Towards a Computational Model of Grammaticalization and Lexical Diversity

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Outline

Background

- Lexical diversity
- Grammaticalization

Computational Model

- Architecture
- Outcome

Future Directions

- Model improvement

Lexical diversity

Definition

Definition: The **distribution of word forms** used to encode a **constant information content**

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Parallel texts:

- Universal Decalaration of Human Rights ($\sim$ 400 languages)
- Parallel Bible Corpus ($\sim$ 1000 languages)
- Europarl (21 languages)

Lexical diversity

Driving factors

- **Morphological marking**
  English: *the ship*
  German: *das Schiff, dem Schiff(e), des Schiffes*

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- **Orthography**
- **etc.**

Lexical diversity

Quantitative measure

Zipf-Mandelbrots law: Order types (word forms delimited by white spaces) according to their token frequencies (Zipf, 1949; Mandelbrot, 1953)

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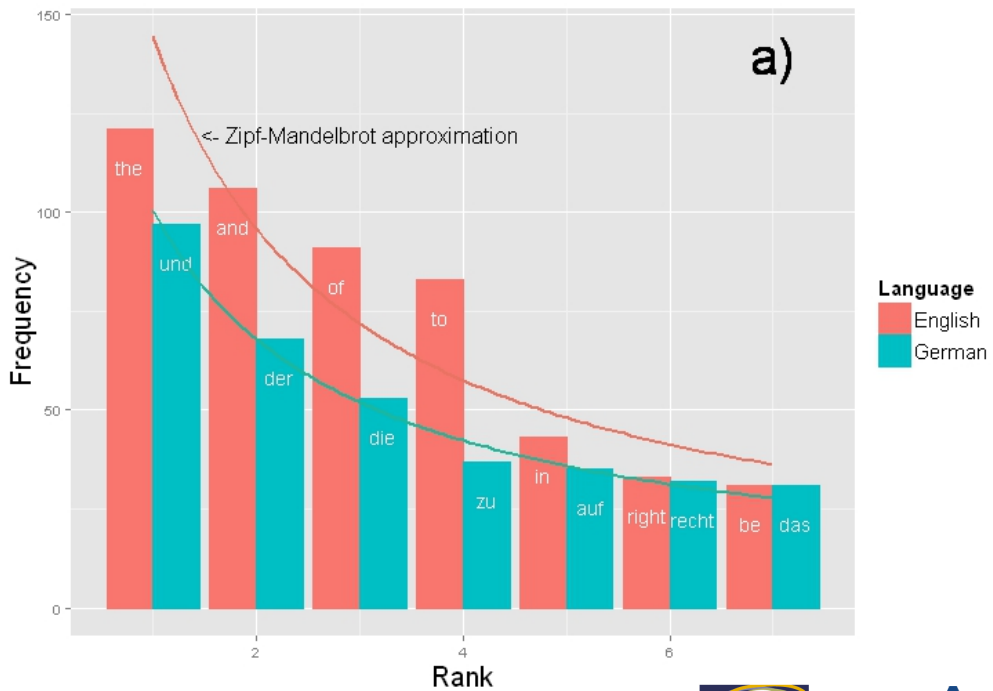

Lexical diversity

Zipf-Mandelbrot's law

$$f(r_i) = \frac{C}{\beta + r_i^{\alpha}},$$

$C > 0,$
$\alpha > 0,$
$\beta > -1,$
$i = 1, 2, \ldots, n$

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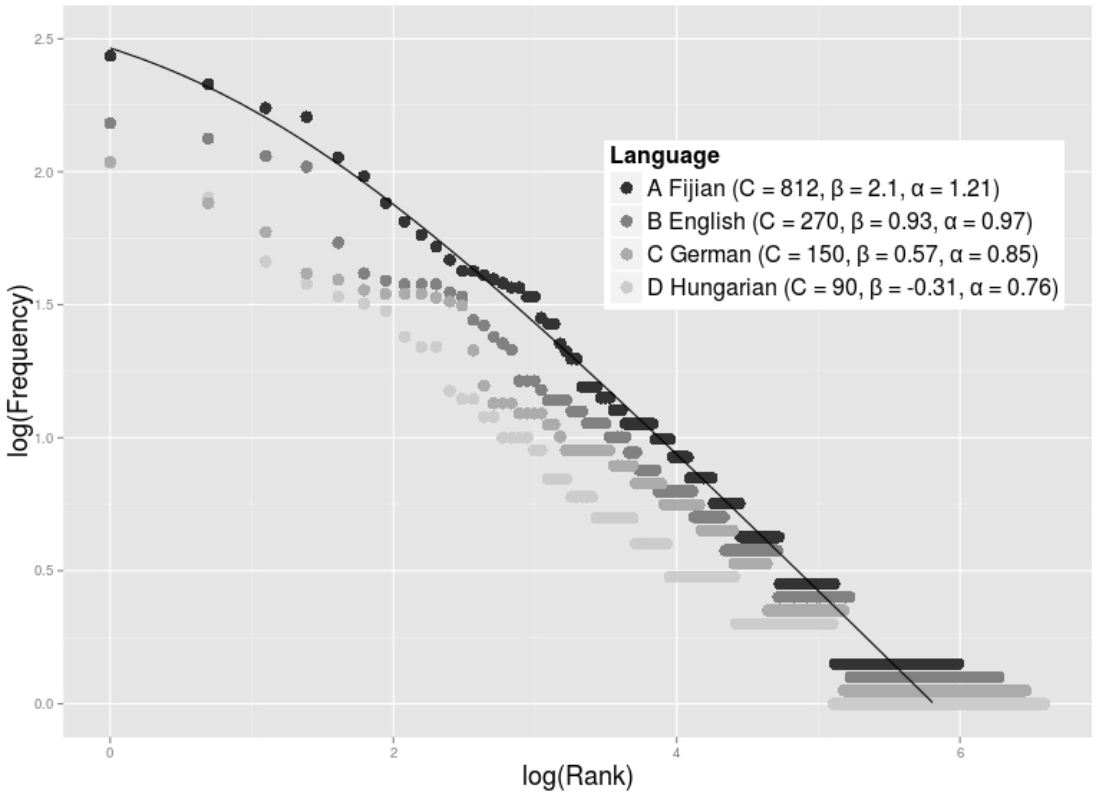

Diachrony

Bentz, Kiela, Hill & Buttery (2014) Zipf's law and the grammar of languages. *Corpus Linguistics and Linguistic Theory.*

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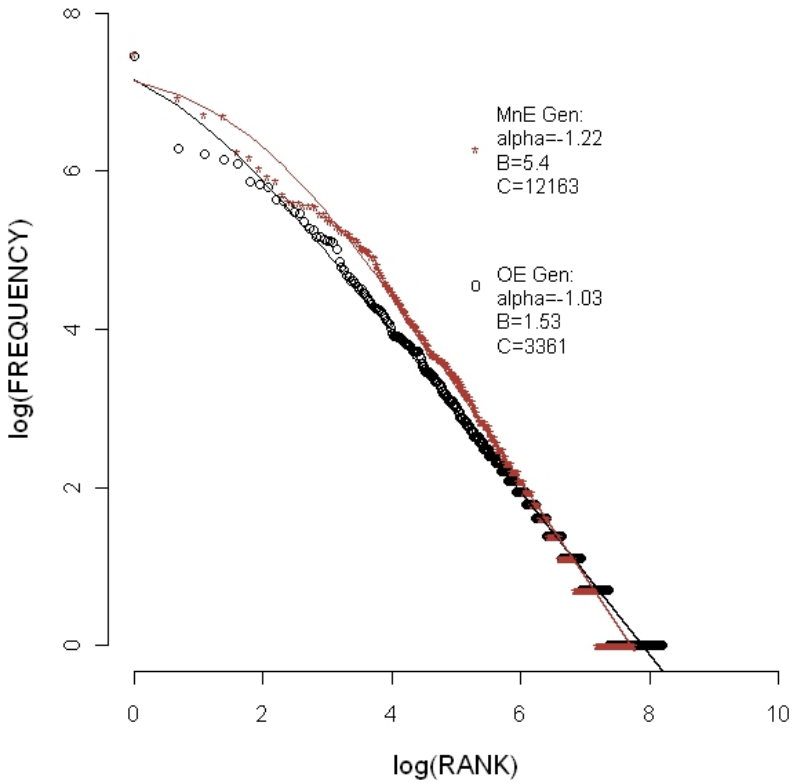
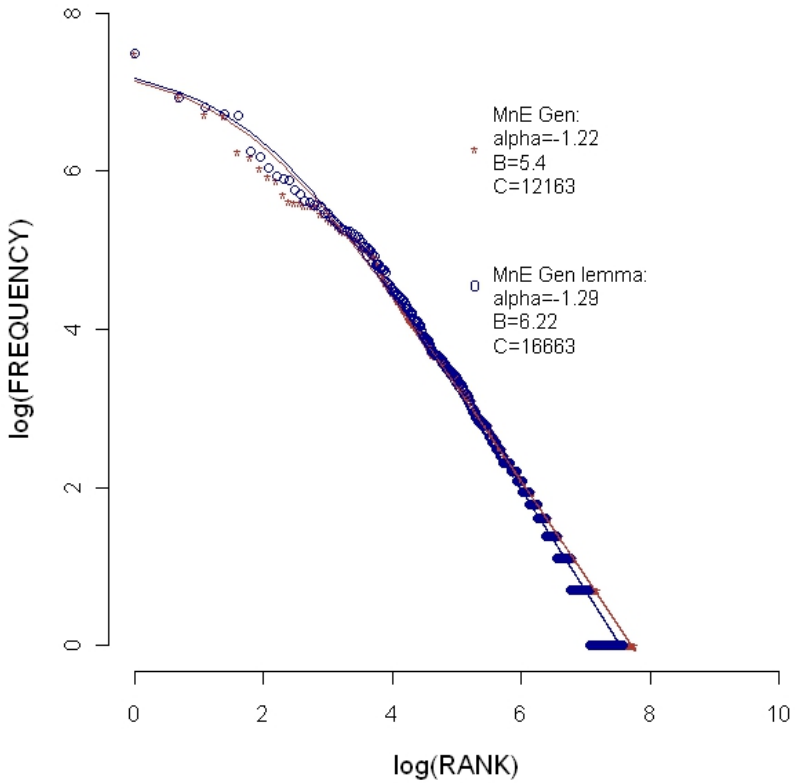
10a) MnE and OE Genesis



10b) MnE Genesis + lemmatized version



Synchrony

Bentz, Kiela, Hill & Buttery (in preparation) Adaptive languages: Modeling lexical diversity cross-linguistically.

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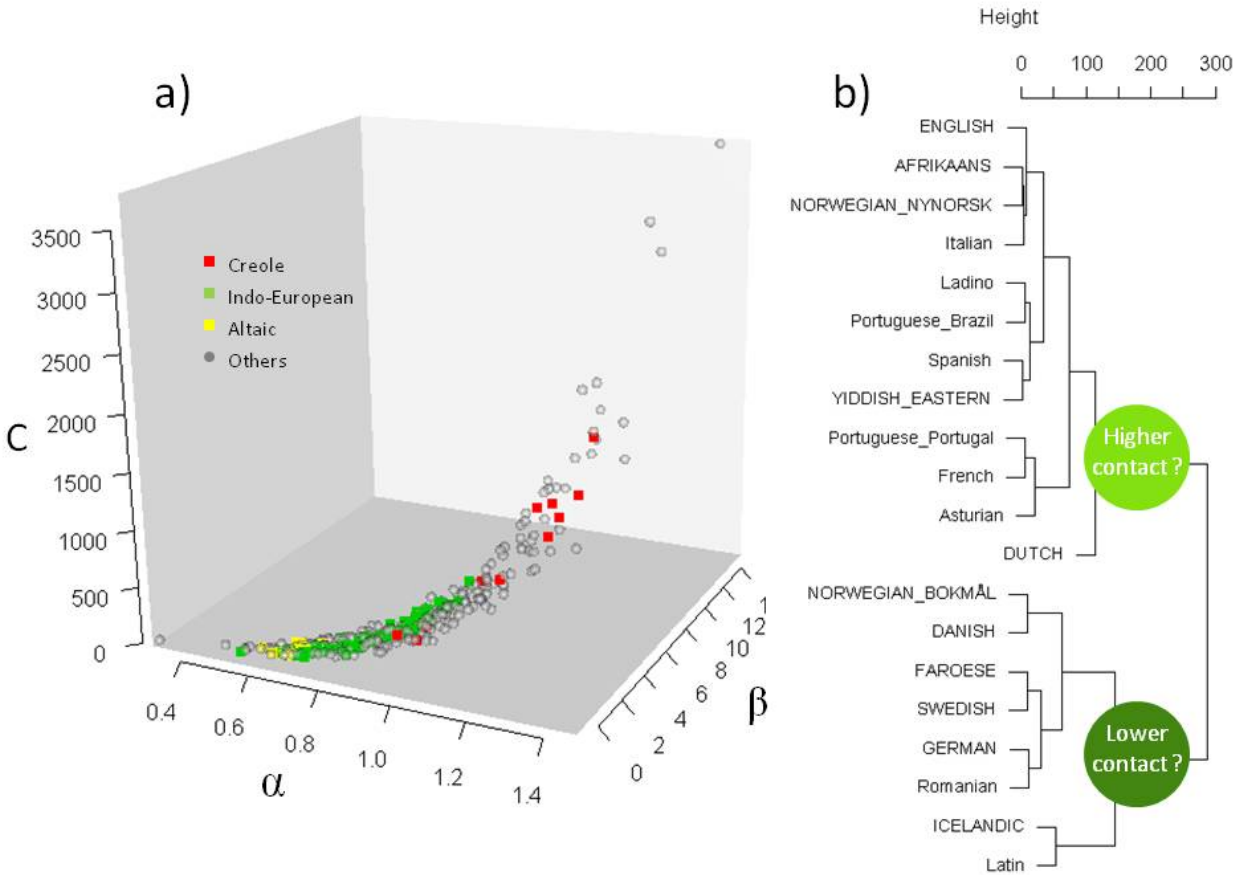

Lexical diversity

- Seems to be reduced in contact scenarios (non-native language learning, see Trudgill, 2011; Lupyan & Dale 2011; McWhorter, 2007)

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Question

WHY DO LANGUAGES GET HIGH LEXICAL DIVERSITIES IN THE FIRST PLACE?

Grammaticalization

Definition

In the final stage of grammaticalization **frequently co-occurring** words **merge** by means of phonological fusion (Bybee, 2003: 617) and hence 'morphologize' to built **inflection**s and **derivations**

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Cline

content item >grammatical word >clitic >inflectional affix
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Example

Old English *līc* 'body' → *-ly*
Latin *cantare habeo* 'I have to sing' → Italian *canterò*

Grammaticalization

Hypothesis

Grammaticalization → **increasing** lexical diversity

Deflexion → **decreasing** lexical diversity

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Can we computationally model the impact of grammaticalization on lexical diversity?

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Computational Model

Starting point: Fijian UDHR

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Process

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Endpoint

- Do we arrive at lexical diversities similar to the ones for German or Hungarian?

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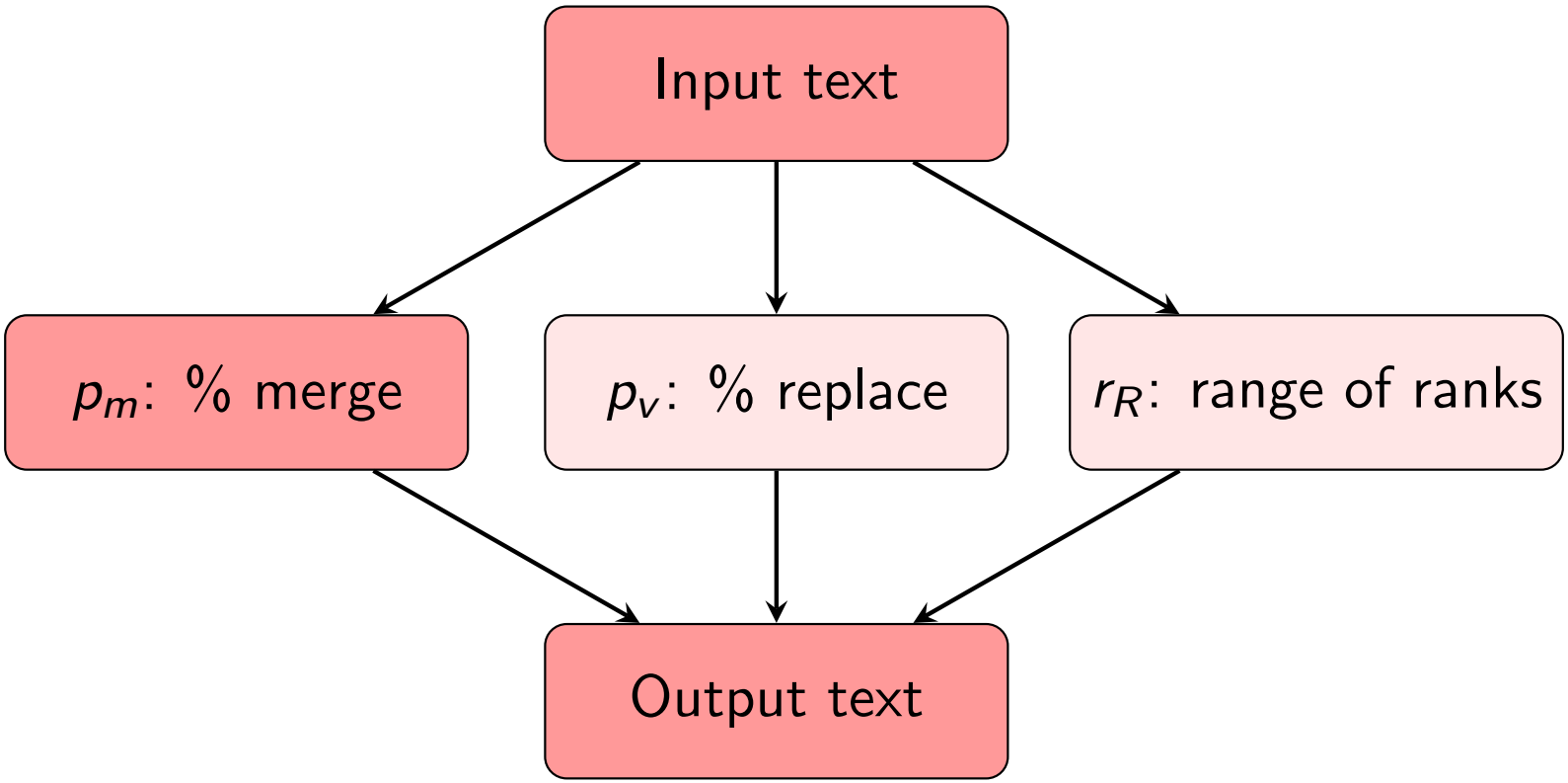
Architecture



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$p_m = 2.5, p_v = 0; r_R = 0; n_G = 10$

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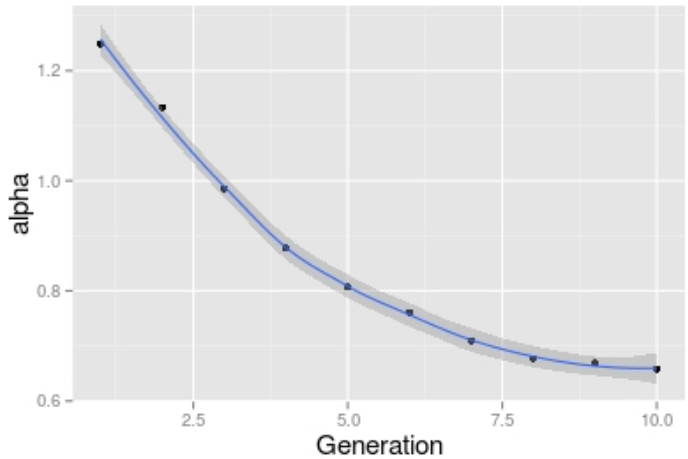

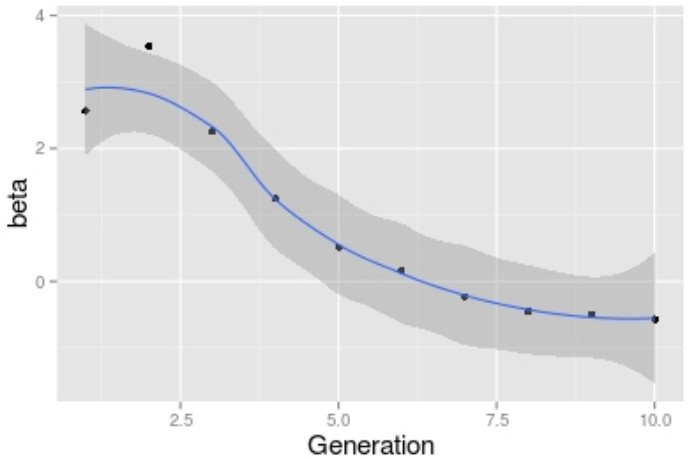

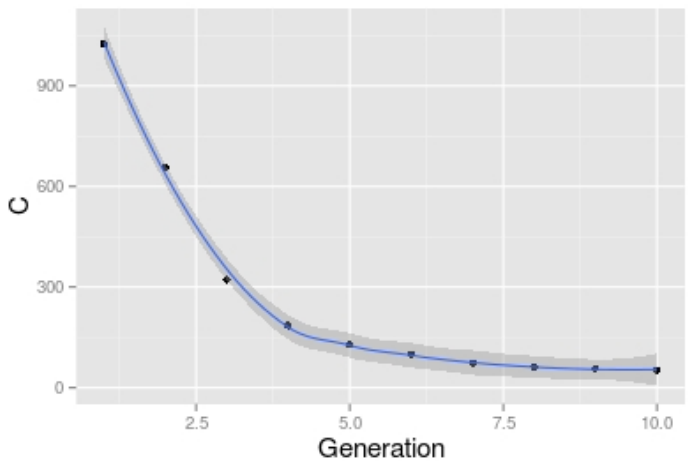

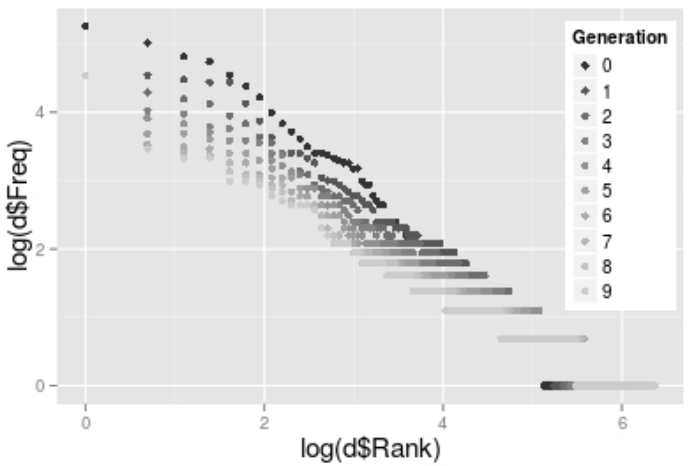

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- *ofthe* $\rightarrow$ genitive marked article, German: *des*

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- *everyonehastherighttofreedomof, withoutanydiscrimination*

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- Exploring models with varying parameters for vocabulary replacement and merging of bigrams (comparison to actual language change data)

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- More realistic model by parsing and POS tagging
- Considering frequency measures beyond bigram frequencies

Collaborators

Douwe Kiela

Felix Hill

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Thank You!

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