Measuring diachronic evolution of evaluative adjectives with word embeddings: English, Norwegian, and Russian

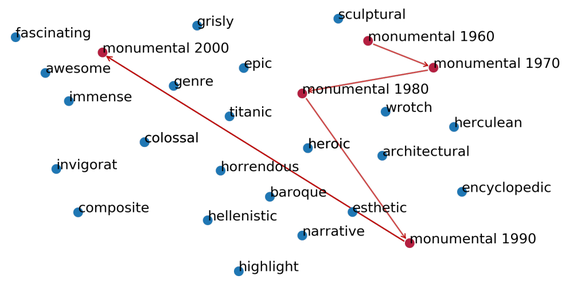
Julia Rodina†, Daria Bakshandaeva†, Vadim Fomin†, Andrey Kutuzov⋆, Samia Touileb⋆, Erik Velldal⋆

† National Research University Higher School of Economics, Moscow, Russia; ⋆ University of Oslo, Oslo, Norway

{julia.rodina97 | dbakshandaeva | wadimiusz}@gmail.com, {andreku | samiat | erikve}@ifi.uio.no

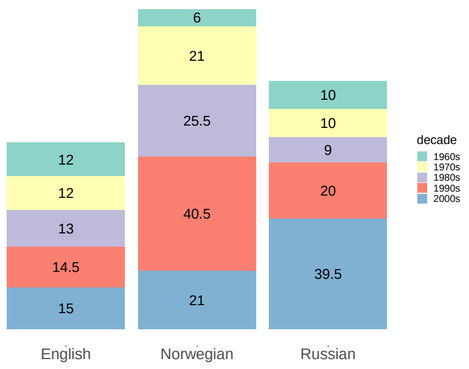
Rigid or flexible: evaluative adjectives change faster?

- Many evaluative adjectives in English have completely switched their sentiment during the last 150 years (consider *'terrific'* or *'sick'*) [Hamilton et al., 2016a]
- We focus not only on sentiment changes, but semantic shifts in evaluative adjectives in general.



Is there a general trend in human languages that makes evaluative adjectives change more intensely over time?

Data: 5 decades, 3 languages



Corpora sizes (millions of words)

- Corpus of Historical American English (COHA) for English;
- NBdigital corpus for Norwegian;
- Russian National Corpus (RNC) for Russian;

CBOW embedding models [Mikolov et al., 2013] trained on each decade for each of the three languages.

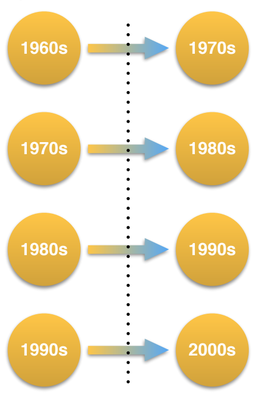
Measuring the degree of semantic shift between two time points...

1. **Jaccard distance**: between sets of 10 nearest neighbours of one word (by cosine distance) in two embedding models [Jaccard, 1901];
2. **Procrustes alignment**: the models' vector spaces are first aligned using an SVD-based orthogonal transformation; then cosine distance is calculated between word vectors in transformed models [Hamilton et al., 2016b];
3. **Global Anchors**: the degree of semantic change is the cosine distance between the vectors of a word's similarities to all other words in the intersection of two models' vocabularies ('anchors') [Yin et al., 2018].

. . . and across the whole time span

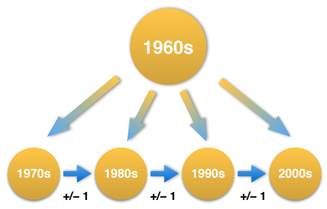
Mean pairwise distances:

- measures the degree of 'semantic jitter'
- simple mean between the 4 pairwise distances



Mean deltas from the 60s:

- measures the 'steadiness' of the shift
- the distance of the current word representation to its representation in the initial time point is calculated
- distance increased => one point is added to the word's score, distance decreased => one point is subtracted; then, the average score is calculated

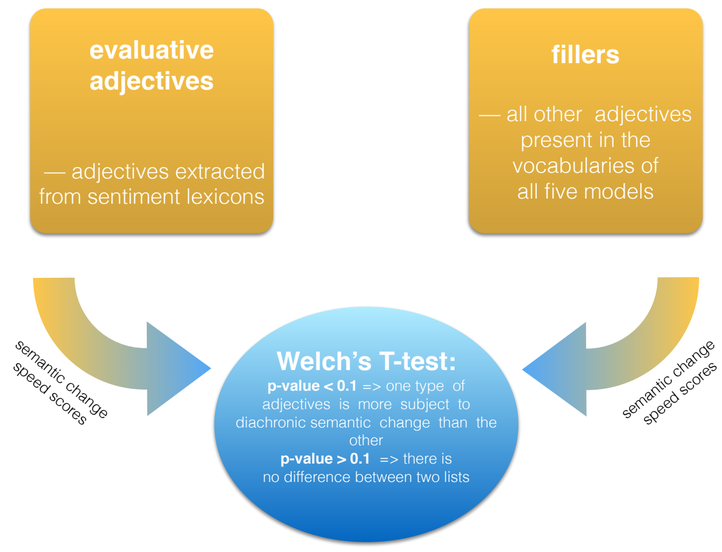


Meaning goes in circles

Alterations in meaning of the Russian adjective 'бескомпромиссный' (*uncompromising*): from *ruthless* over *fanatical*, *passion*, later *conviction*, *heroic* to *intransigence*, *confrontation*

Similar or different: 2 groups of adjectives

- Sentiment lexicons: the source of evaluative adjectives:
  - English, Norwegian: English lexicons from [Hu and Liu, 2004] translated to Norwegian;
  - Russian: *RuSentiLex* lexicon [Loukachevitch and Levchik, 2016].



- Positive t-statistic values mean that evaluative adjectives change faster than other types of adjectives, according to particular metrics;
- Negative values mean that evaluative adjectives change slower.

Frequency matters

Correlation of semantic change speed and normalized word frequency:

Method	English	Norwegian	Russian
Mean distances			
Jaccard	-0.37	-0.33	-0.32
Procrustes	-0.19	-0.21	-0.17
Global Anchors	0.29	-0.08	0.11
Mean deltas from 1960s			
Jaccard	0.05	0.10	0.08
Procrustes	0.07	0.12	0.08
Global Anchors	0.07	0.12	0.05

- Statistically significant correlations between word frequencies and the intensity of temporal semantic shifts, across all languages
- More frequent words => lower intensity from **mean distances**, higher intensity from the **mean deltas** technique (these words are more prone to steady semantic shifting)

Results disprove the initial hypothesis

All adjectives

Method	English	Norwegian	Russian
# fillers	8994	3989	7535
Freq diff	0.00001	0.00003	0.00001
Mean pairwise distances			
Jaccard	-11.08	-4	-15.05
Procrustes	-15.52	-5.04	-12.01
Global Anchors	11.91	-4.40	12.62
Mean deltas from 1960s			
Jaccard	3.28	0	0
Procrustes	2.98	0	3.92
Global Anchors	3.57	3.24	3.11

Adjectives with frequency > 100

Method	English	Norwegian	Russian
# fillers	1133	571	929
Freq diff	0	0	-0.00002
Mean distances			
Jaccard	0	-1.68	-2.54
Procrustes	-4.77	-3.24	-5.03
Global Anchors	-3.70	-4.07	0
Mean deltas from the 1960s			
Jaccard	0	0	-2.44
Procrustes	0	2.94	0
Global Anchors	0	0	-1.79

- **Mean pairwise distances**: evaluative adjectives change over time **less intensely**; the same when controlling for word frequencies.
- **Mean deltas**: evaluative adjectives do not differ from other adjectives with respect to the 'steadiness' of diachronic semantic changes.

Evaluative adjectives are not more prone to semantic shifts than other adjective types (at least in these 3 languages).

Re-use our data!

Diachronic embedding models, word lists and code:
https://github.com/ltgoslo/diachronic_multiling_adjectives

Parts of this work has been carried out in context of the SANT project, as funded by the Research Council of Norway (project number 270908).