

Background

The authorship of Hebrews has been a point of contention for scholars for centuries. While the epistle is traditionally attributed to Paul, many other authors have been proposed, including Apollos, Barnabas, Luke, Priscilla, and others. This study conducts a statistical analysis of the original Greek text of Hebrews, comparing it to the writings of Paul and Luke (the only proposed authors with other extant New Testament literature). The Lukan corpus was assumed to consist of Luke and Acts; the Pauline corpus of the thirteen epistles explicitly attributed to Paul. The analysis was conducted using the growing discipline of stylometry (holistic quantitative analysis of authorial style), utilizing the stylo package in R for calculations and production of graphs. Quantitative analysis of the Greek New Testament has been performed previously; however, it has typically been restricted to more naïve techniques such as analysis of plentitude of hapax legomena, use of compound words, or use of specific prepositions. Recently, stylometry has been performed on the Greek New Testament; however, its focus has typically been on authorship of disputed Pauline epistles, rather than taking Pauline authorship of such as a presupposition. Therefore, this study fills a significant gap in the existing research.

Research Questions

1. Does sufficient quantifiable stylistic evidence exist to conclude that Paul or Luke has a significantly higher likelihood of being the author of Hebrews? Though an analysis of this nature cannot make a conclusive determination of authorship, it can provide a probabilistic conclusion based on stylistic similarity.
2. Are any specific words or n-grams tendentially characteristic of Pauline or Lukan style? To what degree (if at all) are these attributes present in Hebrews as well?
3. Are any quantifiable stylistic differences present at all among New Testament authors, or were these lost within the authorial process?

Methods

The Greek texts under consideration were stripped of punctuation, accent marks, and breathing marks, in order to more accurately categorize the tokens appearing in each text. The Johannine corpus was also included as a benchmark point of comparison. The texts were then analyzed on the level of both corpora and individual books through the computation of pairwise Eder's Delta (Δ_e) metrics. This computes a distance analog for vectors of most frequent tokens, measuring how "far apart" two texts are in their word usage. Eder's Delta improves upon other similar distance metrics by reducing the weight of less frequently used words, making its performance superior for highly inflected languages such as Greek. This analysis was performed for words, digrams (sequences of two characters), and trigrams. It was also performed for various numbers (100 – 500) of most frequent tokens, comparing the results across all variables. Rybicki and Eder show ("Deeper Delta") that such analysis is justified even for highly inflected languages, particularly the utilization of n-grams, despite the significantly lower word frequencies arising from inflected word endings.

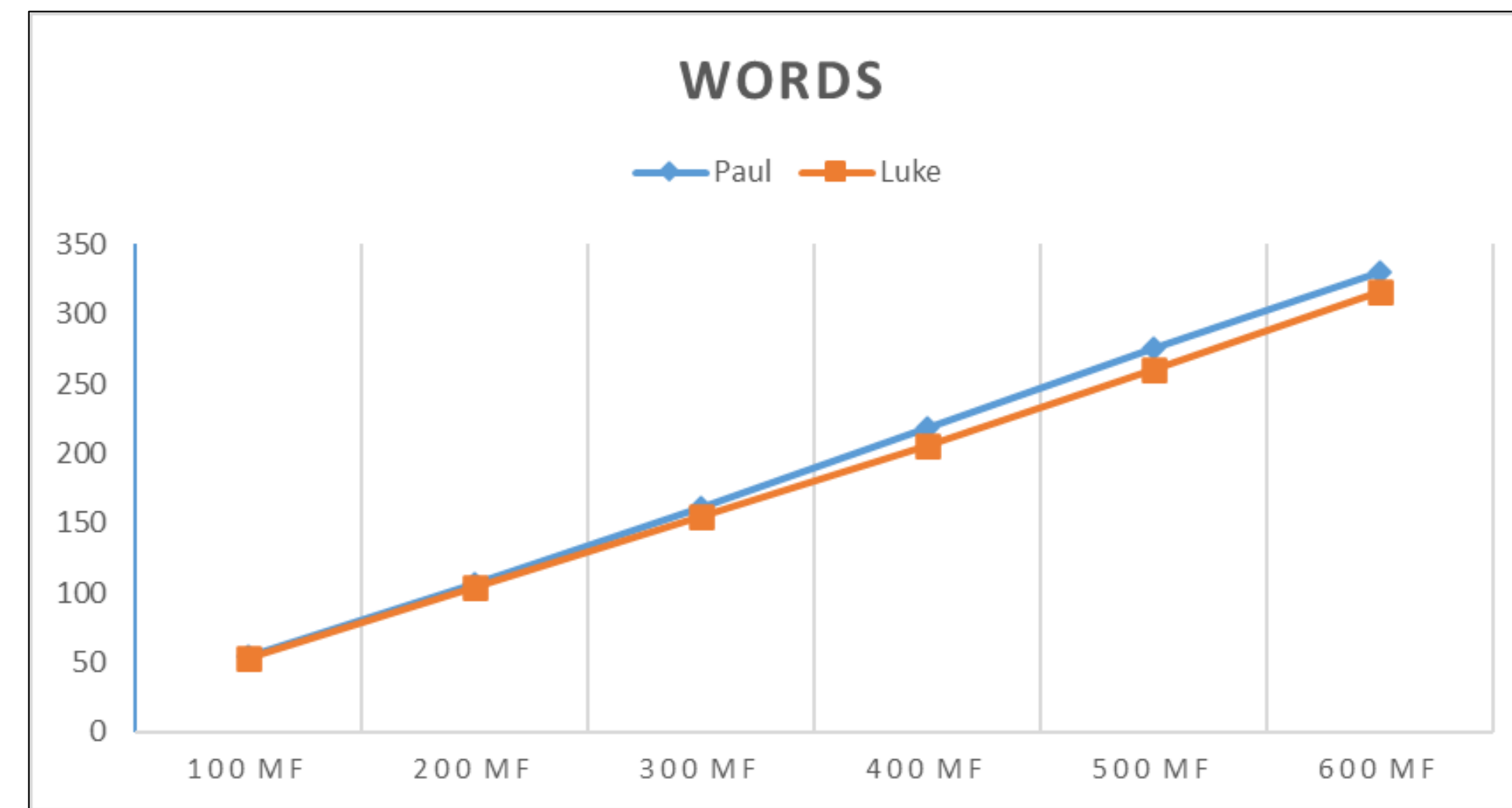


Figure 1: Graphs plotting Eder's Delta (Δ_e) distance for Hebrews vs. Pauline (blue) and Lukan (orange) corpora (lower distance = more similar) for various numbers of words, bigrams, and trigrams. By any metric considered, Hebrews compares very similarly with Pauline and Lukan literature, thus rendering this analysis inconclusive for relative authorial likelihood.

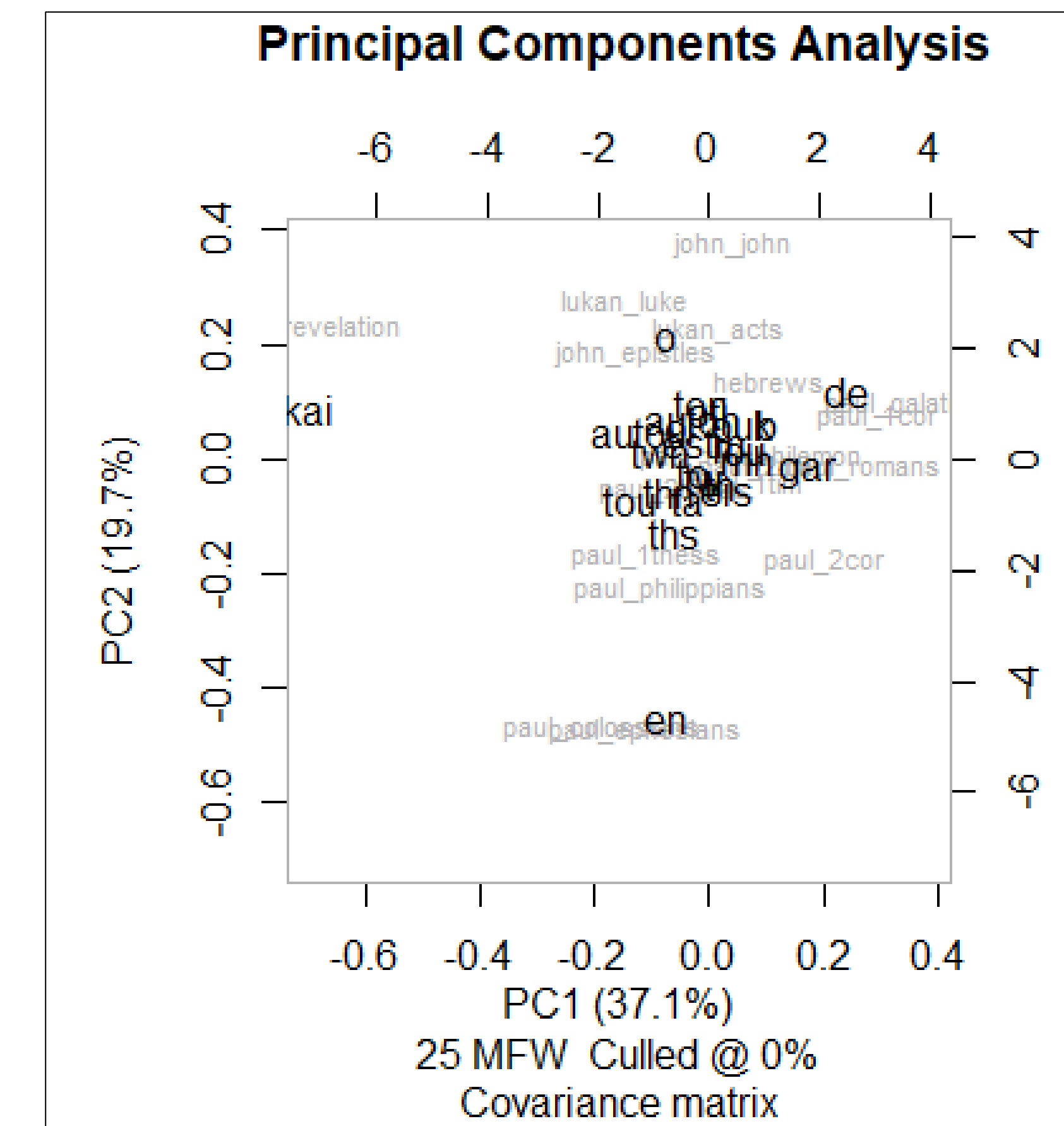
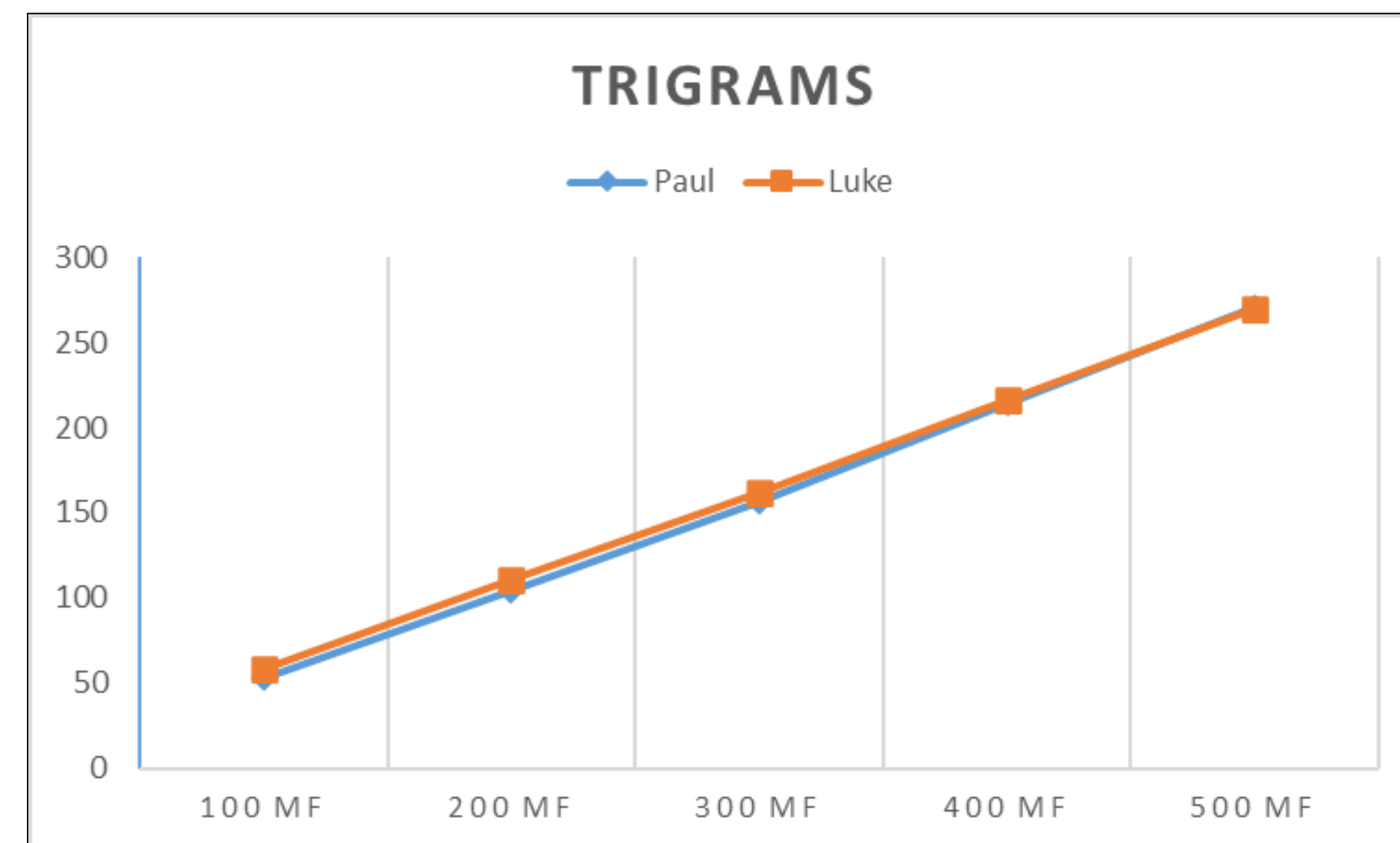
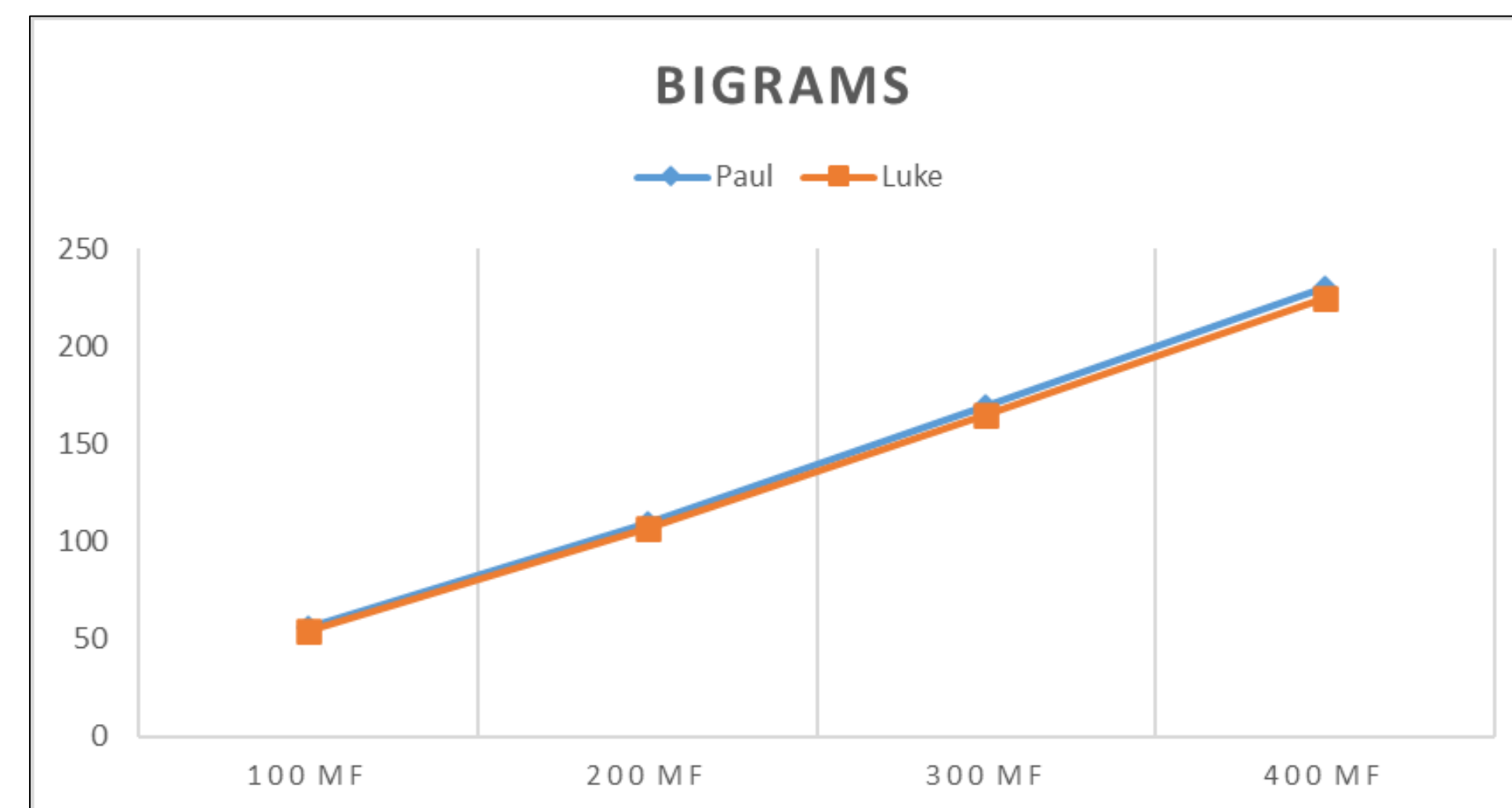


Figure 2: Principal component analysis graph demonstrating Greek words that tendentially characterize each book under consideration. Words are (broadly) closer to books that use them with higher frequency. PCA in general attempts to reduce high-dimensional data to a small and visualizable number of dimensions (here, 2).

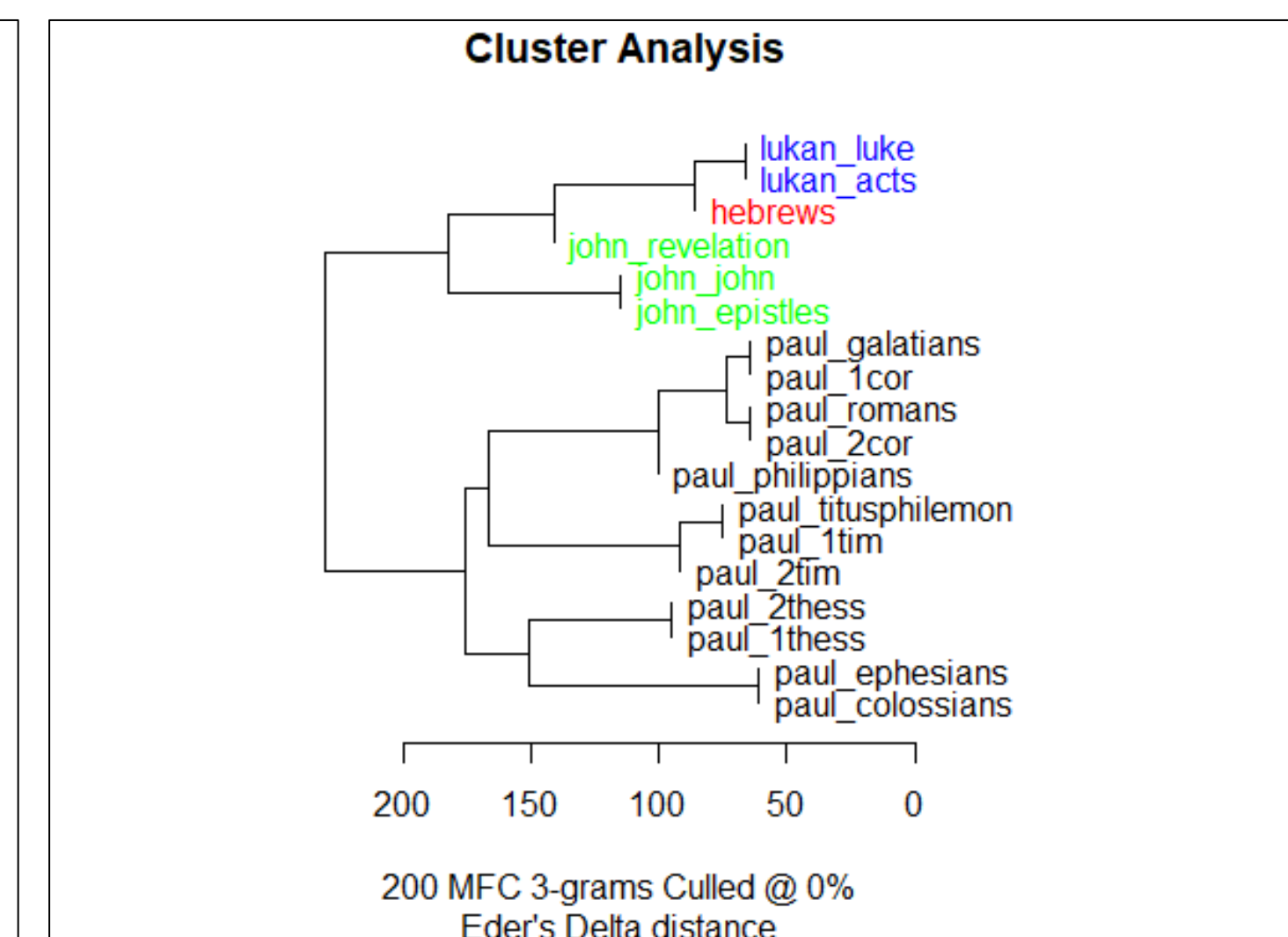
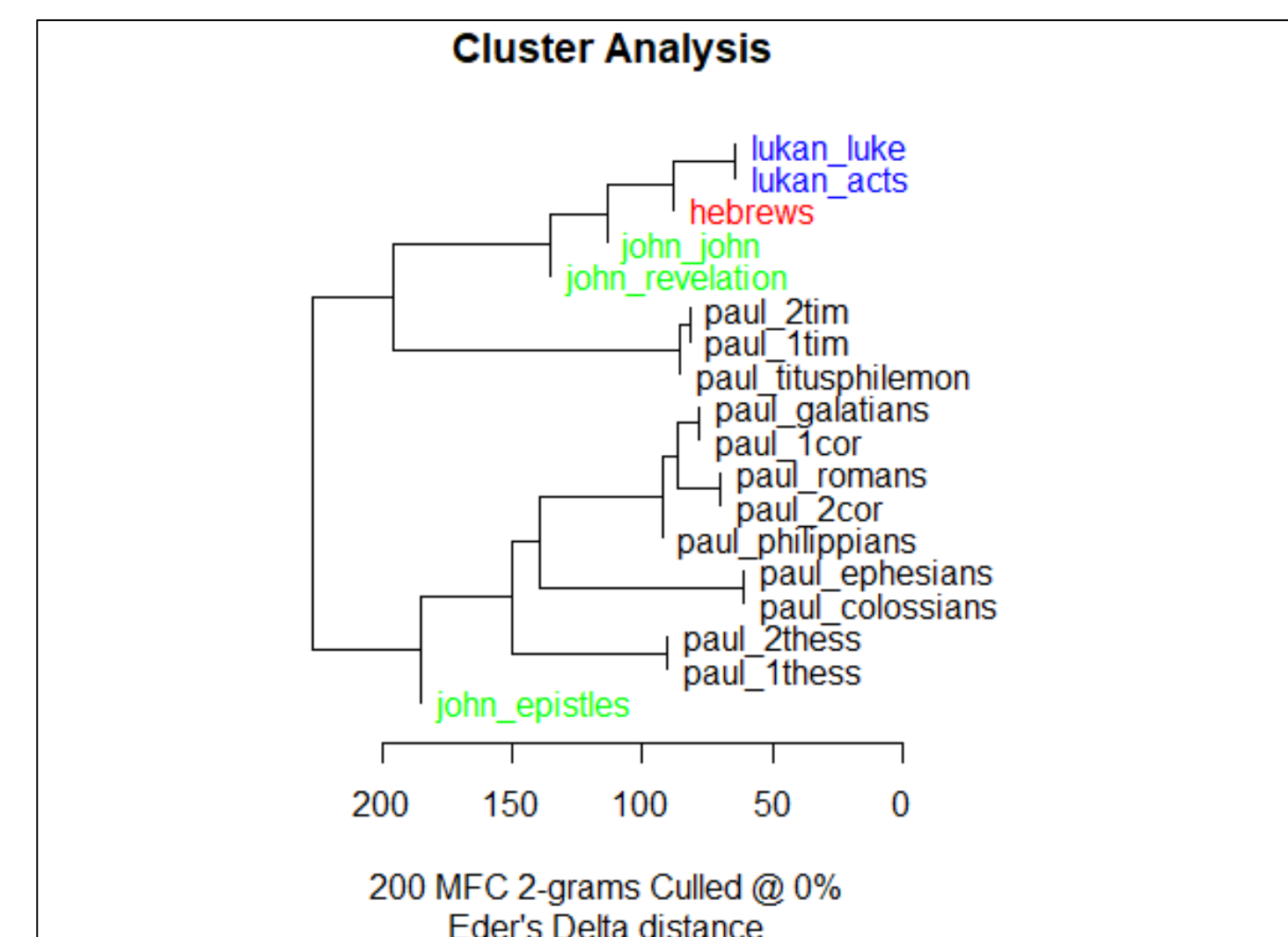
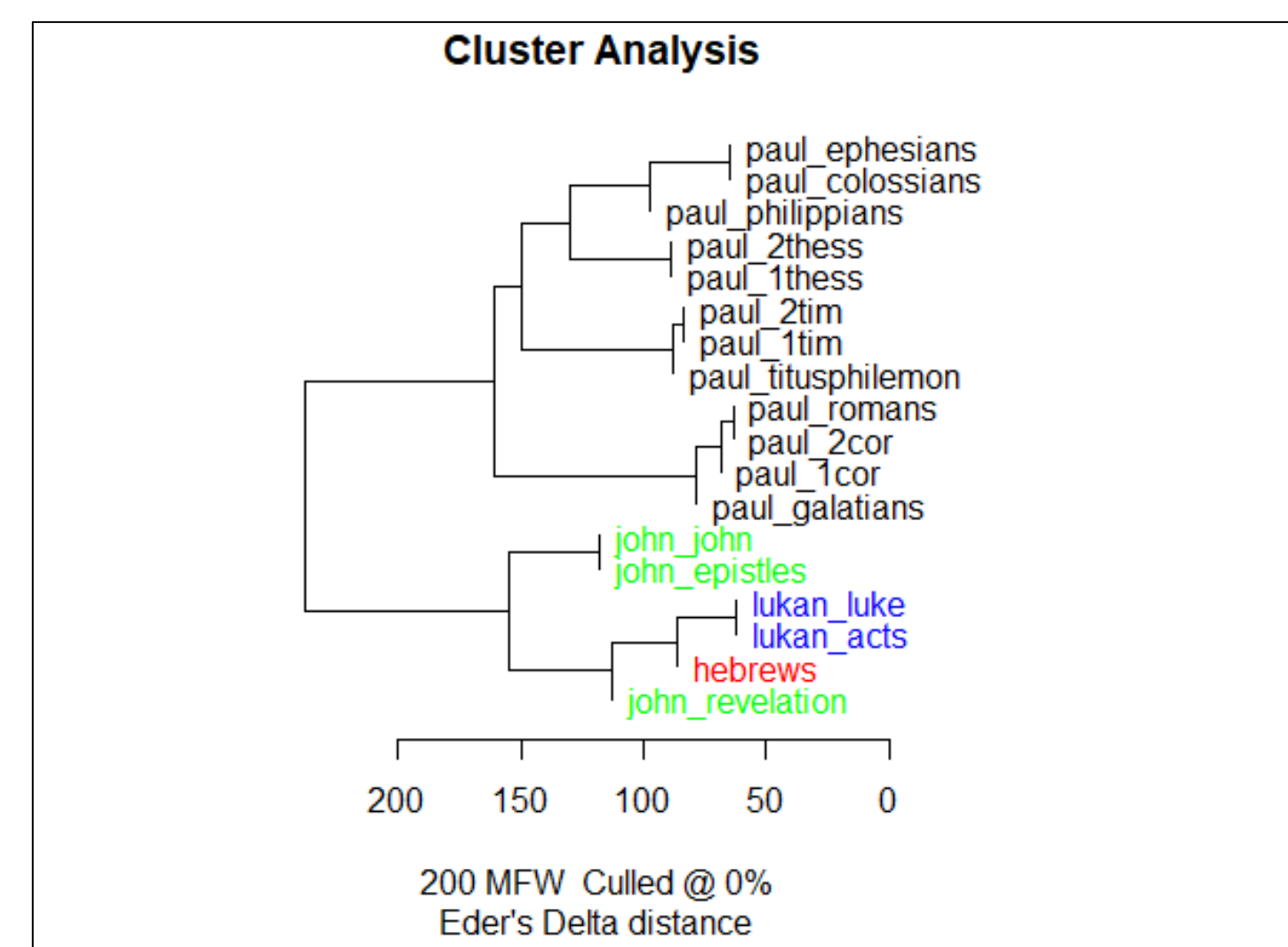


Figure 3: Cluster analysis performed on all individual books under consideration. The graphs were produced by analysis of (from left to right) the 200 most frequent words, bigrams (2-letter sequences), and trigrams (3-letter sequences) in the corpus. Hebrews is categorized adjacent to Lukan literature in all three cases. Cluster analysis in general attempts to group data into similarity clusters based on a distance metric (here, Eder's Delta).

Results

Overall, the style of Hebrews is quantitatively more similar to Lukan literature than to Pauline. However, in answer to research question 1, the difference is minimal and varies across metrics utilized. Figure 3 demonstrates that cluster analysis typically classifies Hebrews with Lukan literature. However, Figure 1 demonstrates the low magnitude of difference (and therefore the statistical inconclusiveness of the study) across all metrics.

In answer to research question 3, clear stratification of biblical authors by style does in fact take place, as clearly demonstrated in the cluster analysis graphs (Figure 1). With very few exceptions, cluster analysis correctly groups literature in the same authorial corpus.

The principal component analysis graphs in Figure 3 demonstrate some measure of the word choice variation that characterizes individual authors, in response to research question 2. For example, the word $\epsilon\nu$ is used with higher frequency in Colossians and Ephesians, while $\kappa\alpha\iota$ is more characteristic of Revelation than any other book.

Ultimately, this study is inconclusive because it does not give a clear probabilistic advantage to either Paul or Luke as the author of Hebrews. Contrary to the claims of some, Hebrews is not significantly more similar to either Pauline or Lukan literature, at least from a stylometric perspective.

Future Work

1. Investigate possible stylistic variations or transformations over the course of Paul's life.
2. Investigate possible stylistic variations between Jews and Gentiles who authored New Testament books.
3. Investigate other comparative stylistic characteristics of Hebrews, such as sentence length or frequency of specific grammatical constructions.
4. Investigate if the stylistic variations between Paul, Luke, and Hebrews reflected in the GNT are retained in English translations.

References

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