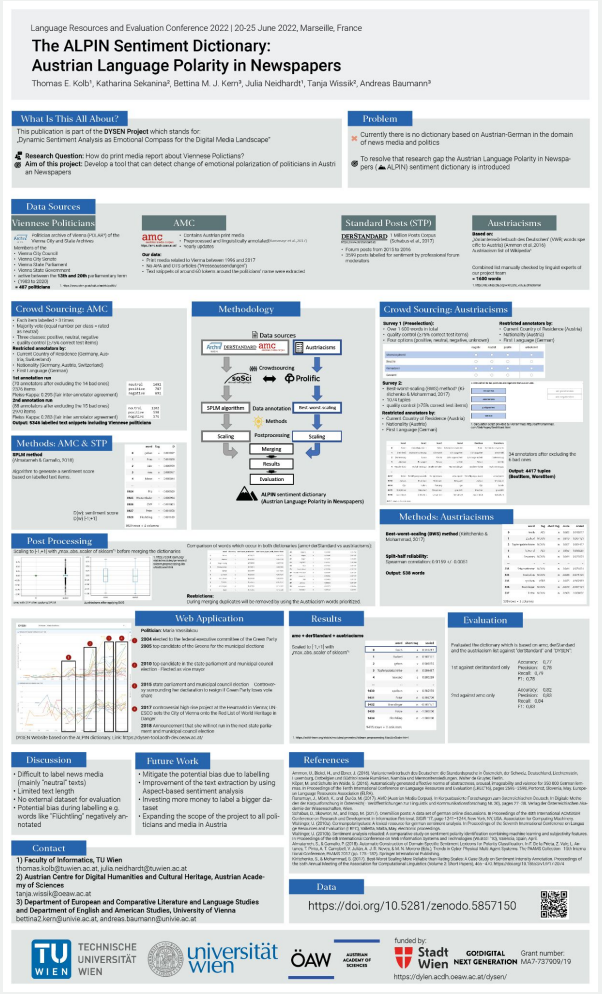
4 **2017** controversial high-rise project at the Heumarkt in Vienna; UNESCO sets the City of Vienna onto the Red List of World Heritage in Danger
2018 Announcement that she will not run in the next state parliament and municipal council election

The ALPIN Sentiment Dictionary: Austrian Language Polarity in Newspapers



Kolb, T. E., Kern, B. M., Sekanina, K., Wissik, T., Neidhardt, J., Baumann, A., (2022) The ALPIN Sentiment Dictionary: Austrian Language Polarity in Newspapers.

https://zenodo.org/record/5857151

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Ongoing Work

Detection of sentiment in user comments of a large Austrian news company to …

… identify the change of positivity or negativity within the commentary section over time.

… investigation potential polarization over time towards a certain topic (e.g. the topic “Coronavirus”)

Beyond Sentiment Analysis: What's next?

Detection of …

… emotions
… hate speech
… toxicity
… populism

Many very recent research topics in this field can be found here:
https://semeval.github.io/

Summary?

- Introduction to sentiment analysis
- Applications and challenges of sentiment analysis
- Sentiment analysis techniques
- Evaluation metrics
- Applications in research
- Future topics

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