

New ways to read

‘Language on a holiday’

Machine learning applied to philosophical texts

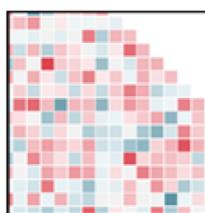
Joshua Banks Mailman

jmailman@alumni.uchicago.edu

spaCy

pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



Seaborn



matplotlib



NumPy



NLTK

Applications

Recommender systems

Automated text-to-speech

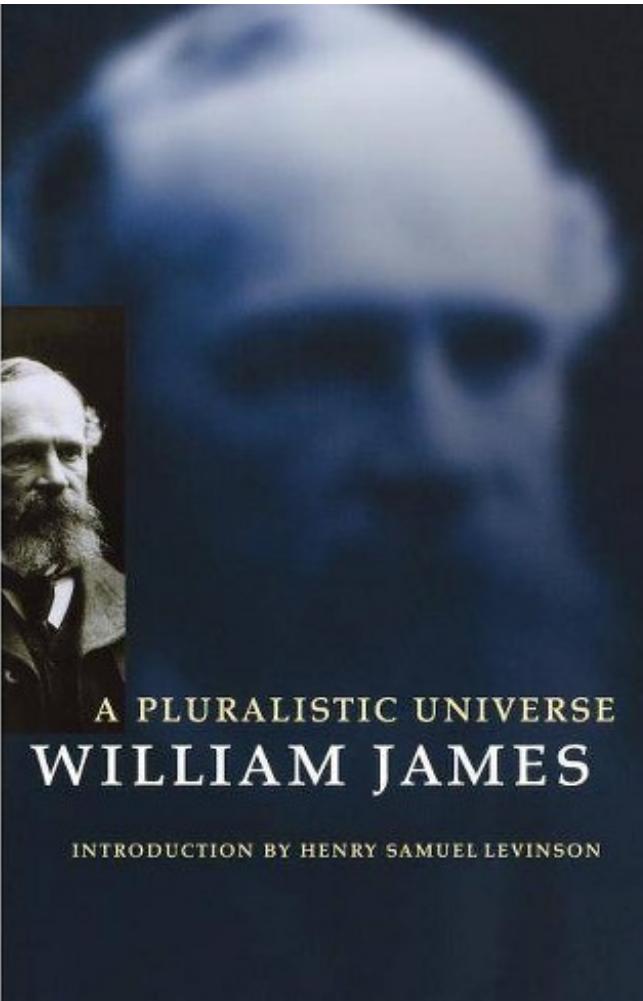
Education

An
**ENQUIRY
CONCERNING
HUMAN
UNDERSTANDING**

David Hume



1748



1909

**Process
and Reality**
CORRECTED EDITION



Alfred North Whitehead

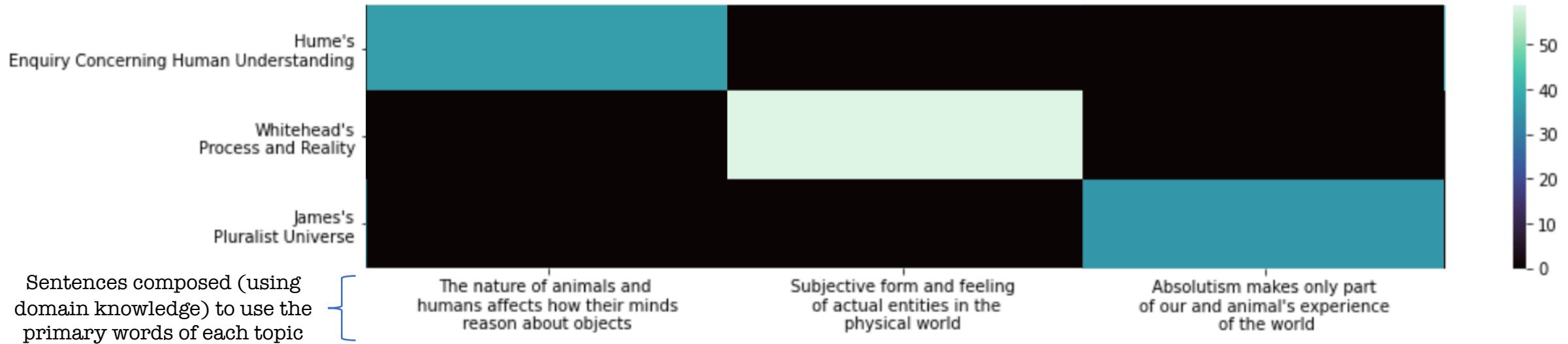
Edited by David Ray Griffin
and Donald W. Sherburne

1928

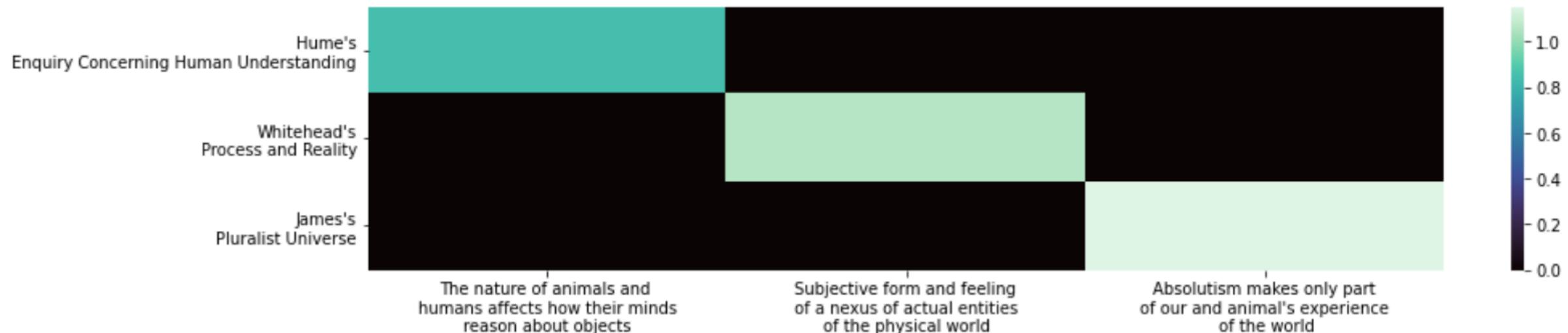
Topic modeling

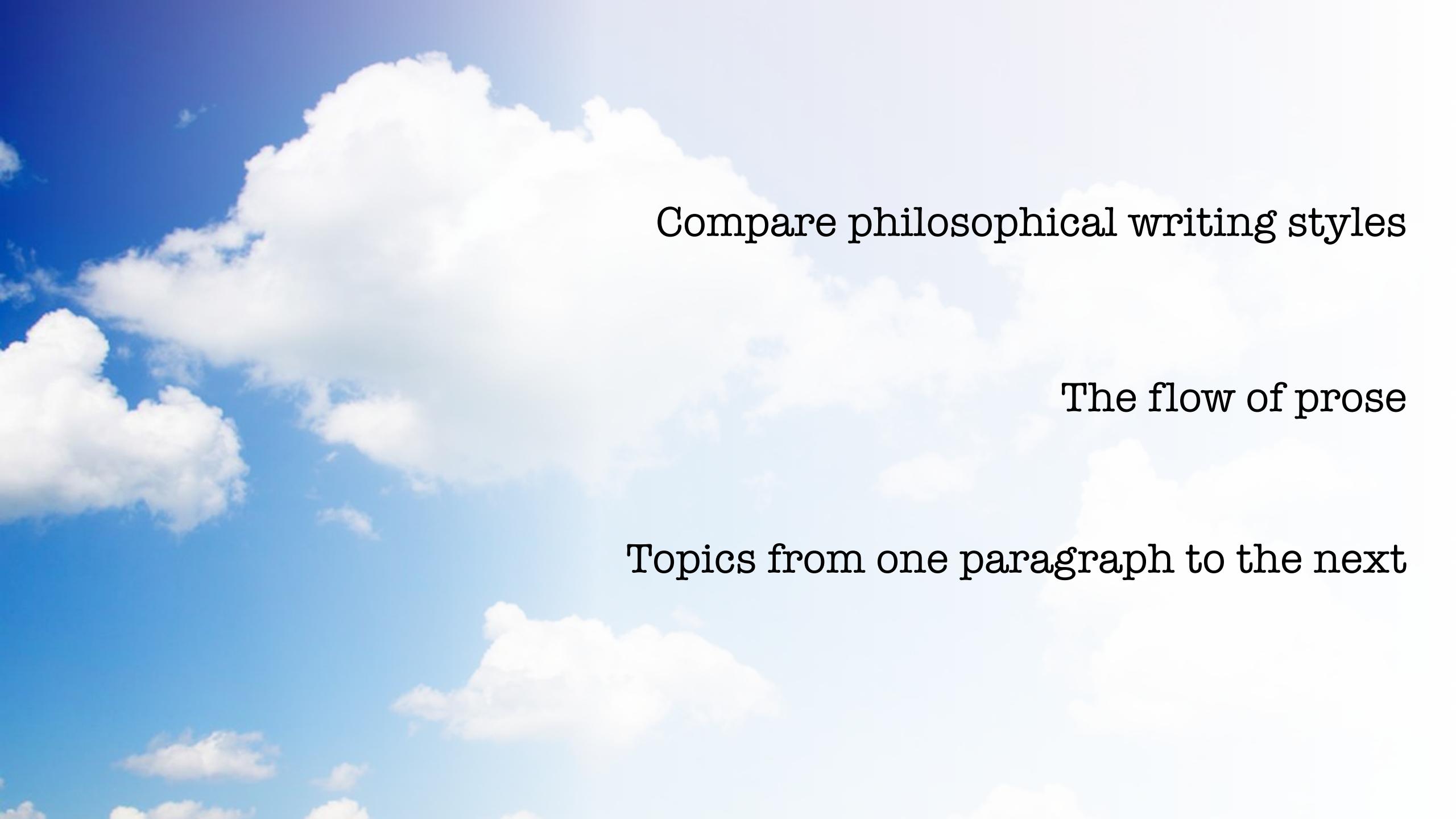
NMF (non-negative matrix factorization)

snowball stemmer



word stemmer



The background of the image is a clear blue sky filled with various sizes of white, fluffy clouds.

Compare philosophical writing styles

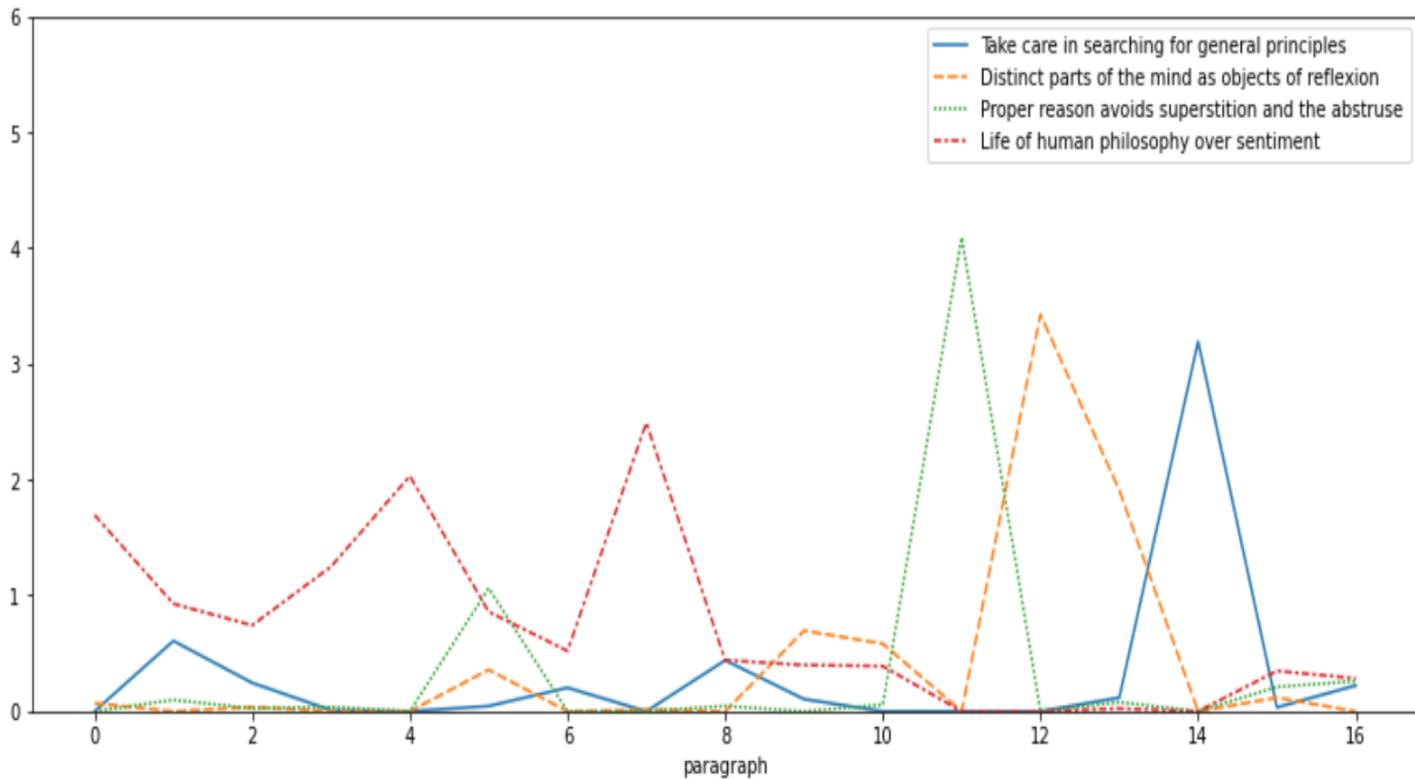
The flow of prose

Topics from one paragraph to the next

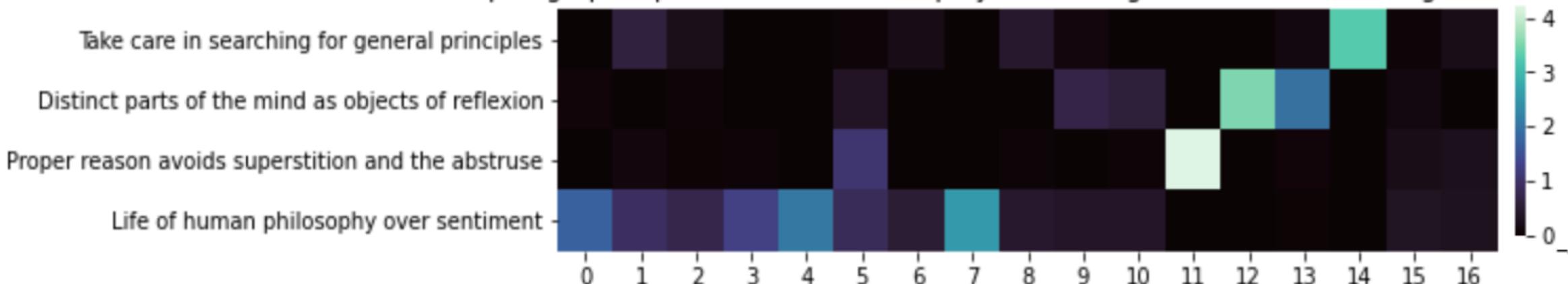
Hume

Paragraph topic flow (four topics)

Begins by maintaining a consistent topic



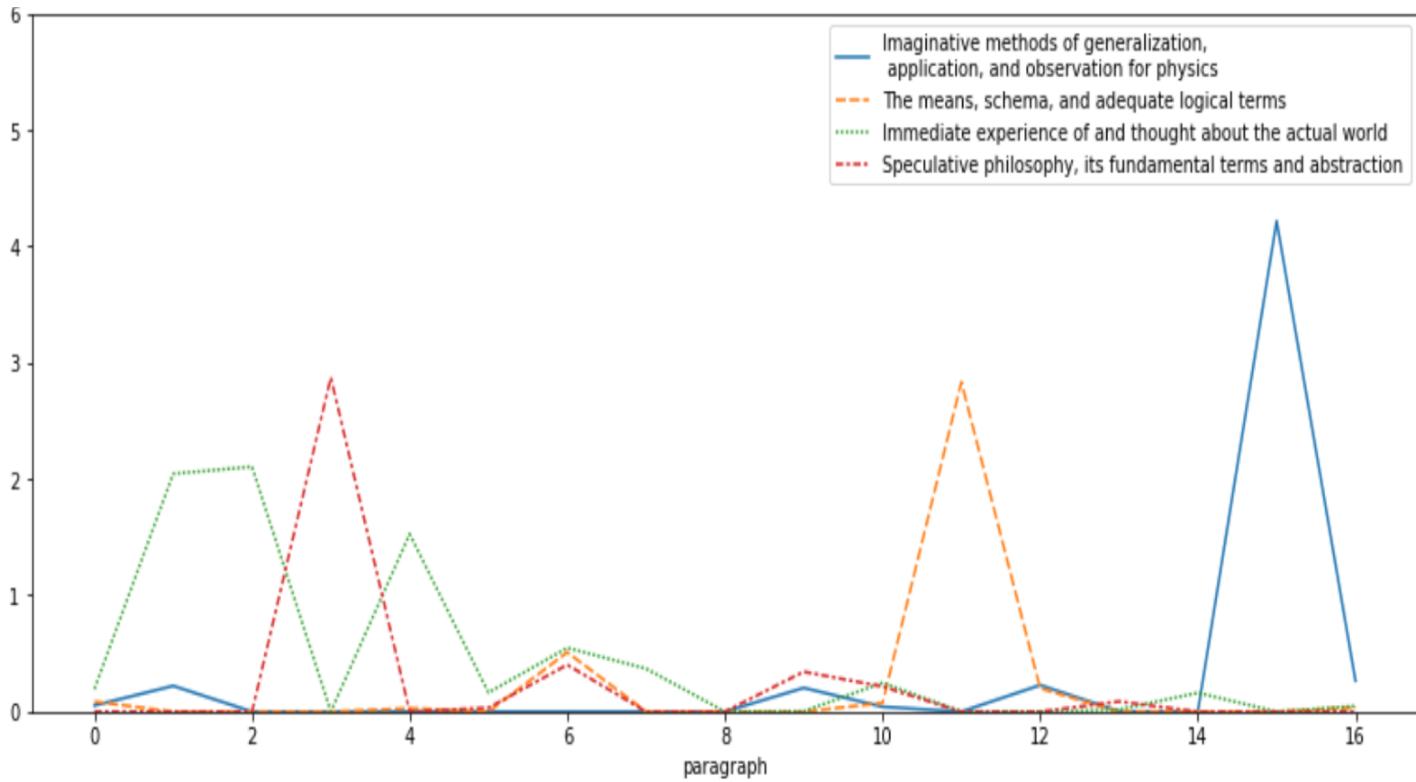
paragraph topic flow in Hume's Enquiry Concerning Human Understanding, section 1



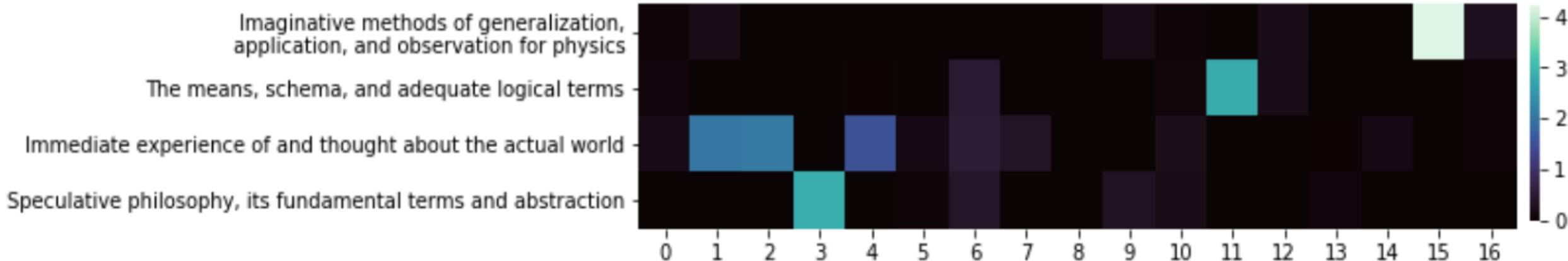
Whitehead

Paragraph topic flow (four topics)

Various topics
surging and
receding

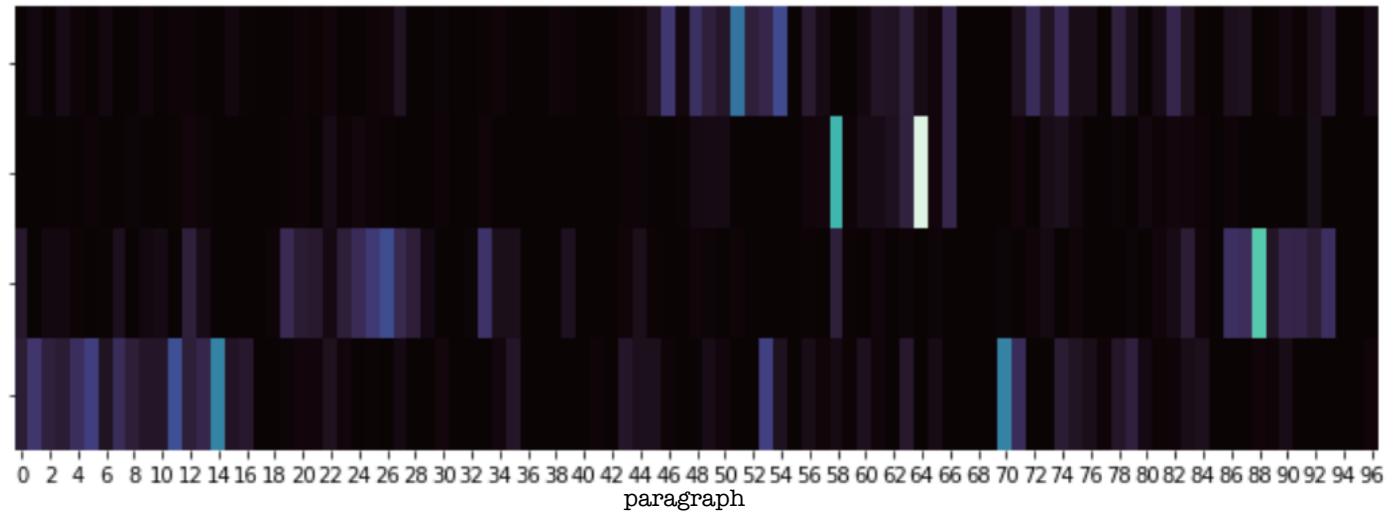


paragraph topic flow in Whitehead's Process and Reality, first 17 paragraphs

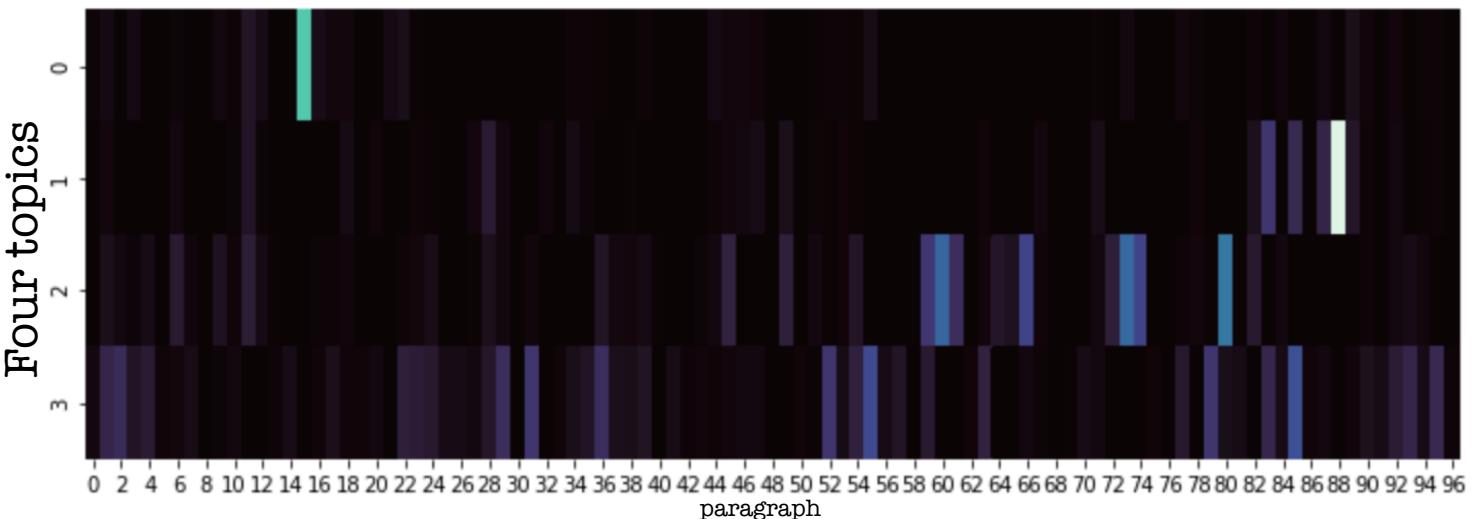


Paragraph topic flow in longer passages

Hume (first 96 paragraphs)



Whitehead's first chapter (96 paragraphs)

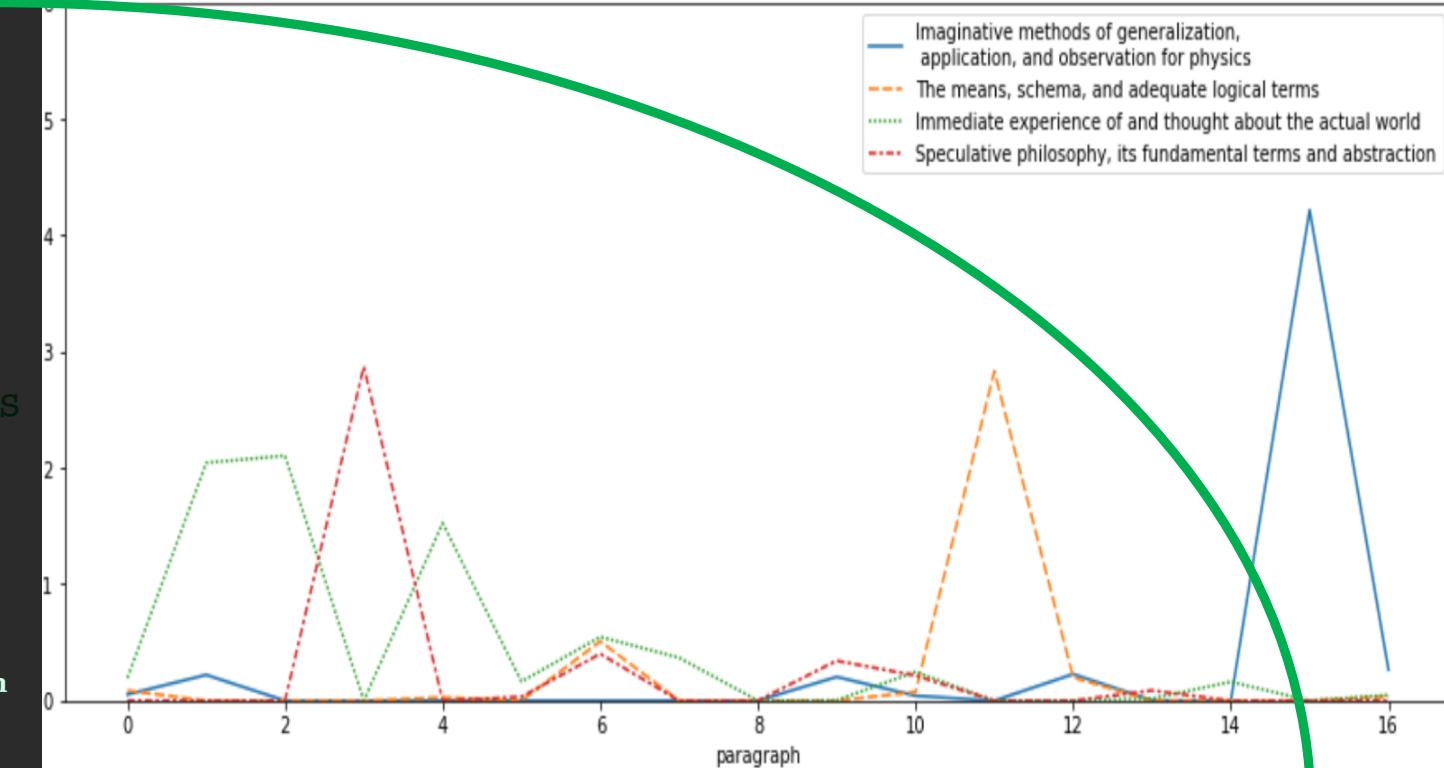


Whitehead

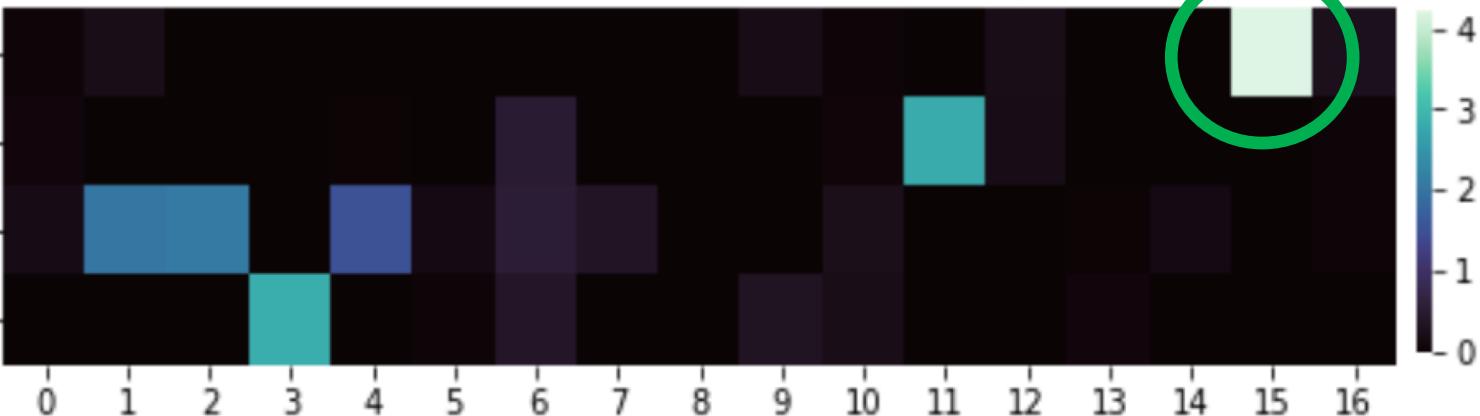
a more free-standing self-explanatory passage

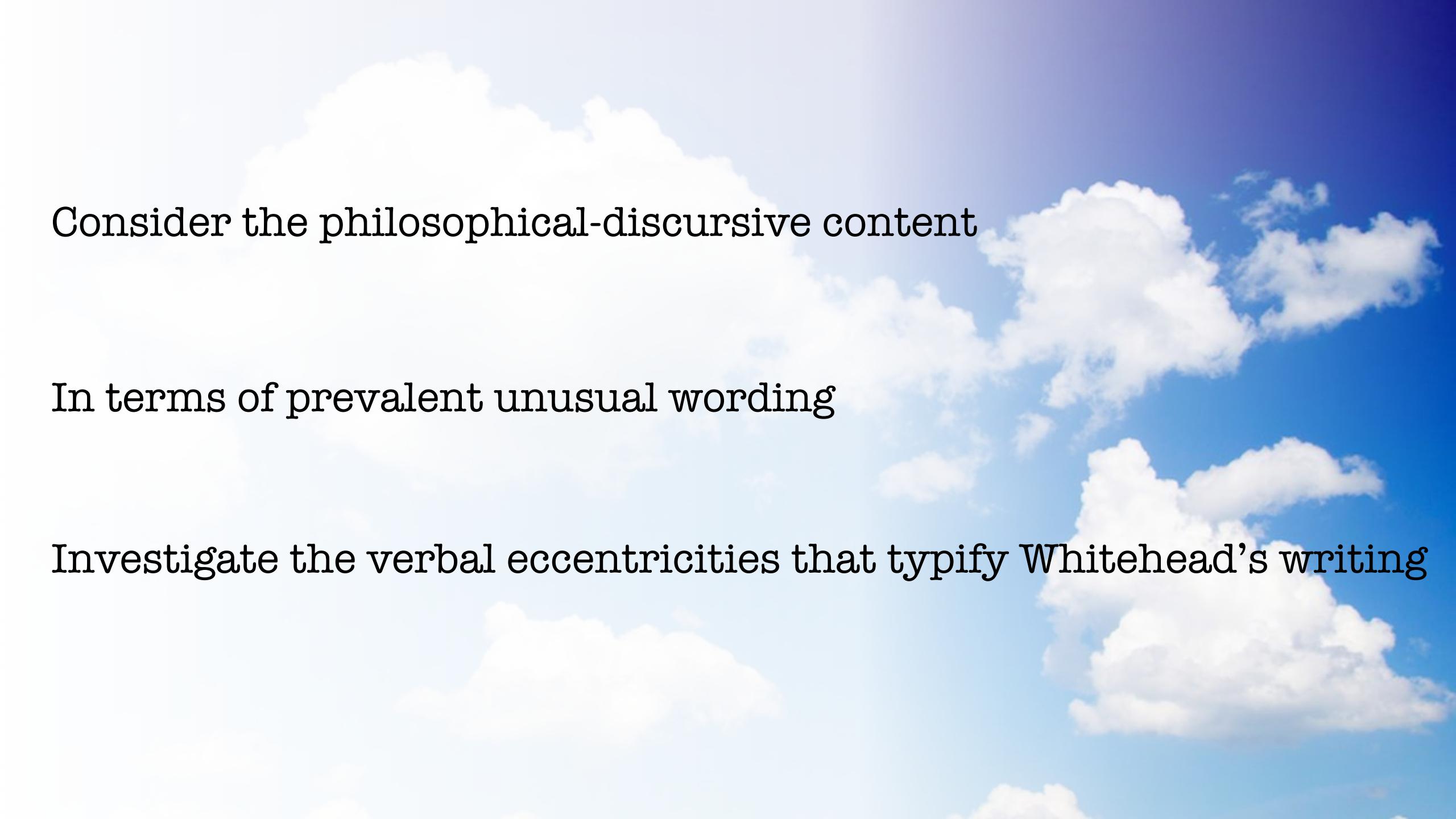
Larger generalities. In natural science this rigid method is the Baconian method of induction, a method which, if consistently pursued, would have left science where it found it. What Bacon omitted was the play of a free imagination, controlled by the requirements of coherence and logic. The true method of discovery is like the flight of an aeroplane. It starts from the ground of particular observation; it makes a flight in the thin air of imaginative generalization; and it again lands for renewed observation rendered acute by rational interpretation. The reason for the success of this method of imaginative rationalization is that, when the method of difference fails, factors which are constantly present may yet be observed under the influence of imaginative thought. Such thought supplies the differences which the direct observation lacks. It can even play with inconsistency; and can thus throw light on the consistent, and persistent, elements in experience by comparison with what in imagination is inconsistent with them. The negative judgment is the peak of mentality. But the conditions for the success of imaginative construction must be rigidly adhered to. In the first place, this construction must have its origin in the generalization of particular factors discerned in particular topics of human interest; for example, in physics, or in physiology, or in psychology, or in aesthetics, or in ethical beliefs, or in sociology, or in languages conceived as storehouses of human experience. In [8] this way the prime requisite, that anyhow there shall be some important application, is secured. The success of the imaginative experiment is always to be tested by the applicability of its results beyond the restricted locus from which it originated. In default of such extended application, a generalization started from physics, for example, remains merely an alternative expression of notions applicable to physics. The partially successful philosophic generalization will, if derived from physics, find applications in fields of experience beyond physics. It will enlighten observation in those remote fields, so that general principles can be discerned as in process of illustration, which in the absence of the imaginative generalization are obscured by their persistent exemplification.

Paragraph topic flow (four topics)



Paragraph topic flow in Whitehead's Process and Reality, first 17 paragraphs



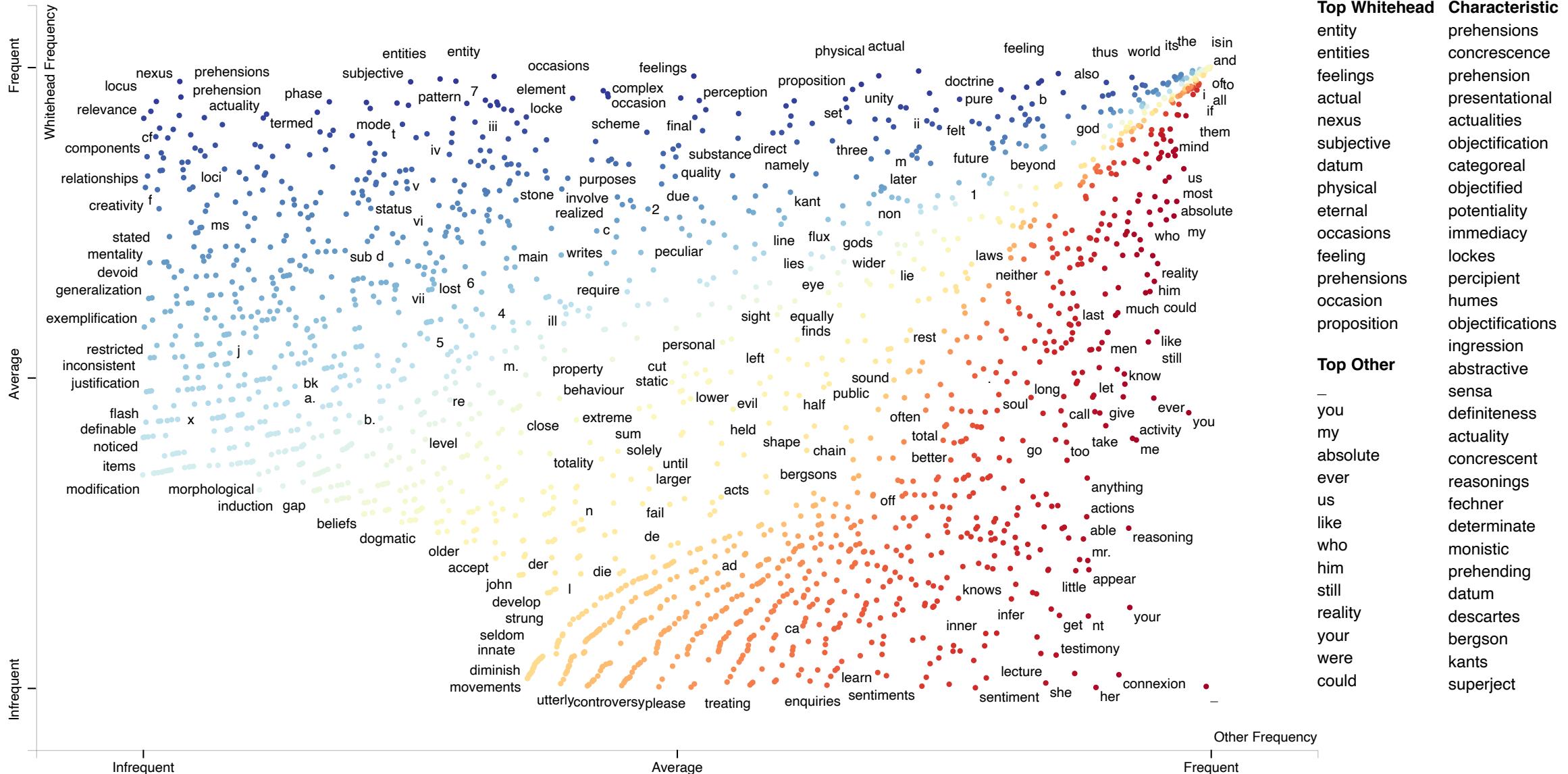
The background of the slide features a clear blue sky with scattered white, fluffy clouds.

Consider the philosophical-discursive content

In terms of prevalent unusual wording

Investigate the verbal eccentricities that typify Whitehead's writing

Scattertext of Whitehead vs. Hume and James

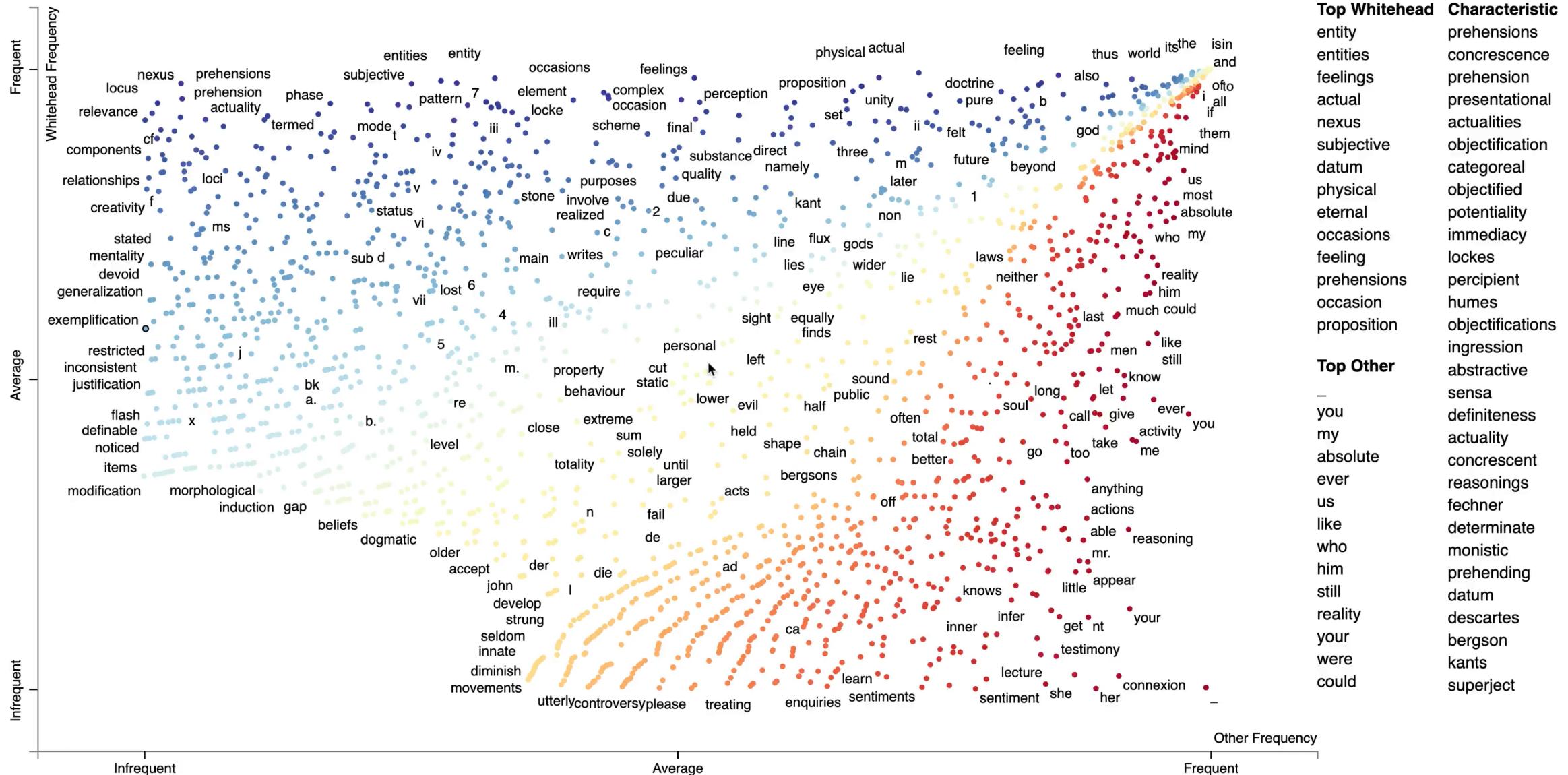


Search the chart

Whitehead document count: 1; word count: 157,800
Other document count: 2; word count: 126,615

spaCy
Jason Kessler

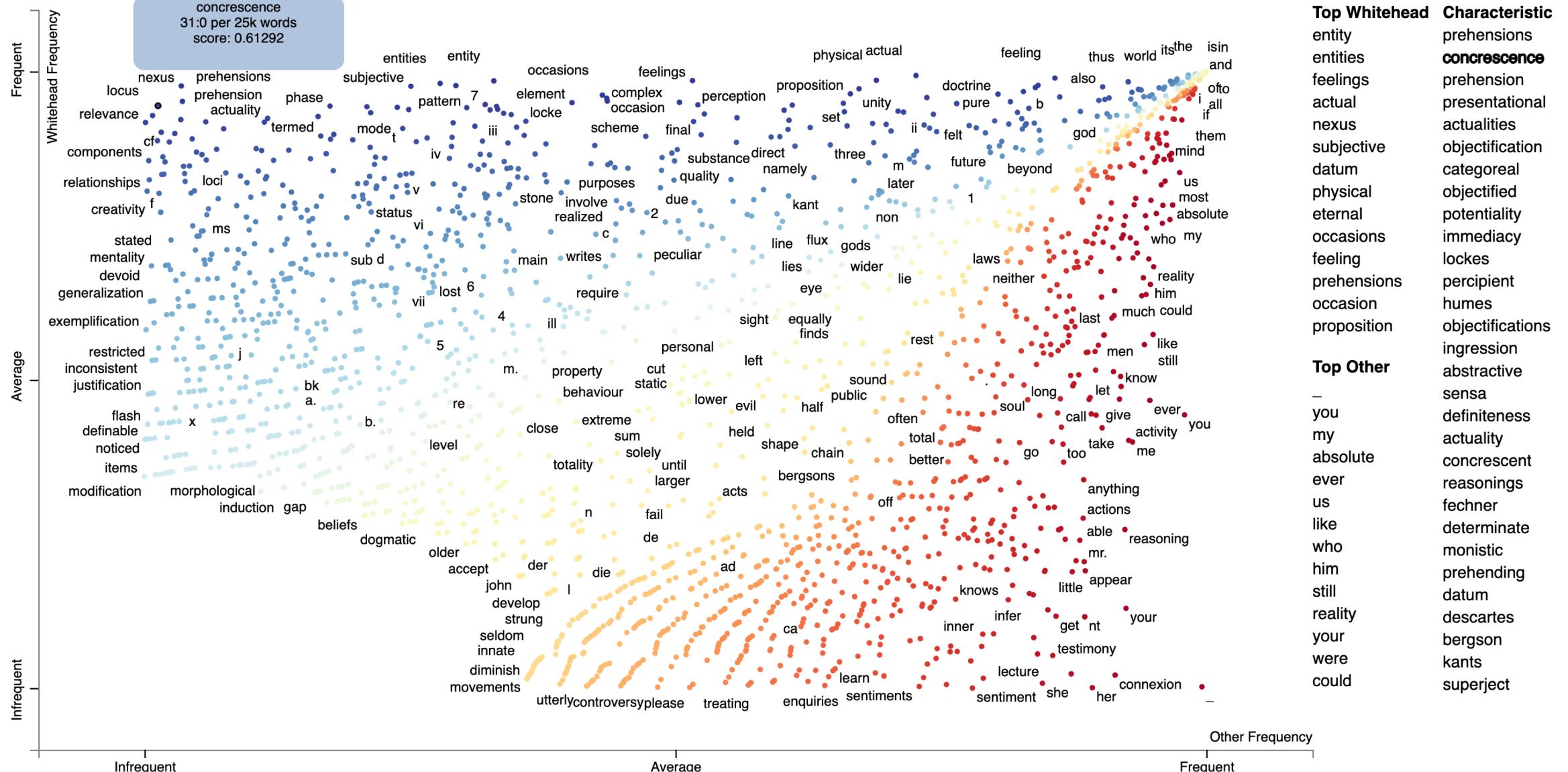
Scattertext of Whitehead vs. Hume and James



Search the chart

Whitehead document count: 1; word count: 157,800
Other document count: 2; word count: 126,615

Scattertext of Whitehead vs. Hume and James



Search the chart

Whitehead document count: 1; word count: 157,800
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Whitehead document count: 1; word count: 157,800
Other document count: 2; word count: 126,615

Term: concrescence

Whitehead frequency:

31 per 25,000 terms

1000 per 1,000 docs

Some of the 177 mentions:

Other frequency:

0 per 25,000 terms

0 per 1,000 docs

Not found in any Other documents.

The coherence, which the system seeks to preserve, is the discovery that the process, or **concrescence**, of any one actual entity involves the other actual entities among its components.

This Category of the Ultimate replaces Aristotles category of primary substance/ Thus the production of novel togetherness is the ultimate notion embodied in the term **concrescence**/ These ultimate notions of production of novelty and of concrete togetherness are inexplicable either in terms of higher universals or in terms of the components participating in the con- 22 The Speculative Scheme crescence.

The analysis of the components abstracts from the **concrescence**.

Thus actual entities are creatures; they are also termed actual occasions/ (ii) That in the becoming of an actual entity, the potential unity of many entities in disjunctive diversity*— actual and non-actual— acquires the real unity of the one actual entity; so that the actual entity is the real **concrescence** of many potentials.

(iv) That the potentiality for being an element in a real **concrescence*** of many entities into one actuality!

is the one general metaphysical character attaching to all entities, actual and non-actual; and that every item in its universe is involved in each **concrescence**.

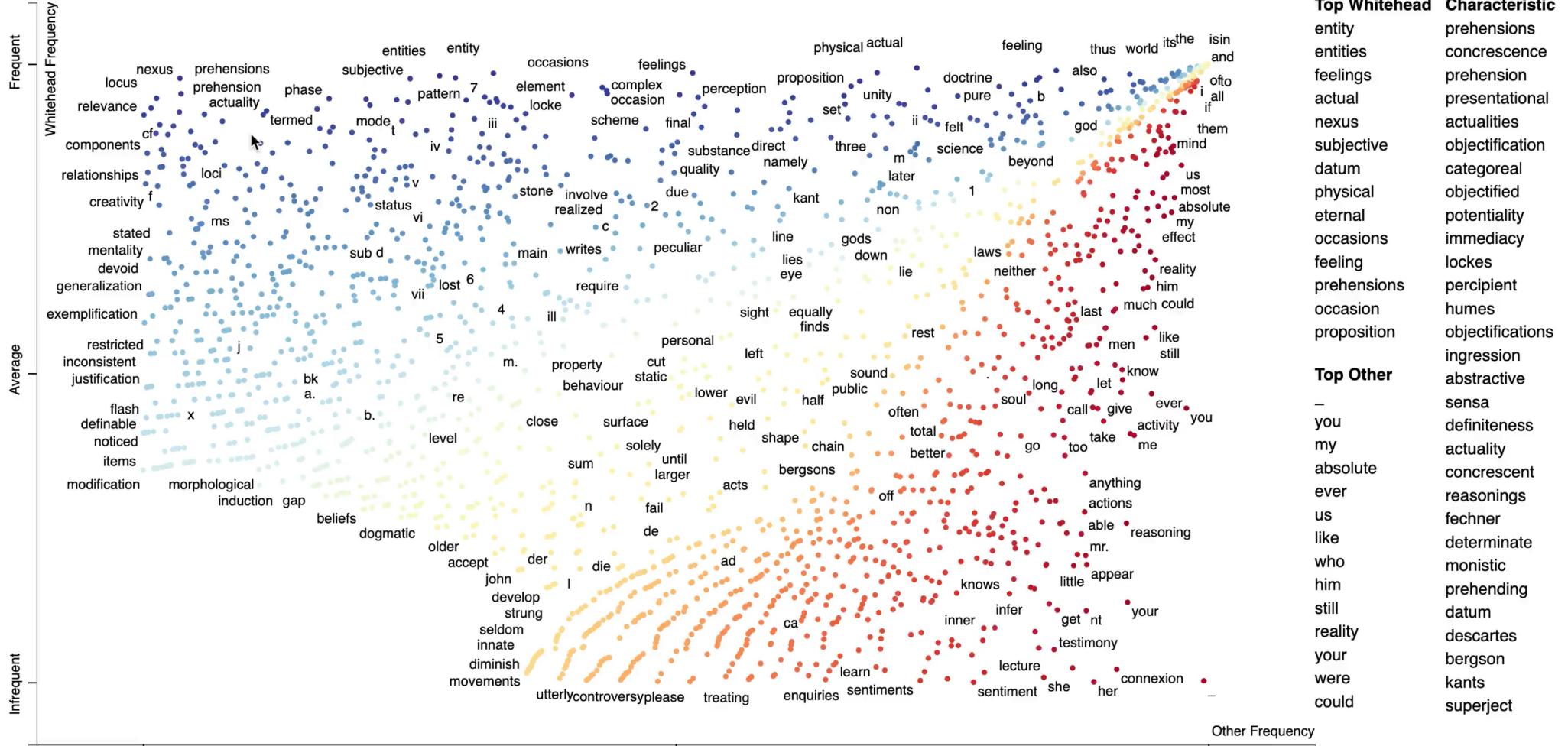
The nexus of actual entities in the universe correlate to a concrescencef is termed the actual world correlate to that **concrescence**.

(vi) That each entity in the universe of a given **concrescence** can, so far as its own nature is concerned, be implicated in that concrescence in one or other of many modes; but in fact it is implicated only in one mode: that the particular mode of implication is only rendered fully determinate by that concrescence, though it is conditioned by the correlate universe.

This indetermination, rendered determinate in the real **concrescence**, is the meaning of potentiality.

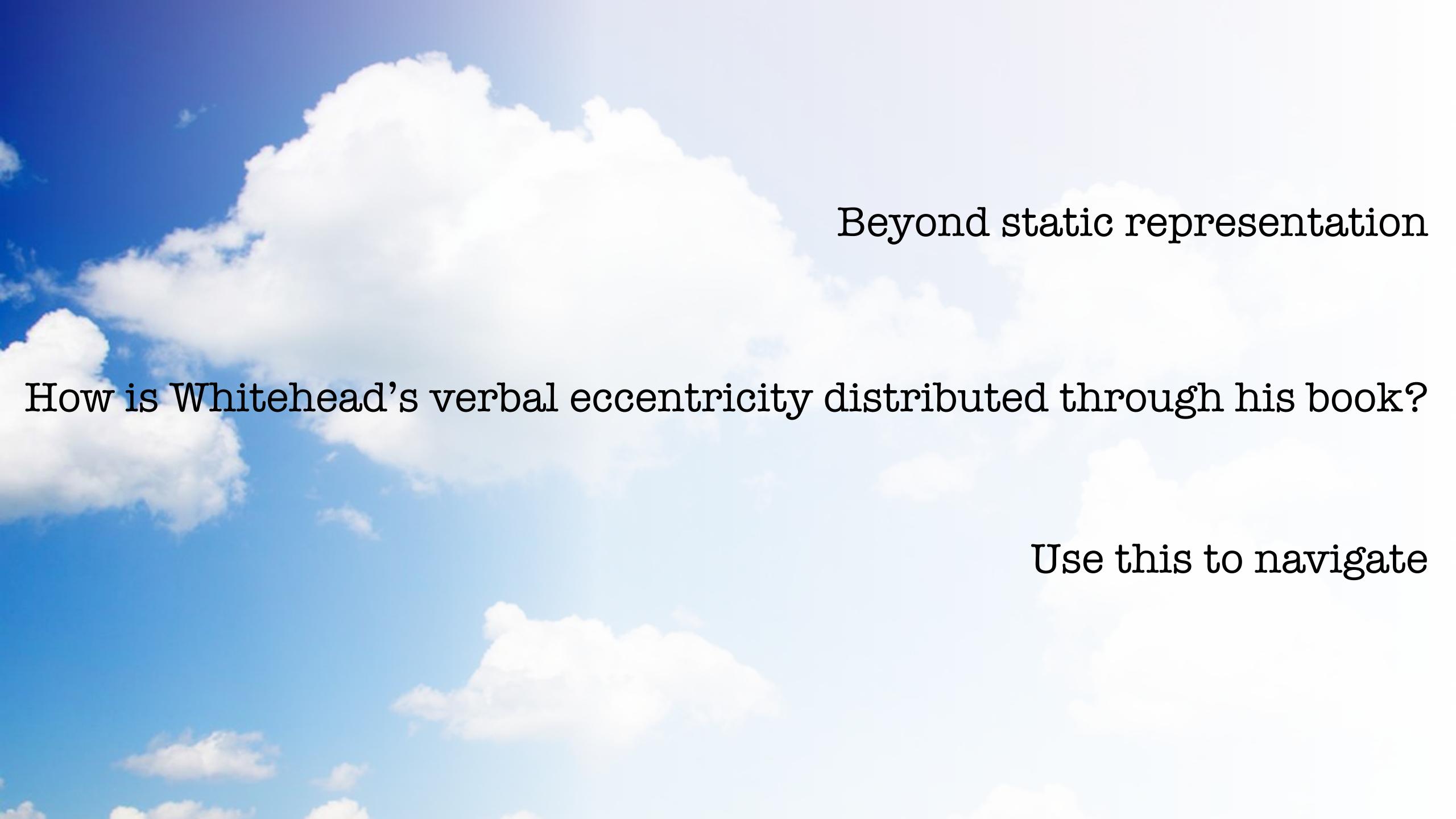
Its being is [35] constituted by its becoming; This is the principle of process/ (x) That the first analysis of an actual entity, into its most concrete elements, discloses it to be a **concrescence** of prehensions, which have originated in its process of becoming.

A negative prehension holds its datum as inoperative in the 24 The Speculative Scheme progressive **concrescence** of prehensions constituting the unity of the subject. (xiii) That there are



Whitehead document count: 1; word count: 157,800

Other document count: 2; word count: 126,615

The background of the slide features a clear blue sky with scattered white clouds of various sizes and shapes.

Beyond static representation

How is Whitehead's verbal eccentricity distributed through his book?

Use this to navigate

TF-IDF

Term Frequency * Inverse Document Frequency

$$\left(\frac{\text{Term Count in document}}{\text{Total Terms in document}} \right) * \log \left(\frac{\text{Total documents} + 1}{\text{Documents containing the term} + 1} \right)$$

TF-IDF

Term Frequency * Inverse Document Frequency

TF

*

IDF

TF-IDF often used for document retrieval.

It's been enhanced with hyperparameters for document length.

But document retrieval is not the present use case.

TF-IDF

Term Frequency * Inverse Document Frequency

$$\text{TF} \quad * \quad \text{IDF}$$

Alpha adjusted TF-IDF

amplifies the effect of rare words when $\alpha > 1$

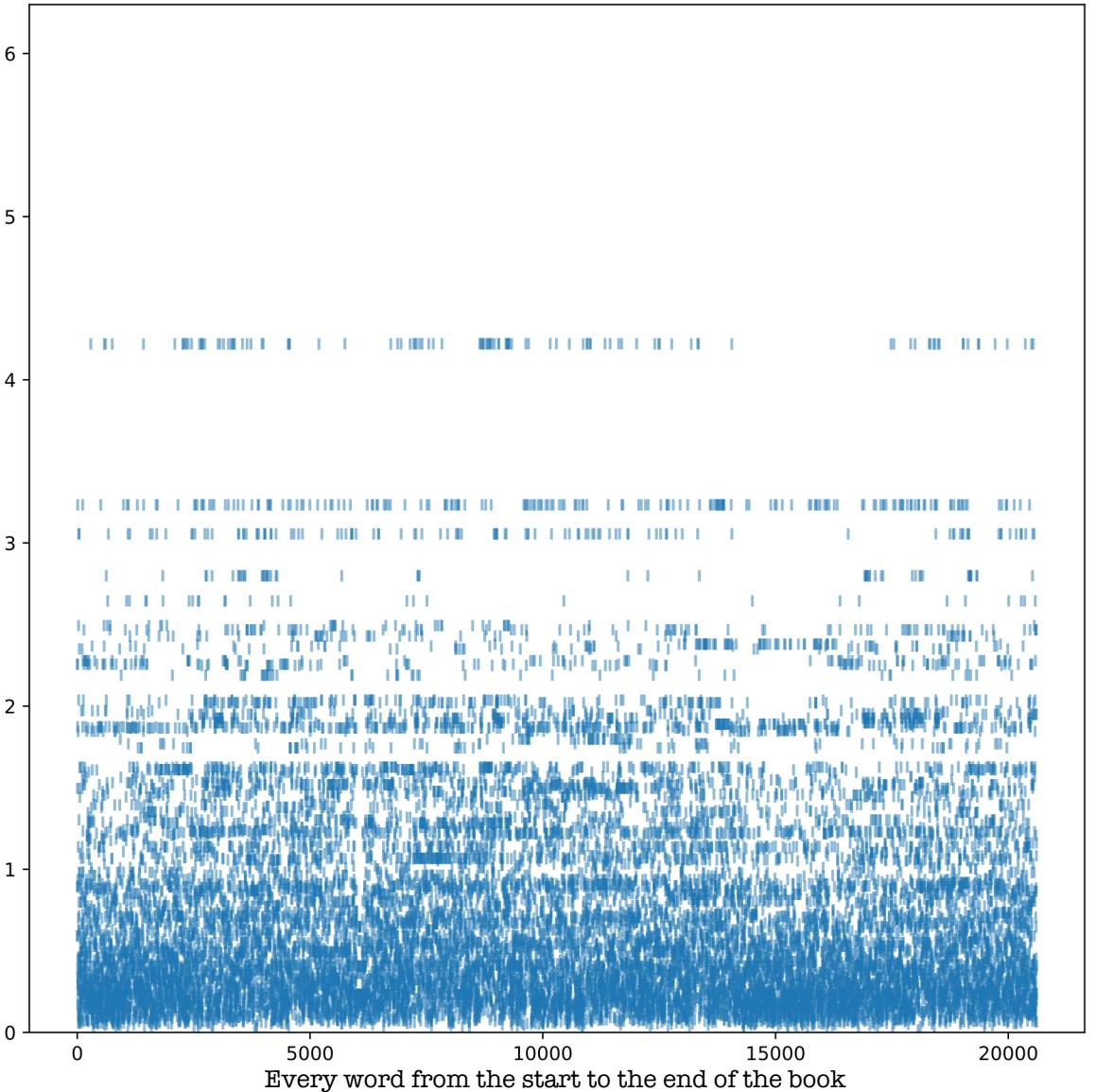
$$\text{TF} * \left(\frac{\text{TF}}{\text{TF}^\alpha} \right) * \text{IDF} * \alpha^{(\text{IDF}-1)}$$

Common words are little affected by α

Hume

Fluctuating verbal eccentricity across Hume's Enquiry Concerning Human Understanding

***alpha adjusted
TF-IDF***



connexion

reasonings

nature

qualities

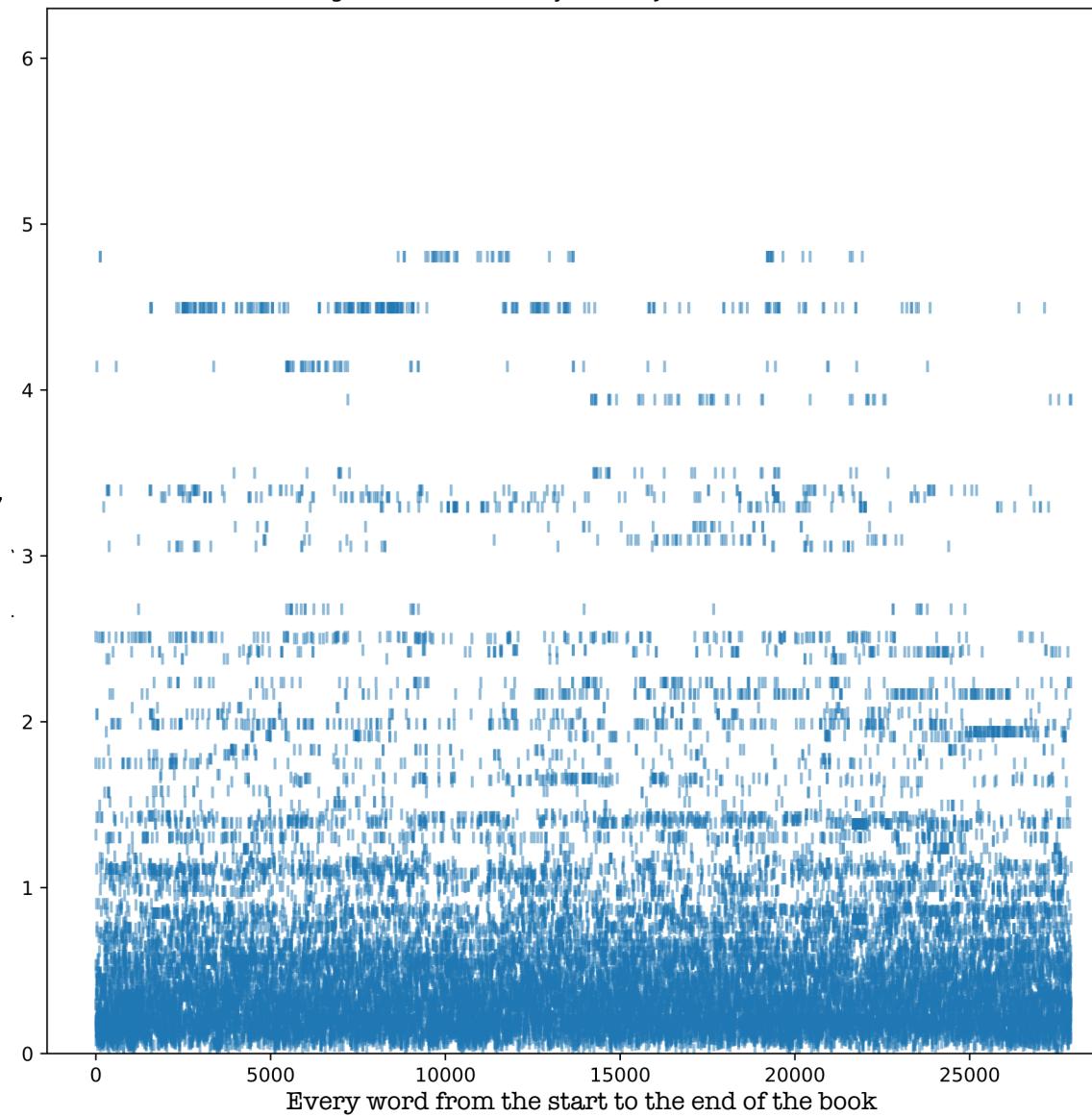
enquiry

connexion	4.221018
reasonings	4.219499
nature	3.233546
objects	3.055582
qualities	2.798734
enquiry	2.644701
sentiment	2.493891
reasoning	2.467368
senses	2.429436
testimony	2.379780
farther	2.367640
philosophers	2.350014
principles	2.278466
philosophy	2.256766
inference	2.249376
sensible	2.189811
object	2.036775
experience	2.020665
sentiments	1.972153
faculties	1.964636
infer	1.954442
concerning	1.949556
cause	1.926071
effect	1.898431
miracle	1.889445
inferences	1.885650
human	1.873031
mind	1.865688
miracles	1.850808
mankind	1.845740
necessity	1.798002
derived	1.769287
principle	1.744044
regard	1.627200
event	1.626139
imagination	1.625687
instances	1.622959

James

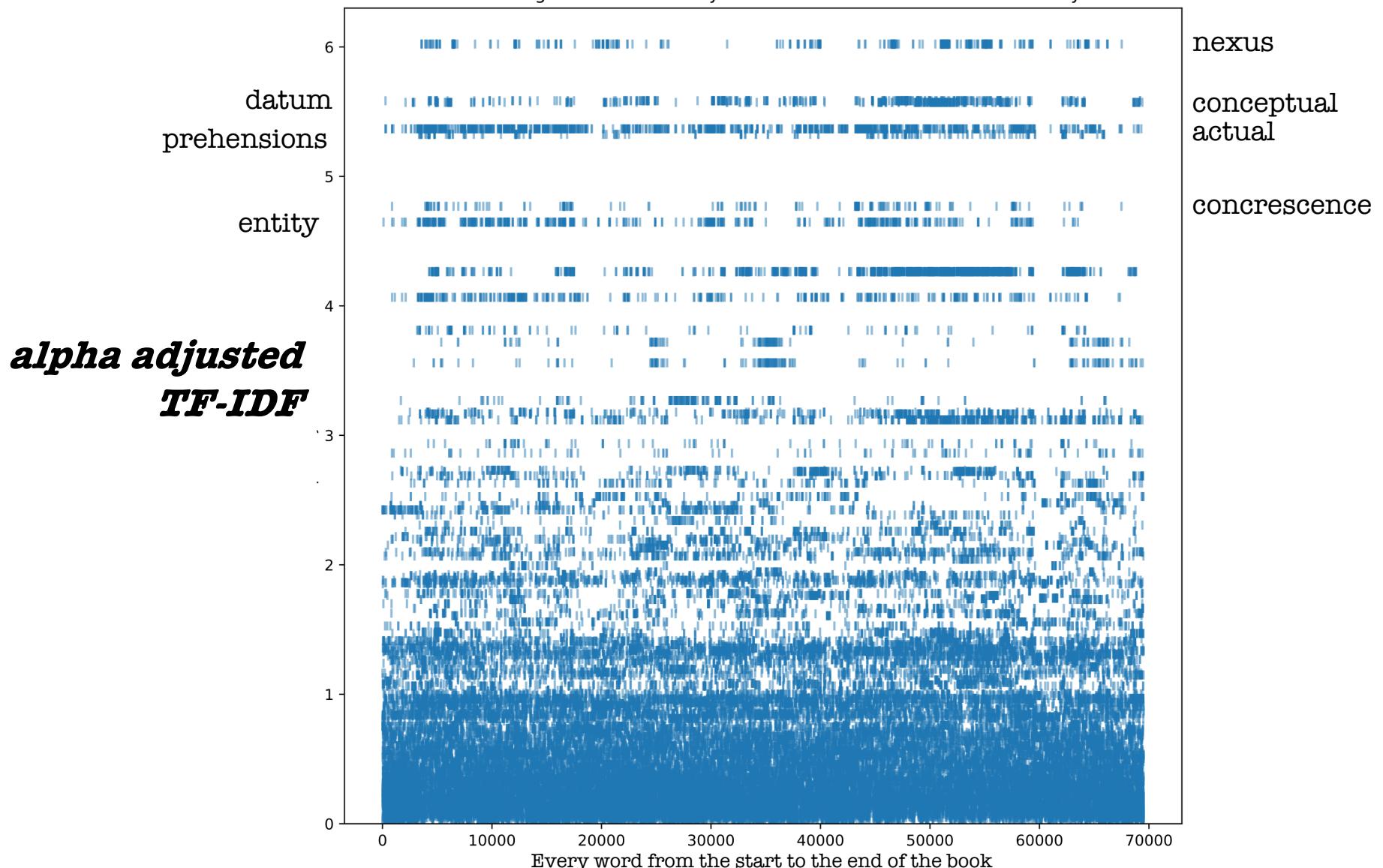
Fluctuating verbal eccentricity across James's Pluralist Universe

***alpha adjusted
TF-IDF***



Whitehead

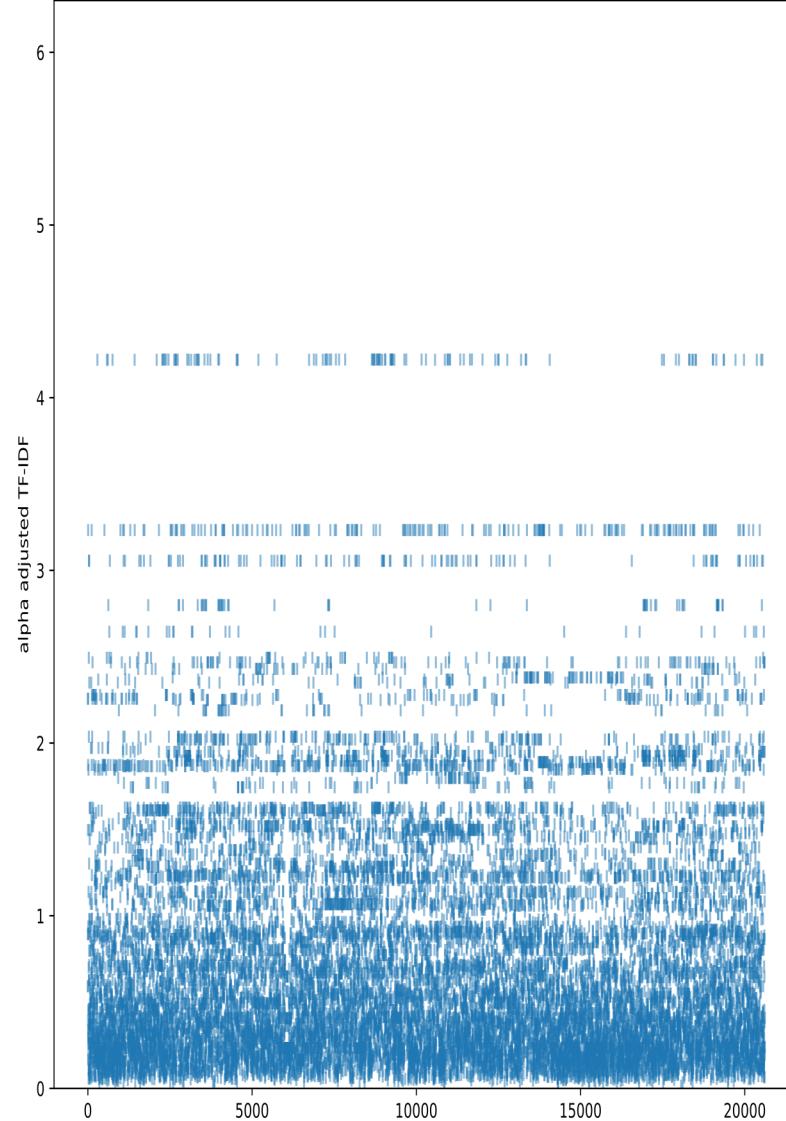
Fluctuating verbal eccentricity across Whitehead's Process and Reality



Comparing ***alpha adjusted TF-IDF*** of all words instances in three philosophical texts

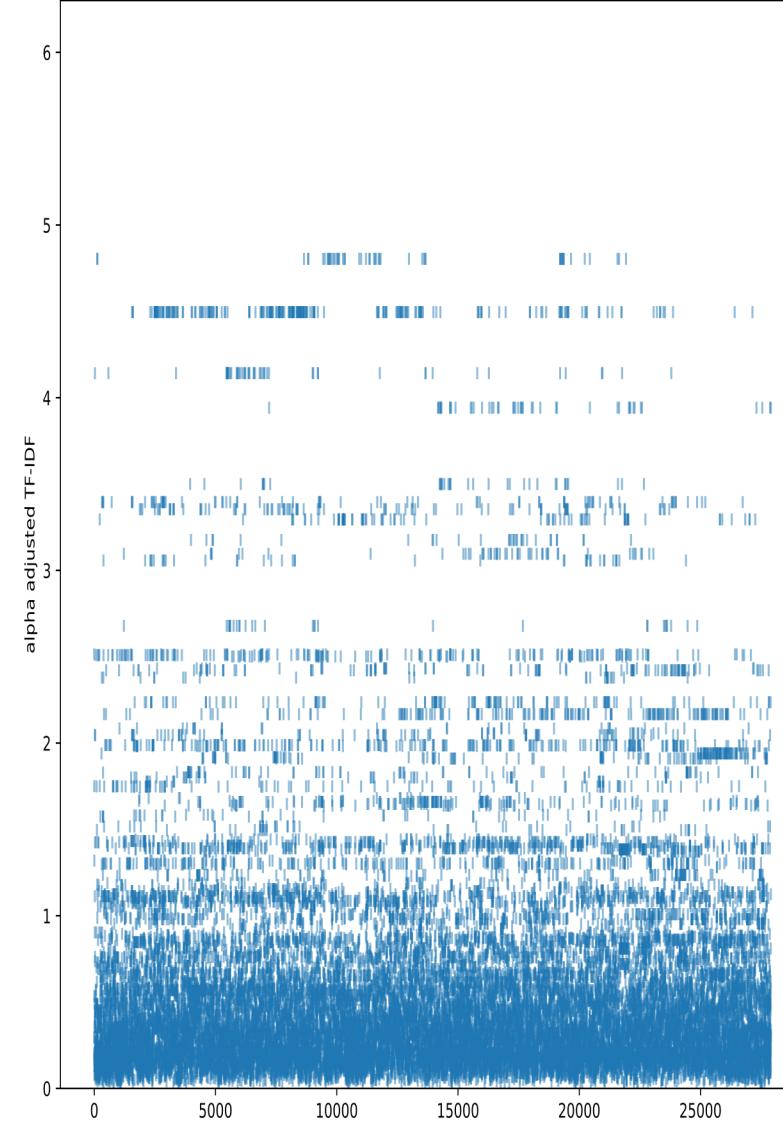
Hume

Fluctuating verbal eccentricity across Hume's Enquiry Concerning Human Understanding



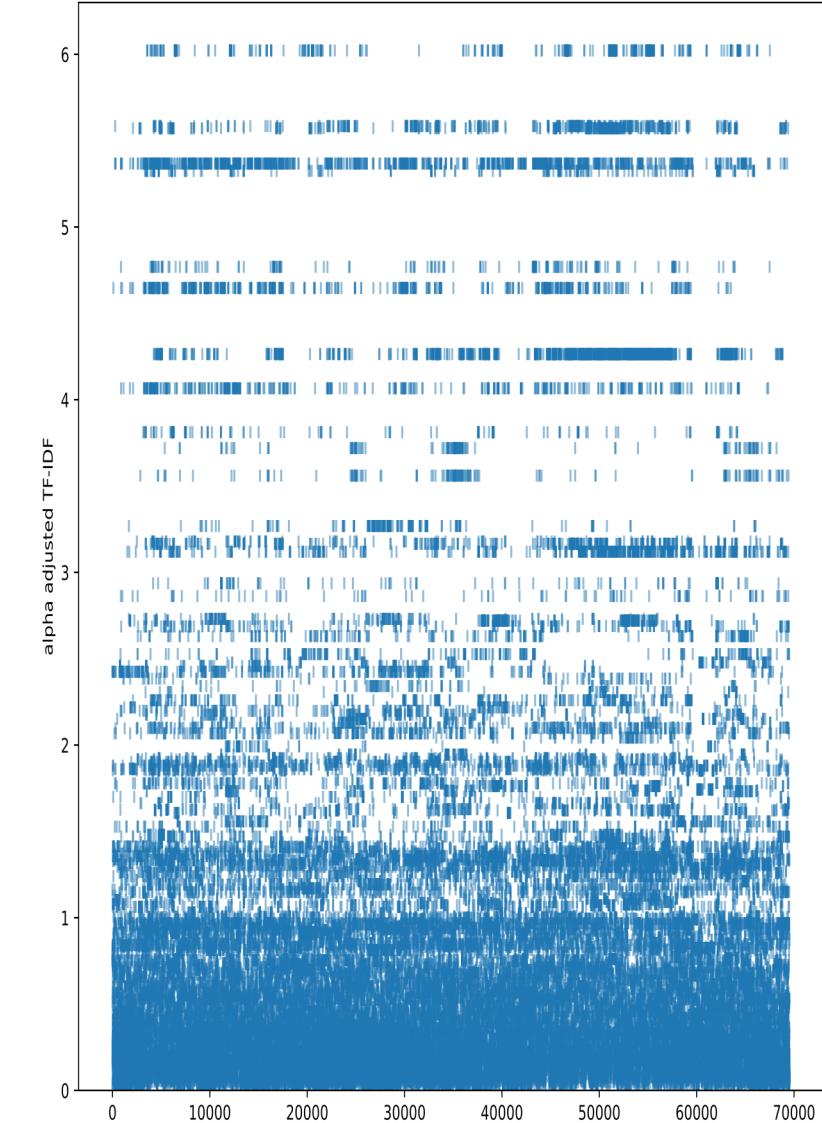
James

Fluctuating verbal eccentricity across James's Pluralist Universe



Whitehead

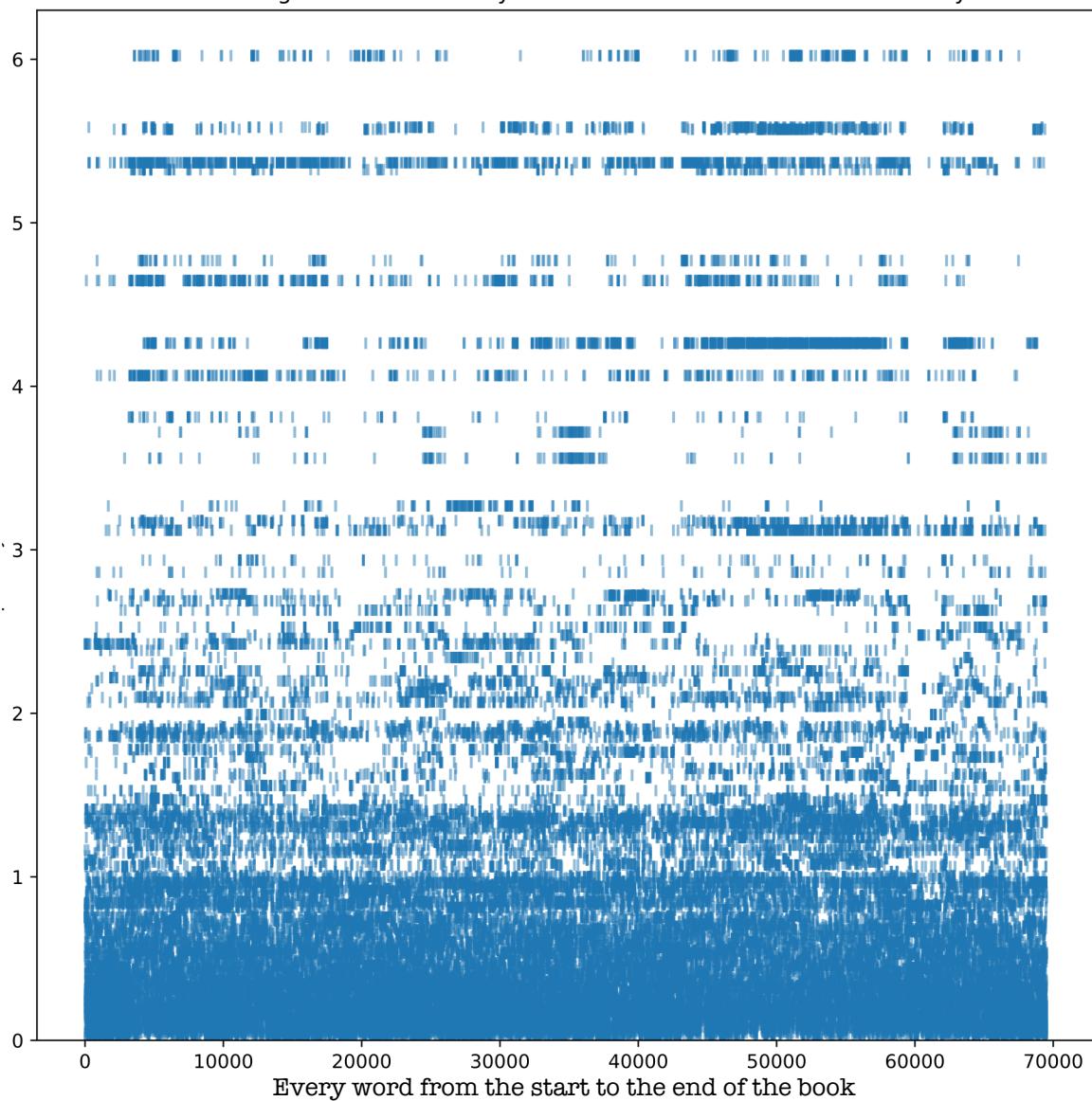
Fluctuating verbal eccentricity across Whitehead's Process and Reality



Whitehead

Fluctuating verbal eccentricity across Whitehead's Process and Reality

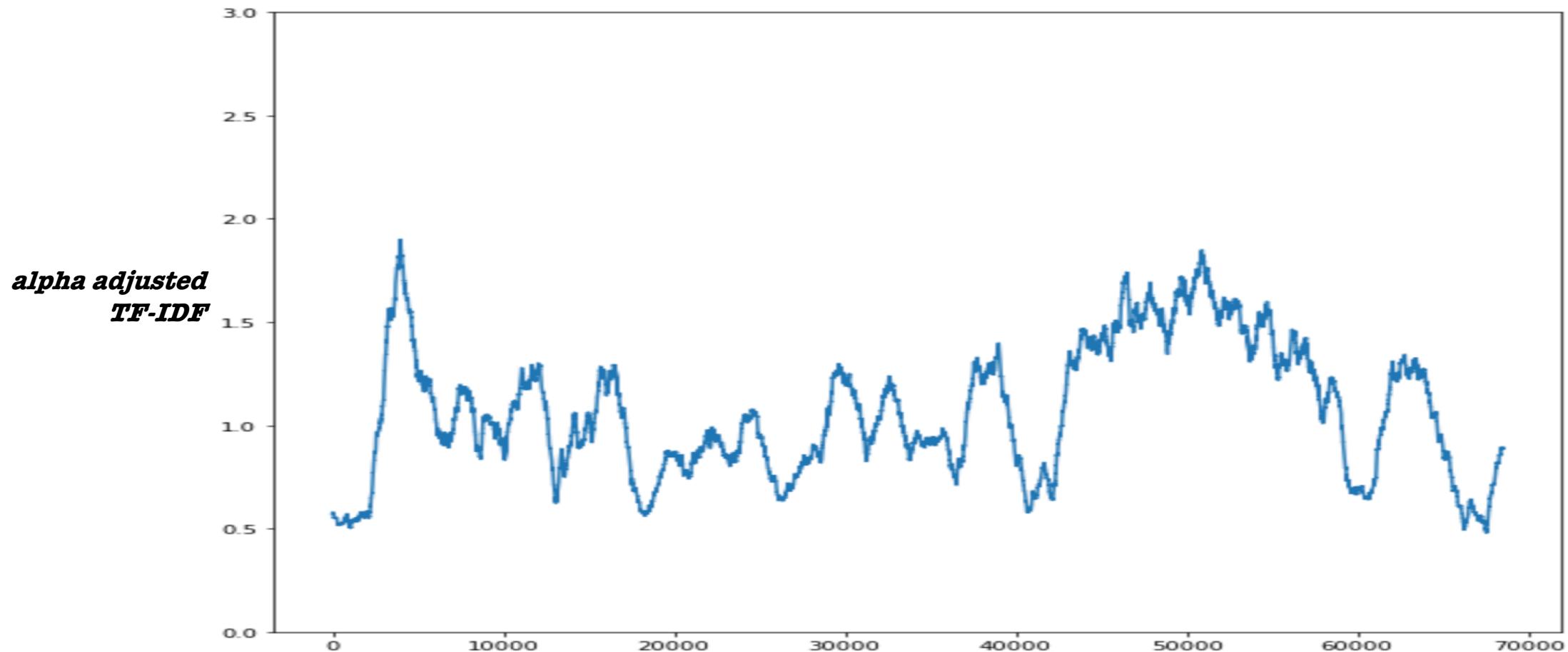
***alpha adjusted
TF-IDF***



nexus	6.022154
datum	5.584408
conceptual	5.571890
actual	5.367737
prehensions	5.324914
concrescence	4.769157
entity	4.646721
feeling	4.264494
feelings	4.263311
entities	4.066136
prehension	3.811648
presentational	3.719660
immediacy	3.560113
hume	3.268694
potentially	3.178895
subjective	3.165532
physical	3.119369
objectification	2.936625
actualities	2.862977
locke	2.730966
proposition	2.720878
objectified	2.689244
actuality	2.686680
occasion	2.630985
occasions	2.526734
geometrical	2.477797
descartes	2.458162
philosophy	2.424313
categorical	2.384607
humes	2.341695
valuation	2.306950
eternal	2.259392
propositions	2.217973

Whitehead

sliding window of 1000 words at a time

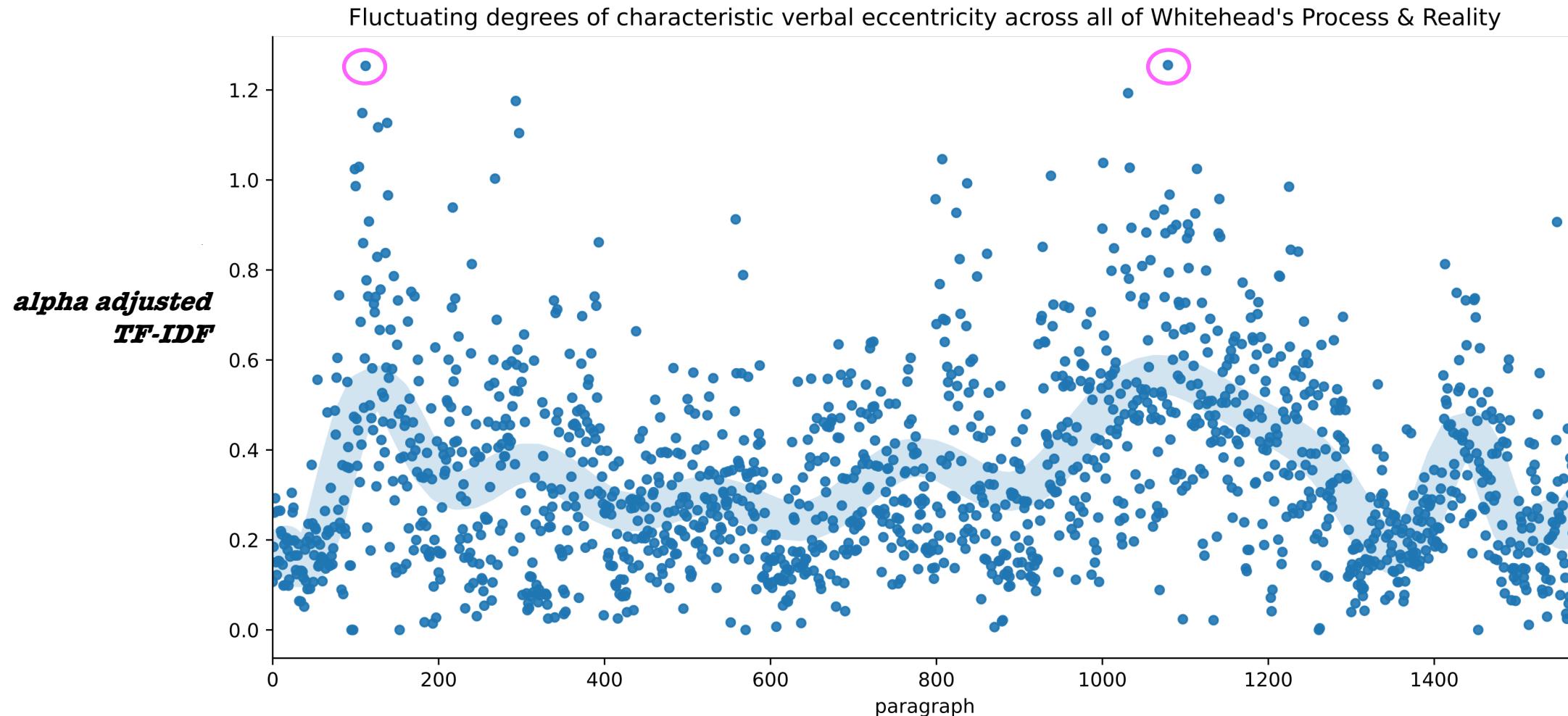


Prehensions of actual entities— i.e., prehensions whose data involve actual entities — are termed 'physical prehensions'; and prehensions of eternal objects are termed 'conceptual prehensions/ Consciousness is not necessarily involved in the subjective forms of either type of prehension.

Whitehead

every paragraph

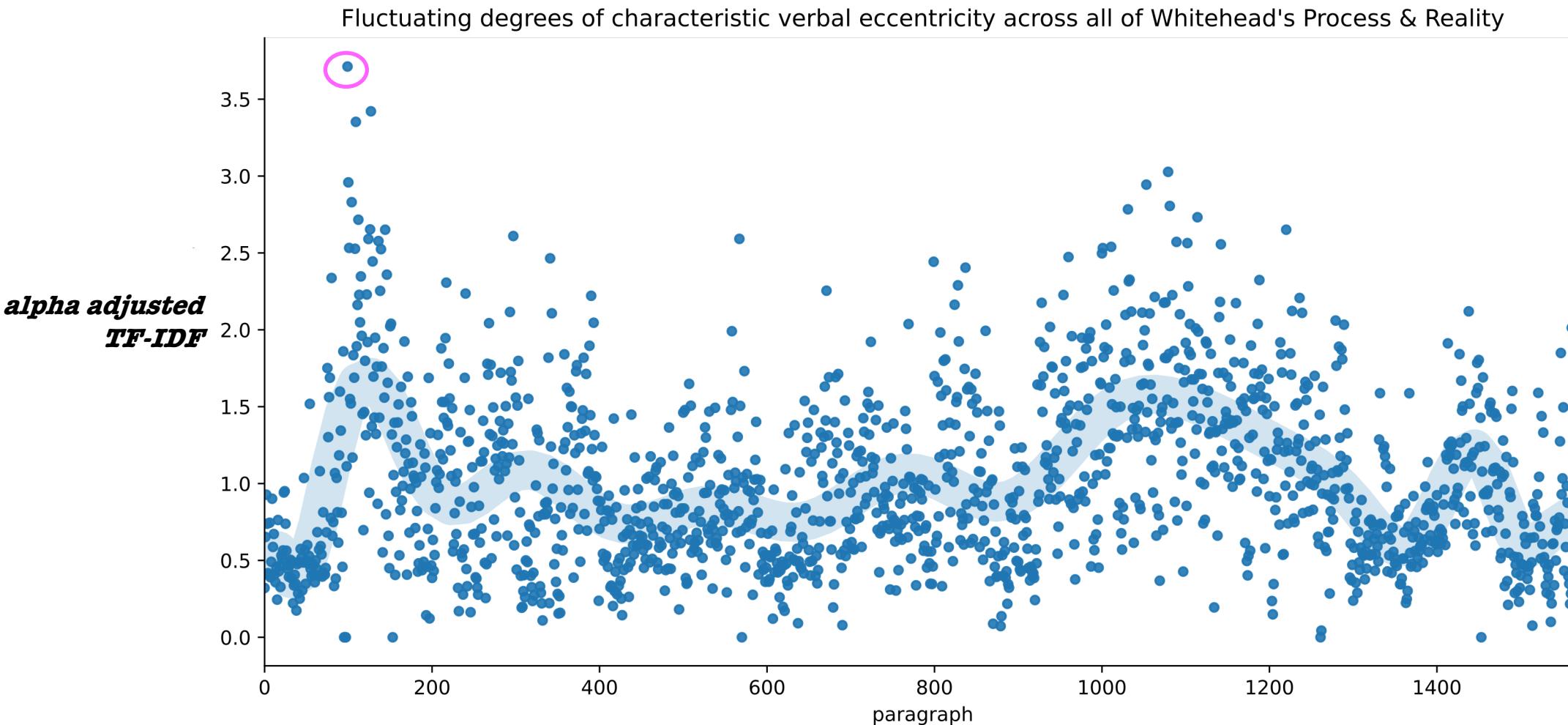
A hybrid physical feeling originates for its subject a conceptual feeling with the same datum as that of the conceptual feeling of the antecedent subject. But the two conceptual feelings in the two subjects respectively may have different subjective forms.



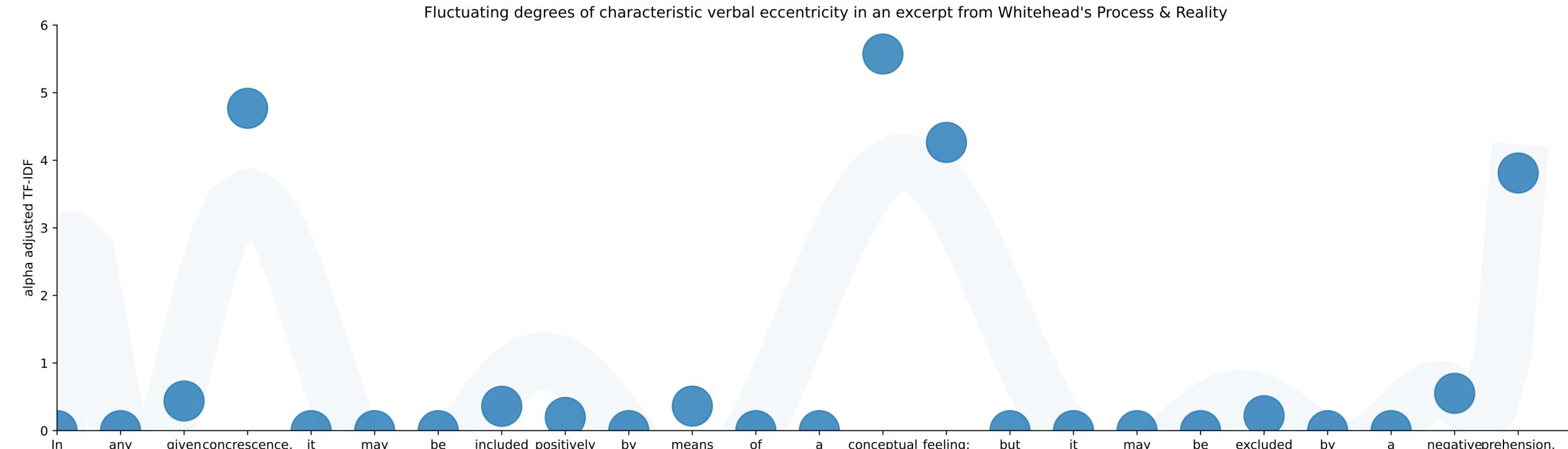
That the actual world is a process, and that the process is the becoming of actual entities. Thus actual entities are creatures; they are also termed 'actual occasions'

Whitehead

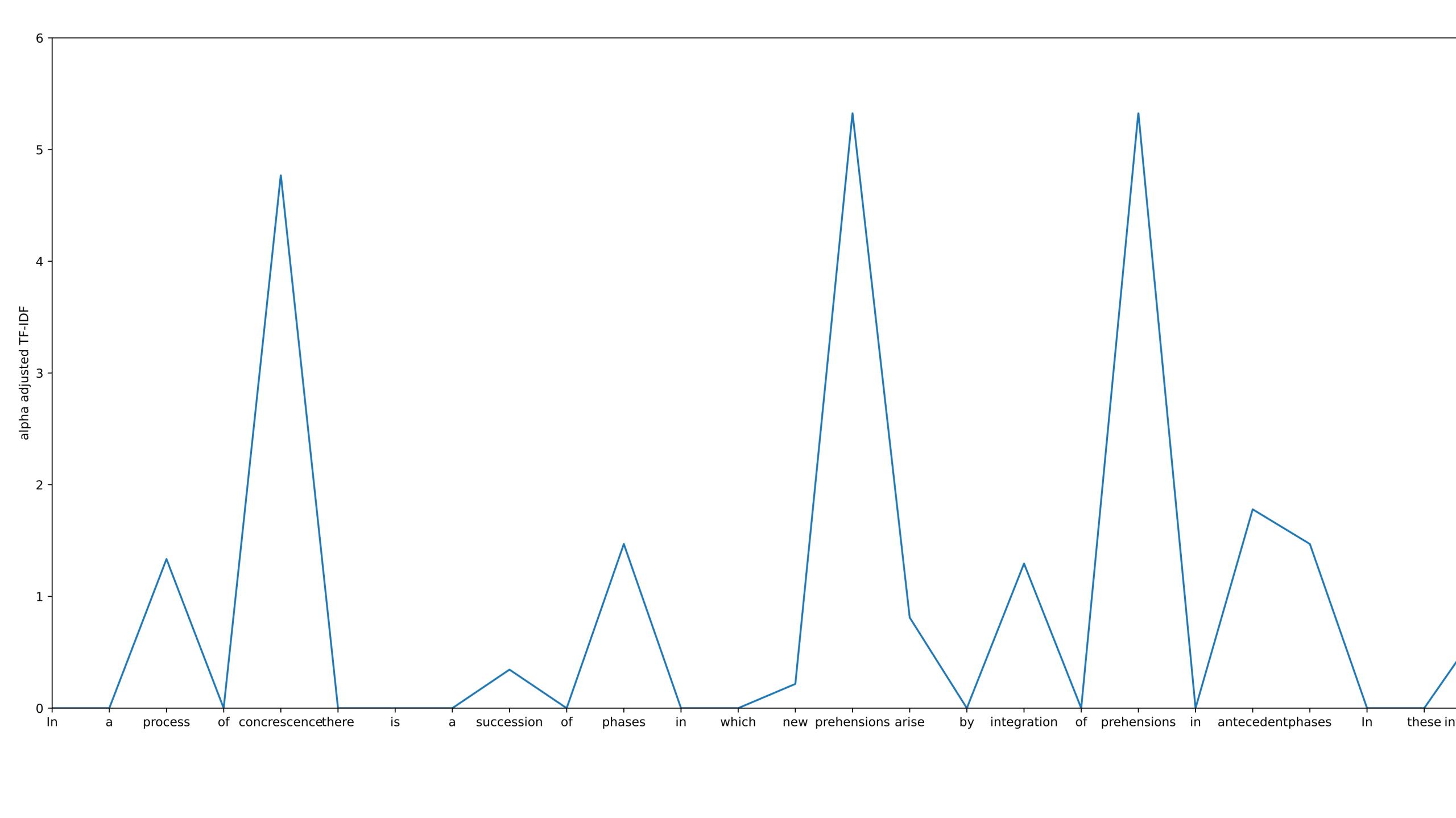
every paragraph
stopwords excluded



Possibilities for guiding inflected speech based on flux of characteristic semantic-verbal eccentricity



scatterplot with a high-degree polynomial regression, just as a visual guide



Applications

Recommender systems:

- Entice book readers and song listeners with book excerpts or song lyric excerpts, based on more specific criteria:
 - Topically consistent passages
 - Self-contained (self-explanatory) passages
 - Verbally unusual, quirky, eccentric, idiosyncratic passages

Automated text-to-speech and algorithmic composition of songs

- Use fluctuating *alpha adjusted TF-IDF* to inflect speech (or melody) based on unusual words prevalent in the document (lyrics)

Education

- New guided approach to navigate difficult, complex, idiosyncratic texts, based on locating (a) topically consistent passages, (b) self-standing (self-explanatory) passages, and (c) idiosyncratic passages.

Further steps

Word2Vec

- Train word2vec separately on each book (each philosopher)
 - Select words important to all (mind, concept, ontology) to compare philosophers
 - Use word2vec *wordmover* to see what words are the same vector move away in each philosophers word vector space
 - Compare the same words in each vector space for different ‘positives’ and ‘negatives’
 - Analyze paragraph-to-paragraph topic-flow in terms of word2vec distance between consecutive paragraphs

CorEx

- Train CorEx separately on each of the book (each philosopher)
 - Select words important to all (mind, concept, ontology) to compare philosophers
 - Use these as *anchor* words and observe the *same* vs. *different* words created in the clustering of words in each book (each philosopher)

More books! More philosophers! More texts of other types!

New ways to read

‘Language on a holiday’

Machine learning applied to philosophical texts

Joshua Banks Mailman

jmailman@alumni.uchicago.edu

Fluctuating verbal eccentricity in an excerpt from Alfred North Whitehead's *Process and Reality*¹

