Studying Semantic Chain Shifts with Word2Vec: FOOD>MEAT>FLESH

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1st International Workshop
on Computational Approaches
to Historical Language Change, 2019

2 August 2019

Introduction

Chain Shifts

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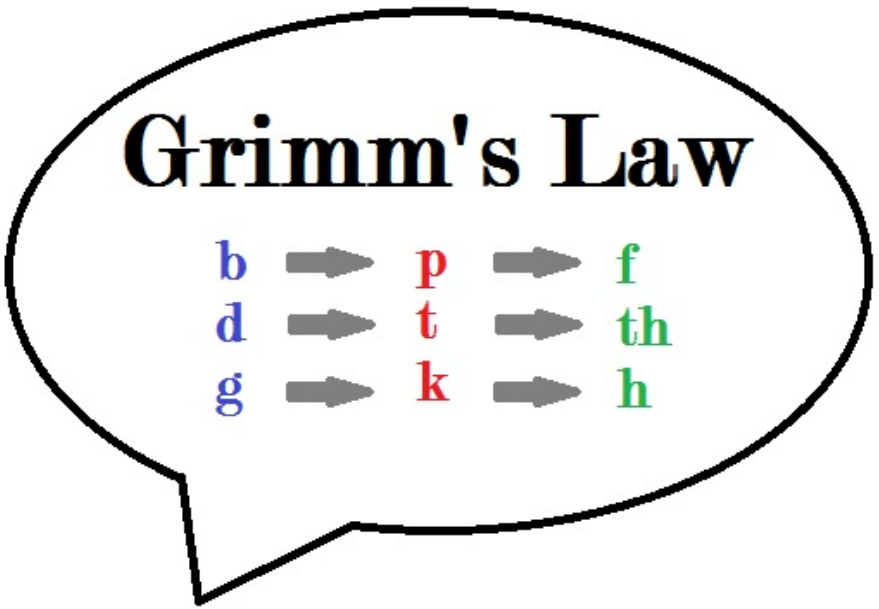

Figure 1 : A simplified representations of Grimm's Law

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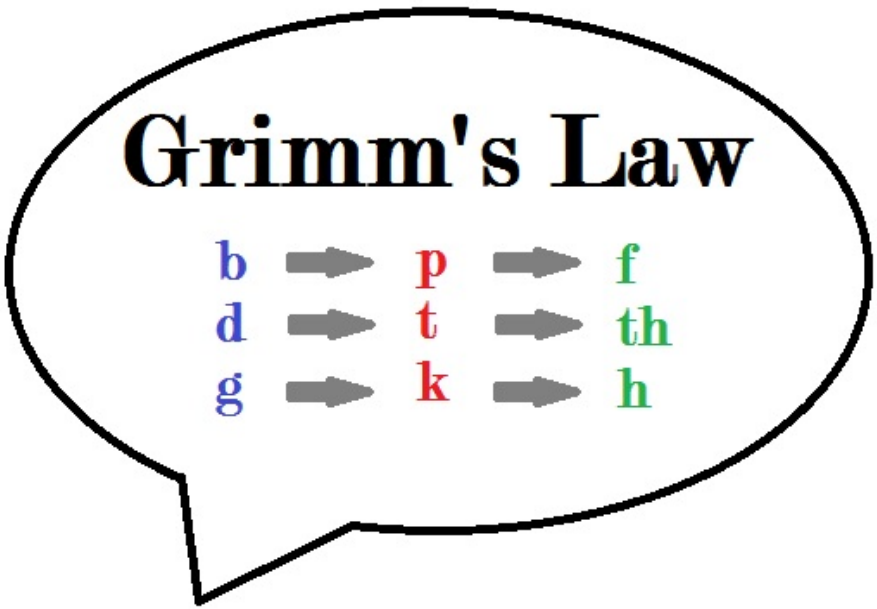

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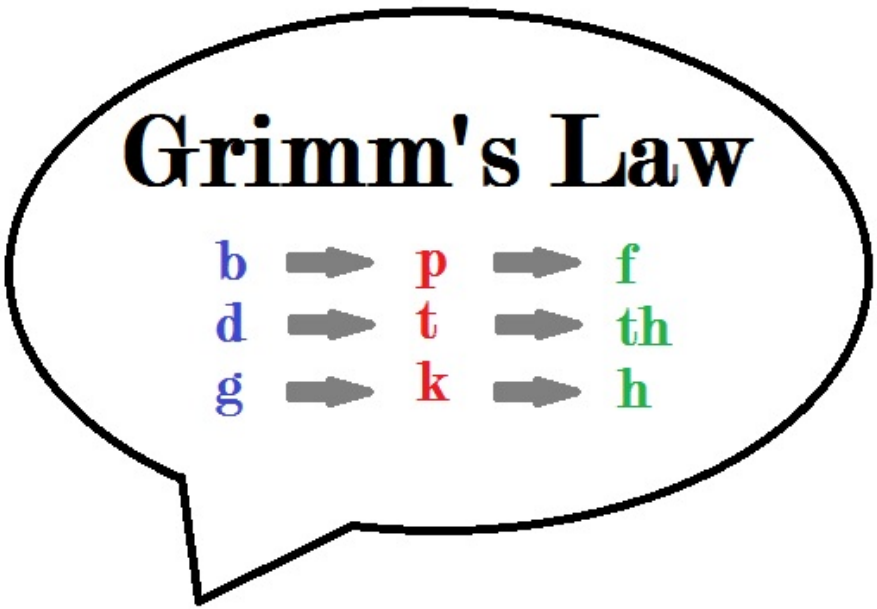

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Ancient Greek: **π***ατήρ* ≈ **f***ather*
Latin: **p***isces* ≈ **f***ish*
Italian: **p***iede* ≈ **f***oot*
...

Chain Shifts in Semantics

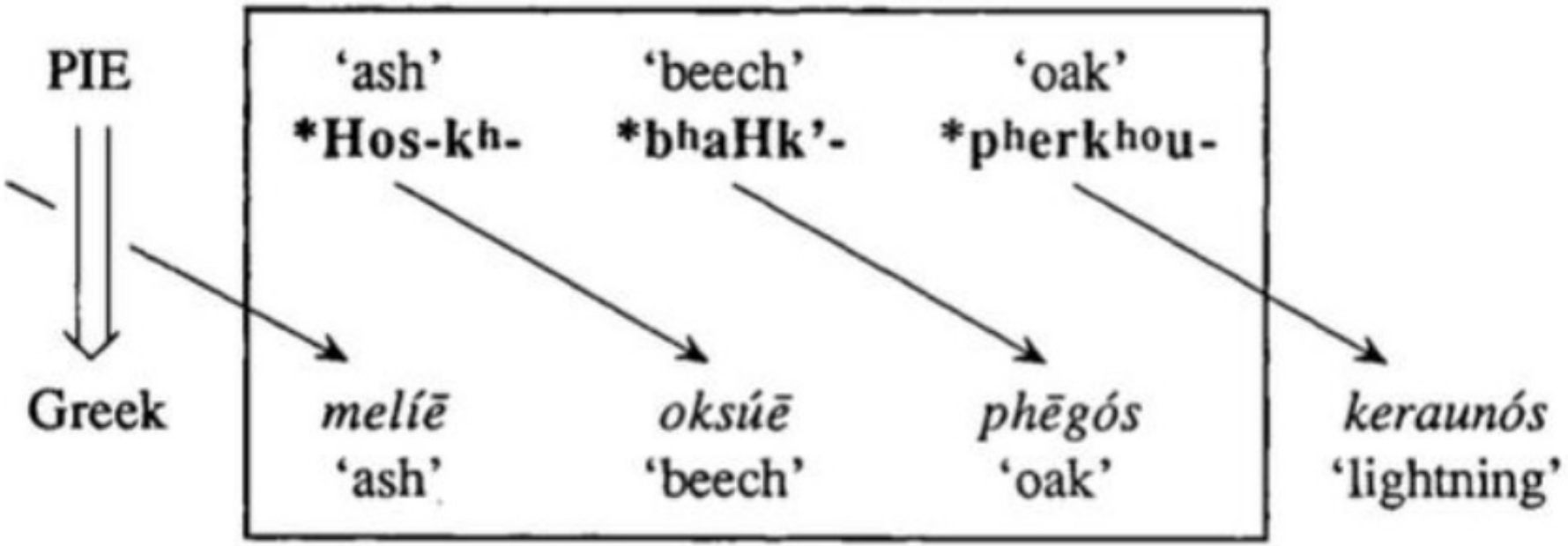

Figure 2 : Semantic chain shift in Ancient Greek tree terminology (from: Gamkrelidze & Ivanov 1995: 538)

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b. hi eton swynen flæsc
'they ate swine's flesh' (PPs (prose) 16.14)

Outline

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Data

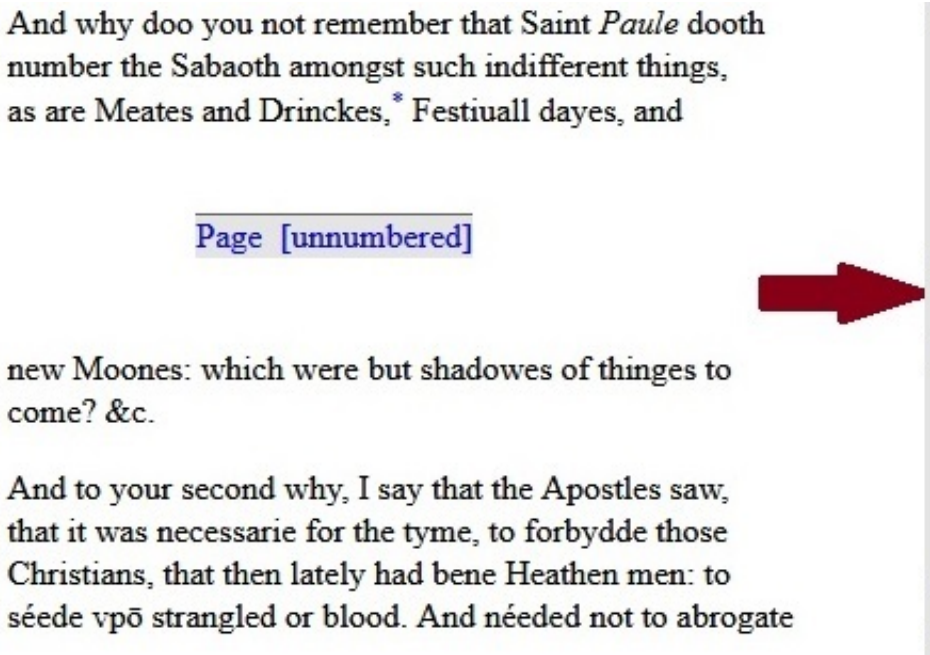
Corpora Used

Period	Corpus	Size
1 1425-1475	Innsbruck*	2.5m
2 1475-1525	EEBO**	9.0m
3 1526-1575	EEBO	35.6m
4 1576-1625	EEBO	149.8m
5 1626-1675	EEBO	330.9m
6 1676-1725	EEBO, ECCO**	230.5m
7 1726-1775	ECCO	31.6m
8 1776-1825	ECCO, CLMET***	38.7m
9 1826-1875	CLMET	10.9m
10 1876-1925	CLMET	8.1m

Table 1 : Periodization of the data, their source corpora, and their size (in million words)

* Markus 2010
** digitzed by the Text Creation Partnership (TCP)
*** Diller et al. 2011

Processing of Textual Material



And why doo you not remember that Saint *Paule* dooth number the Sabaoth amongst such indifferent things, as are Meates and Drinckes,* Festiuall dayes, and

Page [unnumbered]

new Moones: which were but shadowes of thinges to come? &c.

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Figure 3 : Illustration of preparation of the text data

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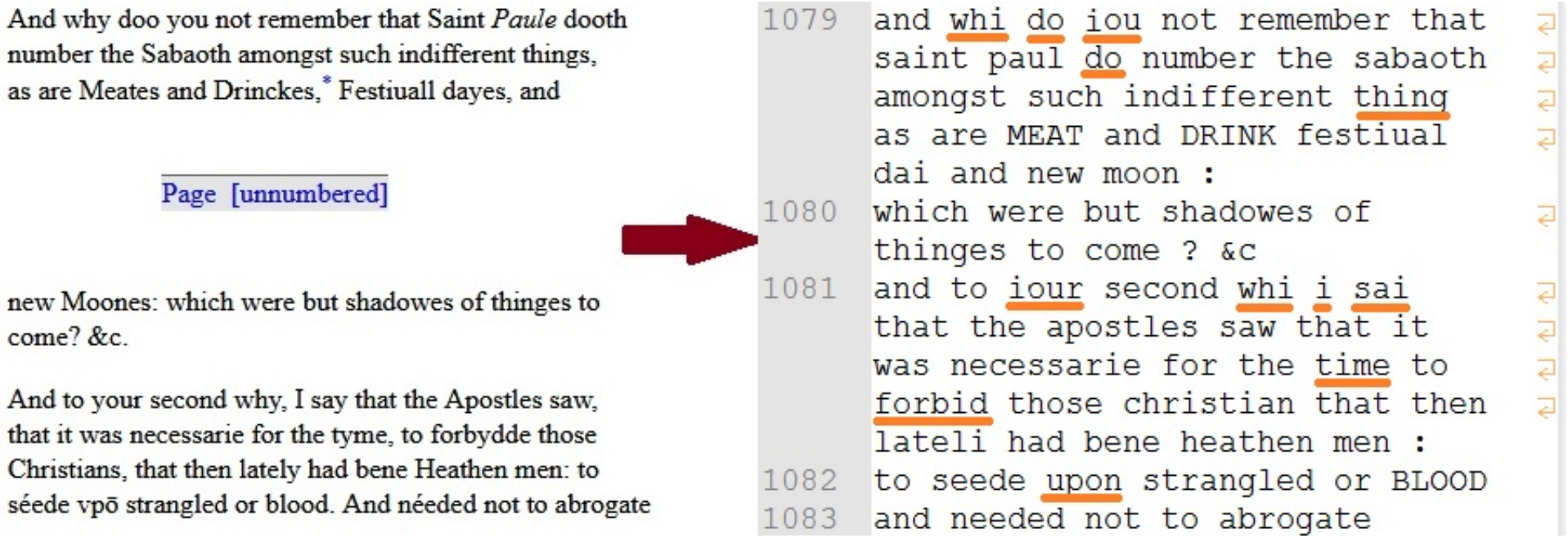

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- c. 850 RegEx for spelling normalization

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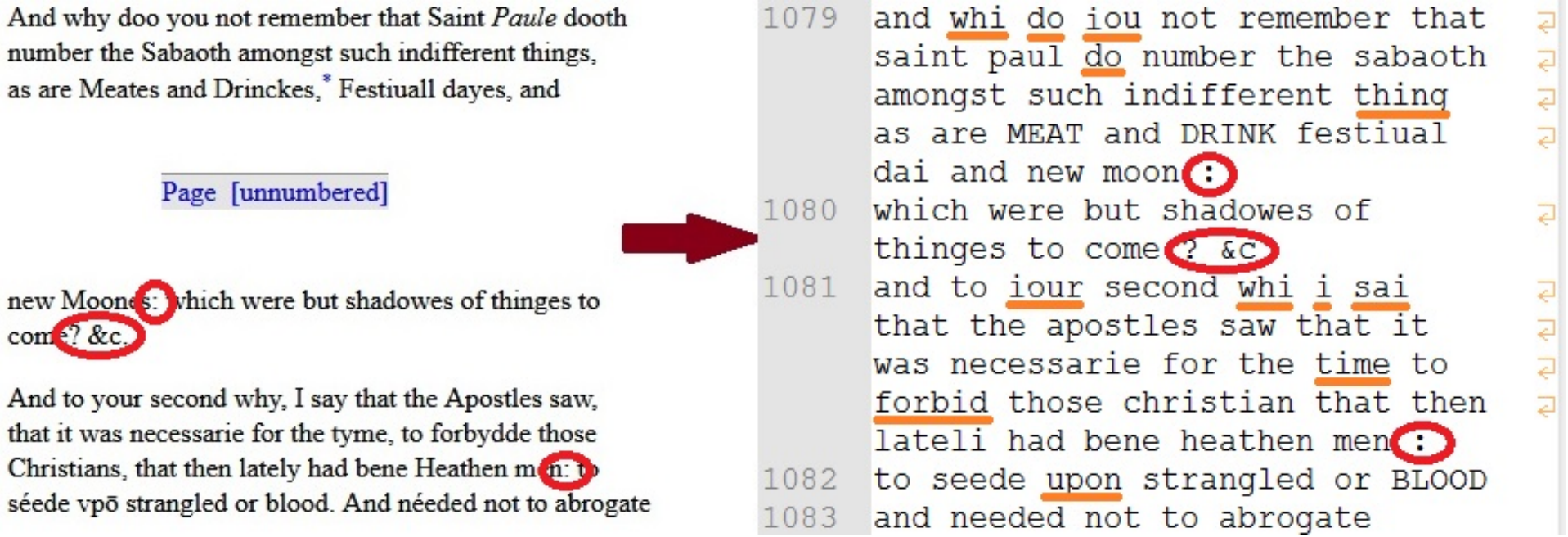

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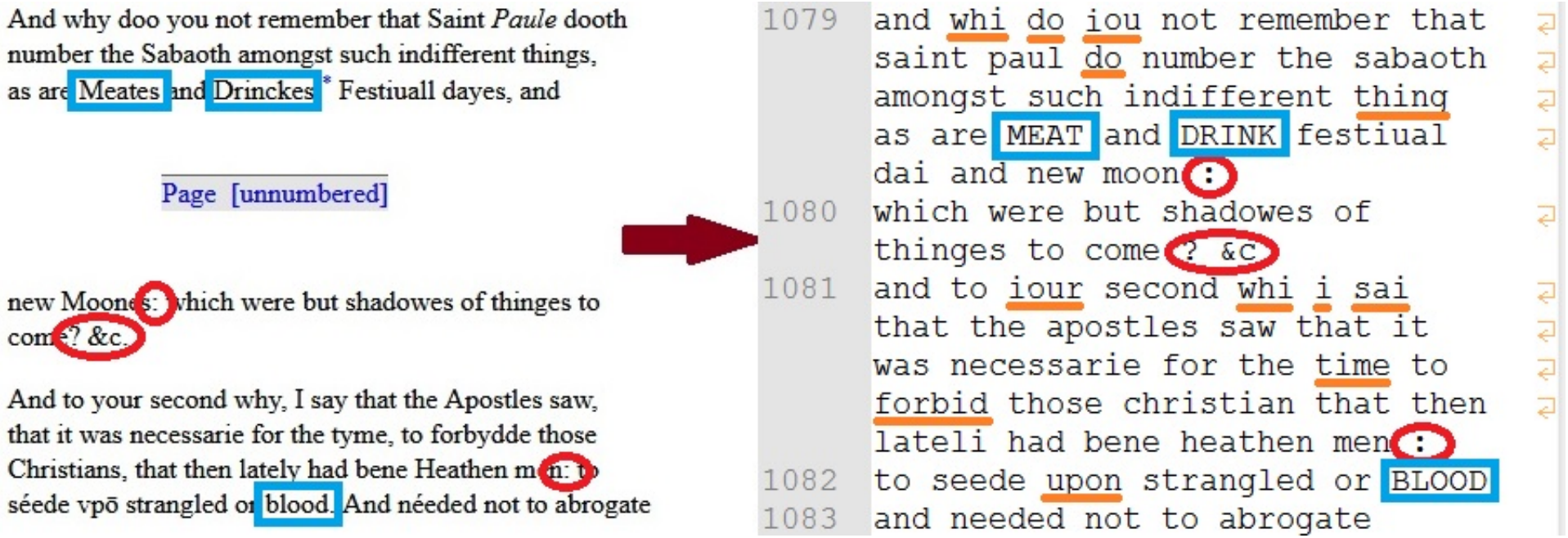

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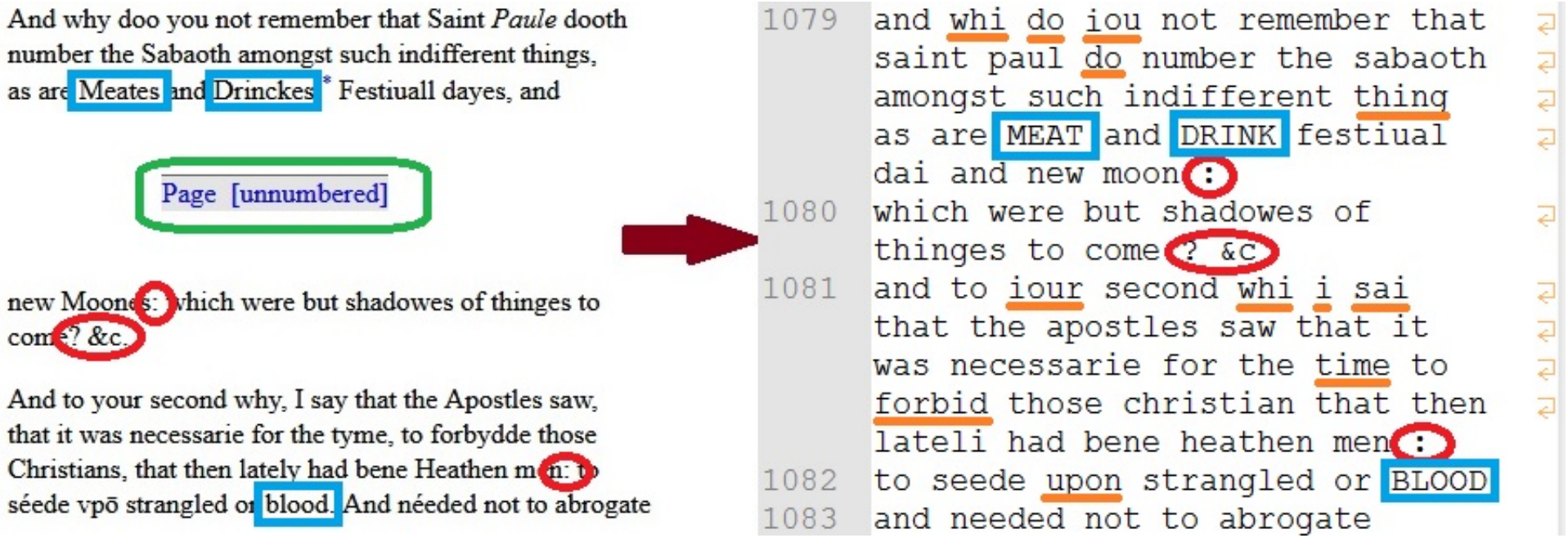

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- punctuation and paragraphs used for tokenization
- lemmatization of target and central context words
- removal of text mark-up

Word Embedding in *Python*

```
######################################################################
### (1) enter the raw data, a .txt file

file_specified = "no"

while file_specified == "no":
    ## raw = raw_input("Please specify a .txt file you wish to format.\n(e.g. 'C
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python™

gensim
topic modelling for humans

```
# import modules & set up logging

import gensim
import logging
logging.basicConfig(format='%(asctime)s : %(levelname)s : %(message)s', level=lo
import time
start = time.time()

# train word2vec on the two sentences
model = gensim.models.Word2Vec(sentences, size=250, window=20, min_count=5, work
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Word Embedding in *Python*

- Word2Vec model implemented in Python's Gensim library (Řehuřek & Sojka 2010)


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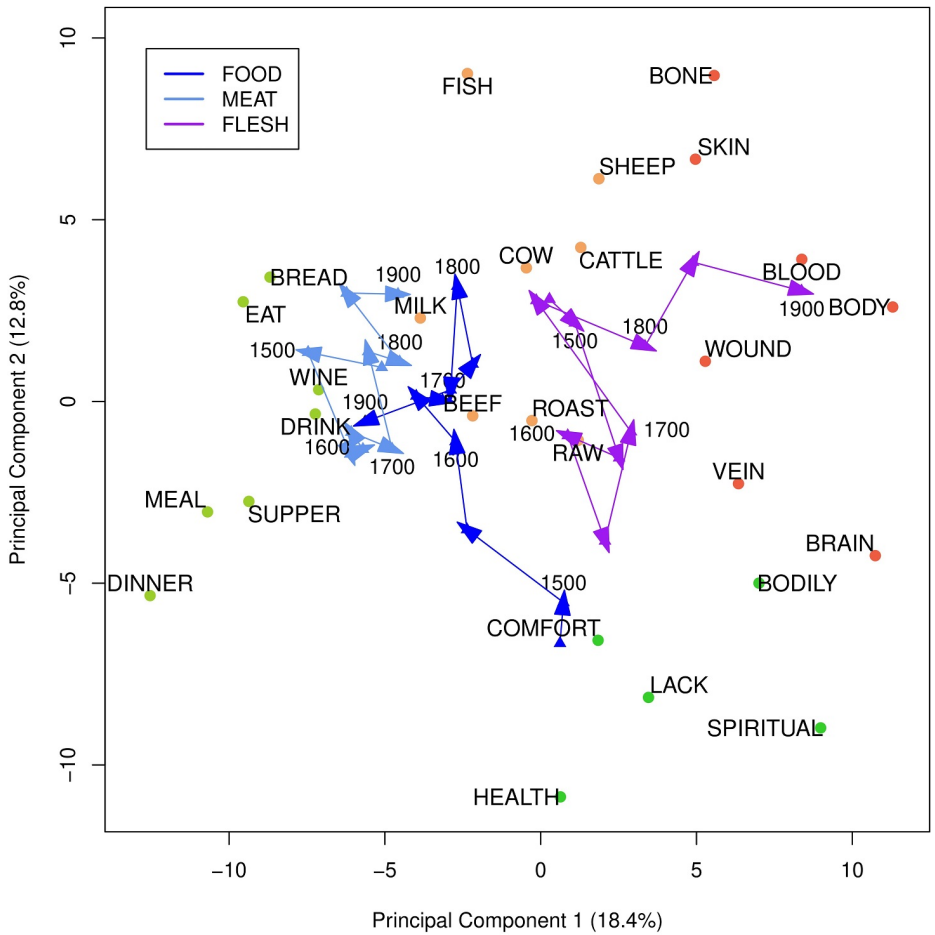
- 250-dimensional word vectors, 20 words context window, 5 word minimum count

Results

PCA Plot (Li et al. 2019)



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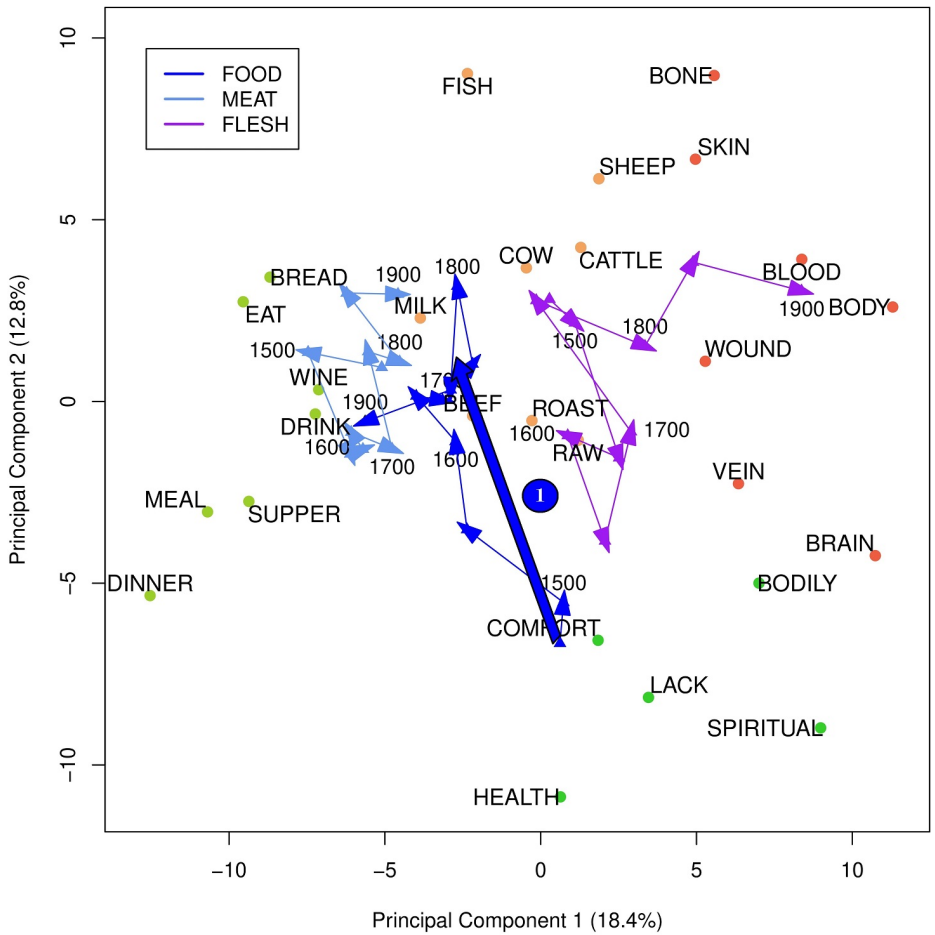

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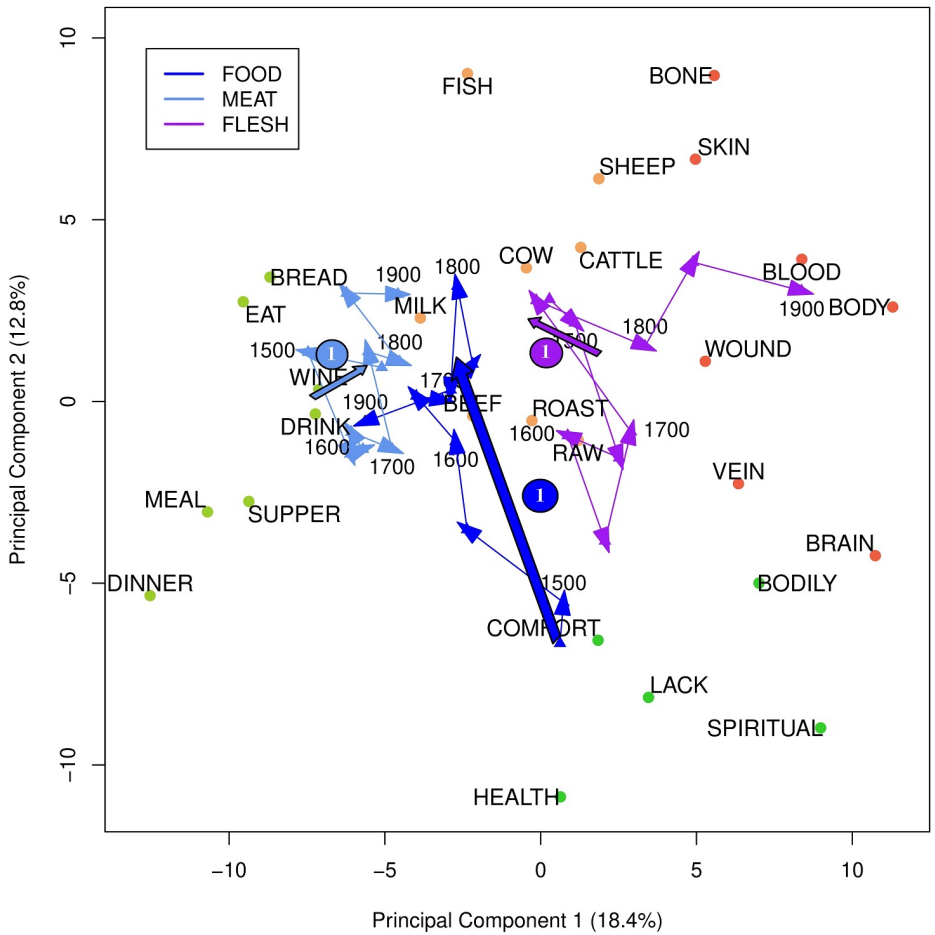

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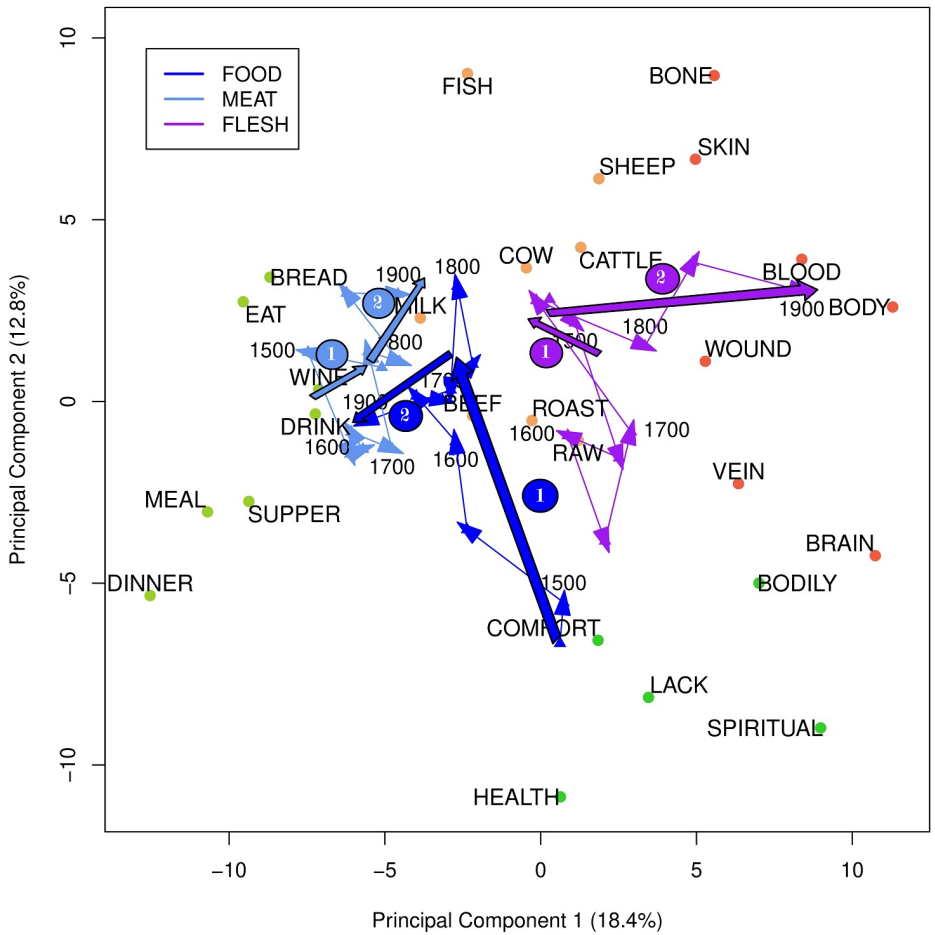

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FOOD pushes on MEAT

Pier's Plowman

A-text, c. 1370

And comaundite of his curteisie
in comoun þre þinges;
[...]
þat on is vesture [...]
þat oþer is mete at meel ...

C-text, c. 1385

He comaundid of his cortesye
in comune þre þynges
[...]
The ferst of þo ys fode and
vesture þe secounde

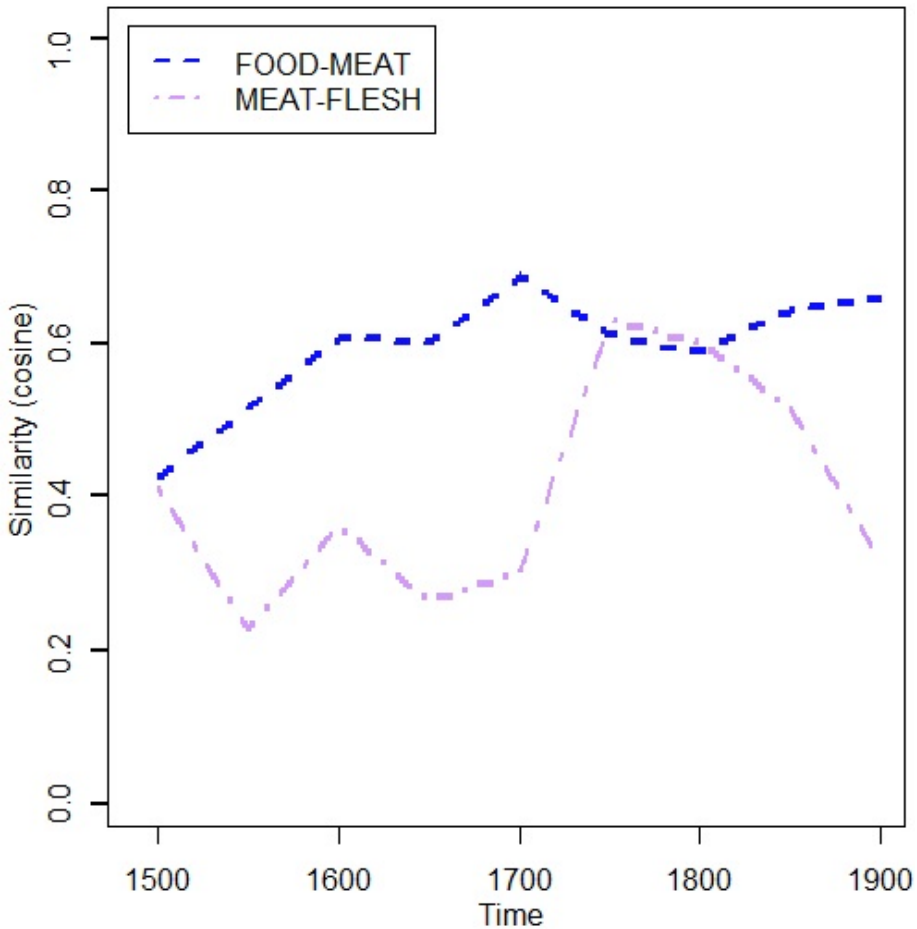

Figure 5 : Cosine similarities

FLESH - High Degree of Polysemy

flĕsh n.

1a. (a) The flesh of the human body; esp., the muscular, gristly, and glandular portions
(b) corresponding portions of an animal's body

1b. *Theol.* The communion bread: **Cristes ~**, bread as transubstantiated

1c. *Med.* and *surg.* (a) A muscle; (b) the flesh of an animal used medicinally;

2a. (a) The flesh of an animal (or fowl) used for human food, meat
(b) *pl.* kinds of meat

2b. (a) **bef ~, calf (calves) ~, camel ~, capoun ~, colver ~, cou(es) ~, deres ~, gos ~, gotes ~, hen ~, hors ~, rotheres ~, shepes ~, swin(es) ~**, etc.; (b) **fat ~**, fat meat; **fresh ~**, fresh meat, unsalted or uncured meat; **gret ~**, coarse meat, plain meat; **ibred ~**, broiled or roasted meat; **rau ~**, raw meat; **rest(i) ~**, rancid meat; **rosted ~**, roast meat; **salt ~**, meat cured with salt; **soden ~**, boiled meat; etc.

...

5a. The physical or sensual nature of man (as opposed to the spiritual)

5b. The sex urge, sexual desire or passion; sexual intercourse

(excerpt from the Middle English Dictionary)

Gradualness and Vagueness of Semantic Change

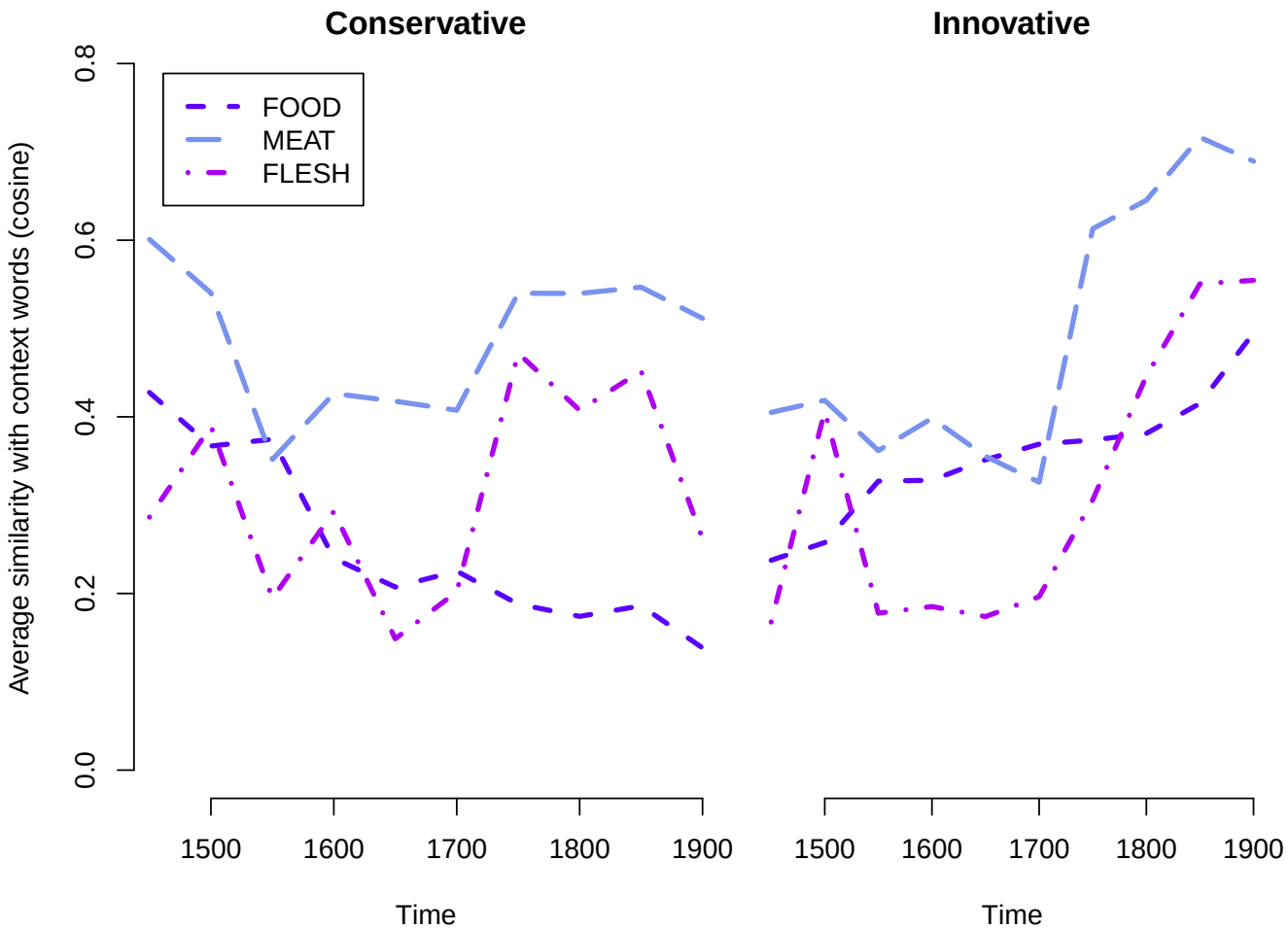

Figure 6 : Average similarity values between a set of conservative and innovative contexts words and each target word

Direction and Time Course of the Chain Shift

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Central Finding

The semantic shift FOOD > MEAT > FLESH likely proceeded as a **push chain**. It is possible to discern two phases, an initial push **c. 1450-1700** and subsequent changes **c. 1700-1900**.

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MEAT > FLESH, c. 1700-1900

The shifts in MEAT and FLESH are harder to pinpoint. There is some evidence for a secondary push from c. 1700 on (cosine similarity).
However, this finding remains uncertain. (1) FLESH is highly polysemous (genre effect, noise). (2) MEAT does not clearly dissociate from the 'eating' domain even after FOOD has acquired its modern meaning. (3) The MEAT and FLESH measures move roughly in parallel (average similarity).

Conclusion

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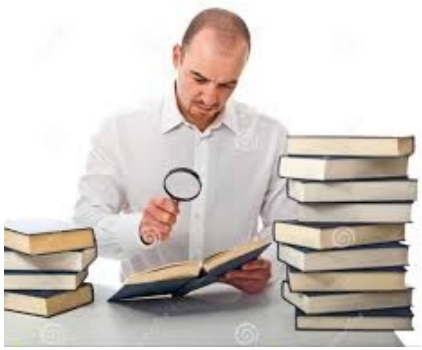
Manual analysis



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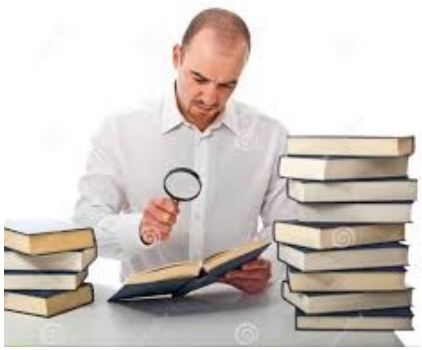
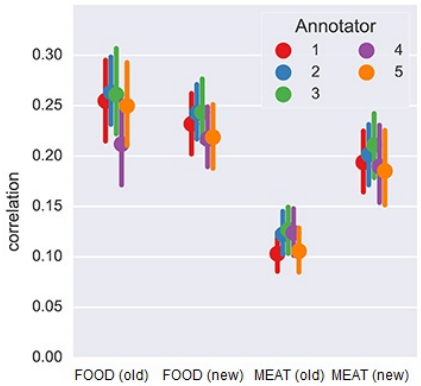


Inter-annotator agreement



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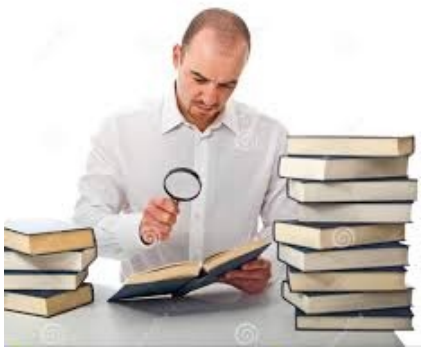

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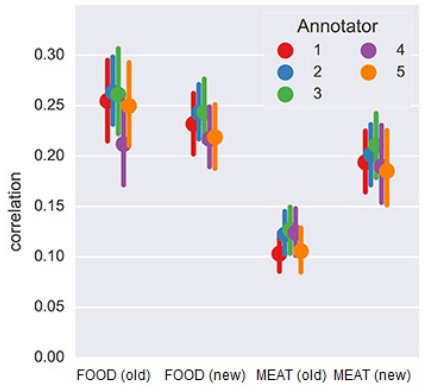
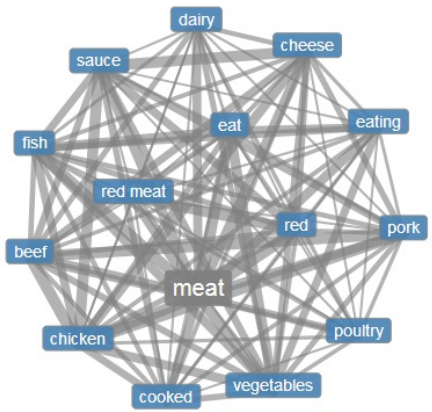


Collocations



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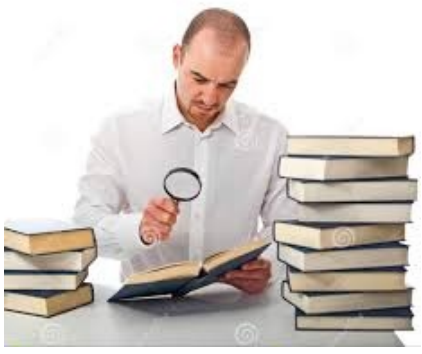

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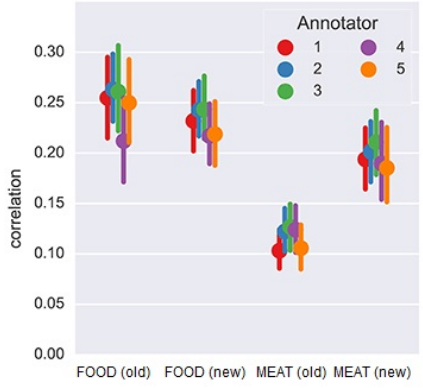

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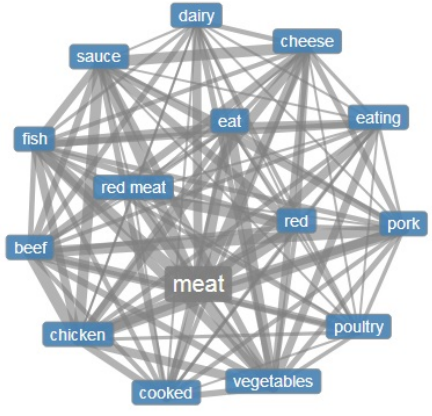

Collostructions (Stefanovitsch & Gries 2003)

Collexeme	Collostruction strength	Collexeme	Collostruction strength
trick (92)	2.11E-267	delude (19)	8.83E-49
fool (77)	1.68E-187	talk (62)	2.38E-48
coerce (53)	1.15E-158	goad (18)	1.35E-46
force (101)	6.31E-136	shame (19)	1.28E-45
mislead (57)	9.57E-110	brainwash (13)	2.42E-37
bully (45)	2.53E-109	seduce (17)	2.56E-35
deceive (48)	5.94E-109	push (34)	6.66E-35
con (34)	4.41E-102	tempt (22)	3.37E-32
pressurise (39)	4.8E-101	manipulate (19)	3.3E-31
provoke (48)	4.05E-87	inveigle (10)	1.04E-30
pressure (30)	3.88E-85	hoodwink (10)	1.52E-29
cajole (28)	4.08E-85	panick (15)	7.75E-28
blackmail (25)	3.31E-64	lure (14)	1.23E-27
dupe (19)	7.77E-52	lull (11)	4.62E-26
coax (22)	6E-51	dragoon (8)	1.63E-25

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- "Currently, word embedding methods can supplement, but should not supplant, careful linguistic studies on semantic change."

Thank you very much for your attention!

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