The Process of Imitatio Through Stylometric Analysis: the Case of Terence's Eunuchus

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Abstract

The Early Modern Era is at the forefront of a widespread enthusiasm for Latin works: texts from classical antiquity are given new life, widely re-printed, studied and even repeatedly staged, in the case of dramas, throughout Europe. Also, new Latin comedies are again written in quantities never seen before (at least 10,000 works published 1500 to 1800 are known). The authors themselves, within the game of literary imitation (the process of *imitatio*), start to mimic the style of ancient authors, and Terence's dramas in particular were considered the prime sources of reuse for many decades. Via a case study "the reception of Terence's *Eunuchus* in Early Modern literature", we take a deep dive into the mechanisms of literary imitation. Our analysis is based on four comedy corpora in Latin, Italian, French and English, spanning roughly 3 centuries (1400-1700). To assess the problem of language shift and multi-language inter-corpora analysis, we base our experiments on translations of the *Eunuchus*, one for each sub-corpus. Through the use of tools drawn from the field of Stylometry, we address the topic of text reuse and textual similarities between Terence's text and Early-Modern corpora to get a better grasp on the internal fluctuations of the imitation game between Early Modern and Classical authors.

Keywords

Neo-Latin, text reuse, Neo-Latin, textual similarity, computational literary studies, stylometry

1. Introduction

In the last few decades, Stylometry has been used to track authorial signals and stylistic similarities between authors with great effectiveness ([9] and [11]). Stylometric tools can be a useful means to help clarify issues of style, relationship and network construction, and it has become a paramount methodology in the field of Computational Literary Studies and Stylistics. While eminently a distant reading environment, it can account for general and specific features of correlation and possible connection between sets of corpora, often with high precision results (cf. [23, 32]). Literary scholars can therefore be presented with new perspectives and definitive evidence; as stated by [25] on the usefulness of Stylometry in literary studies: "literary interpretations can be focused, with computational precision, on the relevant passages. In us-

CHR 2022: Computational Humanities Research Conference, December 12 – 14, 2022, Antwerp, Belgium
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ing such methods, [...] [Stylometry] uses computer-assisted criticism to shed new light on a pre-existing concern". Our paper gives an account of the precise spots where the two drama corpora (Terence and Early Modern comedies) overlap and where Terence's features are most prominent in relation to each textual turning point. The primary scope of our paper is thus to demonstrate the interference of Terence's most renowned piece, the *Eunuchus*, in Early Modern drama writing, by analysing the fluctuations in preference and similarity that different authors might display. Our aim is to account for this deep and complex imitation game between Early Modern and classical authors from a distant reading point of view. Through the use of stylometric methodologies applied to a case study, we set the base ground for a wider inquiry into the intricate phenomena behind the choice of classical models and how these operate in the background of modern writing. Our main contribution is a methodology: gathering of a suitable corpus, analysing the texts and building a stable network of interconnected plays. This new set of correlated analyses on similarity and dissimilarity between corpora can in turn be then replicated on wider cases.

The remainder of this paper is structured as follows. Section 2 gives a brief overview of the related research. Section 3 presents the data and the process of structuring our corpus. Section 4 sketches our experimental setup. Section 5 gives a detailed analysis of the results and a discussion on a literary history level. Section 6 concludes the paper with an overview on future work.

2. Related Work

Our processing line builds on very stable and already frequented ground. Stylometric tools of different origin and applications have been gaining popularity since the work of Burrows, Holmes, and Craig in the early '90s [4, 16, 7]. For a comprehensive overview of the set of tools offered by Stylometry, the main references are [23] and [12] (which offer a complete rundown of the usage of the main R library for stylometry, *stylo*).

A number of stylometric studies has been devoted to tasks such as authorship attribution and detection (cf. [5, 17, 20, 27, 22, 8]): which is different from our goal, but can serve as a layout for a more general analysis on style and similarities between authors, and, when needed, we point out the differences in approach and scope throughout our paper.

More akin to our topic is that of style variation analysis and stylistic similarities (cf. [32] for an overview): [25, 6, 30] apply stylometric analysis tools to the study of contemporary (19th-20th century) authors' style, while [9, 14, 26] take different perspective on text reuse for ancient historical languages, also implementing network analysis through Stylometry.

The core statistics and algorithms we use in this paper are Burrows' Delta and Sequential Stylometric Analysis (SSA), being already known for their efficiency in the field of stylistic analysis. For an in-depth overview of Burrows' Delta and, in general, Delta analysis for textual similarity tasks, see [18, 3, 1], while for a more hands-on application of Burrows' Delta in a literary case study we suggest [24]. As for Sequential Stylometric Analysis (SSA), [10] is paramount, while for a more in-depth explanation of the usage of the NSC (Nearest Shrunken Centroids) algorithm in SSA, see [22, 30, 29, 28].

3. Data and Corpus Construction

We collected a corpus of 85 comedy pieces from the DraCor Project[1] database (English, French, and Italian) and the Translatin repository (Latin).[2] The original classical Latin text of the *Eunuchus* is taken from the LASLA corpus.[3]

The corpus statistics are shown in Table 1

Table 1
Corpus statistics for the different language corpora in terms of number of texts, period covered and number of tokens.

Language	# of Texts	# Tokens	Time span
Latin	15	160,741	1510-1639
French	34	456,493	1634-1668
Italian	21	409,000	1496-1761
English	15	250,646	1592-1611
Total	85	1,276,879	1496-1761

As is visible from the time spans, the covered period varies, but it fits the general boundaries of the Modern Era (roughly: early 15th - late 18th centuries). A practical reason for this diversified selection is due to the selection offered by DraCor and in literary history: the two most famous Italian comedy writers of the Modern Era, Ariosto and Goldoni, are set apart by 2 centuries, while the vast majority of the most important drama writers of France's Modern Era (Molière, Racine, Corneille) are found in the middle of the 17th century. For English, DraCor only possessed the complete Shakespeare corpus, from which we selected 15 comedies. Finally, we added a random selection of Neo-Latin works from a wide variety of authors, nationalities and years of production, drawn from our project repository, automatically cleaned and manually checked from a previous OCR process.[4]

For this whole experiment, we wanted the translations to be in the background and cause as little noise as possible to keep the focus on the original work by Terence. The translations were thus gathered according to the following criteria:

1. As close as possible (time-wise) to the period span of its related sub-corpus;
2. Freely available and downloadable;
3. A philological translation, as close as possible (style-wise) to the original from Terence.

The first and third criteria helped make up for the linguistic and stylistic divide. If contemporary translations had been taken into consideration, the experiment would have been invalidated from the start, the language of those translations being too distant from their relative Modern Era counterparts. The third point poses another subtle but important aspect: the translation must be "philological", thus as close as possible to the unadulterated original. This rules

[1] https://dracor.org/ Last visited: 29 August 2022
[2] https://www.translatin.nl
[3] https://www.lasla.uliege.be/cms/c_8508894/fr/lasla Last visited: 29 August 2022
[4] The whole corpus, together with the parameter specifications for the Stylo code, can be found in our GitHub repository: https://github.com/AndrewPeverells/The-Imitation-Game

out, for example, an "artistic" translation of Terence's works by Nicolò Machiavelli, supposedly of very little rigorousness as far as adherence to the original was concerned.[5] Spelling variants were unified with a layer of pre-processing from the CLTK/NLTK pipeline.[6]

The translations meeting all criteria at the time of our experiment are:

- FRENCH - H. Clouard, 1937
- ITALIAN - L. Perelli, 1869
- ENGLISH - G. Colman, 1768

The Italian and French translations, while rather late, are still sufficiently suitable, as French altered very little from the end of the 17th century, while Perelli's translation of 1869 still falls roughly under the same pre-unified contemporary Italian.

4. Experiments

In this section, we given an overview of our experiments. We start with a preliminary exploration of our dataset using a clustering algorithm to identify general groupings within our corpus. Then we analyse our texts in their sequential development, with the aim of identifying overlaps and distances between our modern drama sub-corpus and their relative translations of the *Eunuchus*, to accurately identify modern authorial fingerprints and takeovers against Terence's piece, throughout the succession of acts and scenes of the original.

4.1. Experimental Setup

As a pre-processing step, we divided our corpus into two distinct sets: the primary set (test set), composed of the 81 modern texts, subdivided into four language corpora; and the secondary set (training or reference set), composed of the four versions of the *Eunuchus*, again subdivided per language. The training or reference set is the relevant Eunuchus translation, or the "known" text, against which our test is to be conducted to identify authorial signals and similarities. For the first experiment, the clustering analysis, this subdivision is irrelevant, since we need to distribute all the texts together into different clusters, and we need the Eunuchus to be evident in our clusters. The general parameters that were kept for both sets of experiments are the following, based on our previous experiment [26]:

- To overcome issues related with an arbitrary selection of MFWs (Most Frequent Words), we ran several trials on every setting from 100 to 1500 MFWs.[7]. We found 300 MFWs to be the most suitable for our experiment, as the texts are not too long (they rarely exceed 15,000 words) and we noticed that, over this number, the clustering began to gradually merge every branch together. This was already observed in our recent experiment [26] and is confirmed by [18]. This somewhat low parameter of 300 MFWs makes the set of words on which our analysis is conducted almost entirely comprised of function words

[5] Cf. the article on Terence from the Italian Enciclopedia Machiavelliana
[6] NLTK, and CLTK Last visited: 22 August 2022
[7] A practice already well-established in the field of Stylometry: [11]

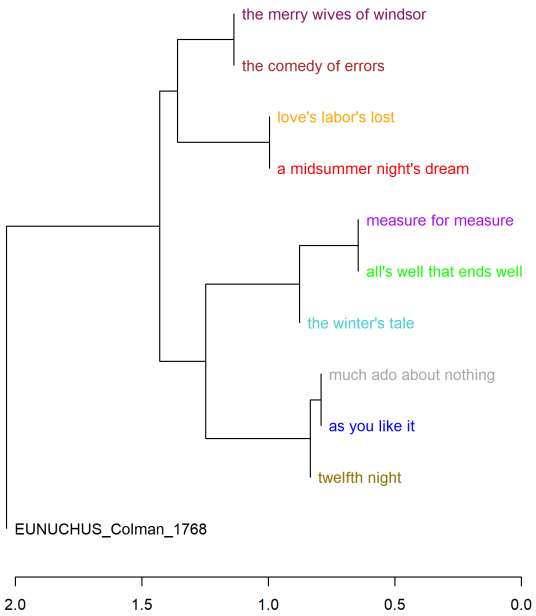

Figure 1: Cluster analysis of the English sub-corpus, Classic Delta distance, 300 Most Frequent Words. Plays are clustered together in branches based on their similarity, with ancestors reuniting them at the root. The score on the x-axis at the bottom indicates the level of Delta (distance) between branches, the lower this score (and the shorter the distance between the texts) the more similar the plays are between themselves.

and a handful of high-frequency semantically meaningful words, mainly related to the dramatic language (e.g. for English "lord, father, lady, pray, brother, true", or for Latin "quaeso, mehercle, dico, amor, senex");

- Contractions were not removed;
- No filtering of the function words was introduced, thus keeping the texts as they appear originally. Interjections and personal pronouns especially were not removed on purpose, as they are a vital part of the dramatic language;
- Maximum culling was set to 20%, meaning that a word needs to appear in at least 20% of the text, to eliminate some background noise.

4.2. Clustering

The first experiment set is a cluster analysis produced via a Delta algorithm. The selected delta measure is Burrows [3], which is widely used for stylistic analysis as a reliable similarity measure between two candidates (cf. [33]). Burrows' Delta is also confirmed to be better suited for shorter-vector corpora [26, 21]. Although Cosine measures are confirmed to outscore others, it is repeatedly stated that it depends on many factors, such as corpus selection, choice of MFWs, type of language and length of vectors [21, 13]. As we are looking for evidence that Cosine measures outscore other traditional measures even in shorter-vector literary texts (10,000-15,000 words) with a lower selection of MFWs for tasks other than authorship attribution, we decided

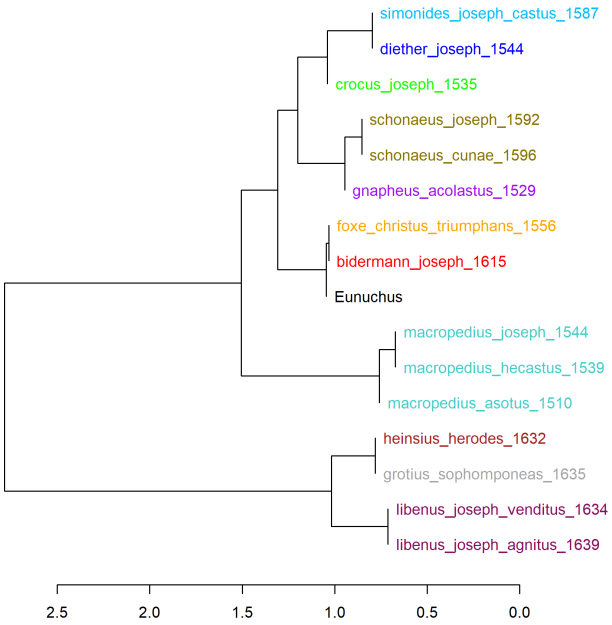

Figure 2: Cluster analysis of the Latin sub-corpus, Classic Delta distance, 300 Most Frequent Words. Plays are clustered together in branches based on their similarity, with ancestors reuniting them at the root. The score on the x-axis at the bottom indicates the level of Delta (distance) between branches, the lower this score (and the shorter the distance between the texts) the more similar the plays are between themselves.

to use Burrows' Classic Delta. Burrows' Delta is calculated as the geometric distance between "two standard-deviation-normalised mean word frequencies" [1]. In summary, "Delta may be viewed as an axis-weighted form of 'nearest neighbor' classification, where a test document is classified the same as the known document at the smallest 'distance'" [1].

A simplified formula of Burrows's Delta, which enriches Burrows's original by taking into account standard deviations between word frequencies, is given in Equation 1:

$$\Delta_B^{(n)}(D, D') = \sum_{i=1}^{n} \frac{1}{\sigma_i} |f_i(D) - f_i(D')| \tag{1}$$

Where n is the set of MFWs, the subscript B indicates the relation to Burrows's original Delta, $|f_i(D) - f_i(D^{'})|$ the computed normalised difference between the frequency of a word f_i in a text D, and σ_i its standard deviation.

Using the 300 MFWs max-culling 20% parameters we introduced in Subsection 4.1, we calculated and produced clusters for each sub-corpus as shown in Figures 1-4.

We then produced a slightly modified version of this delta analysis by implementing the Rolling Delta procedure initially proposed by [8] and implemented in the R Stylo package.[8] This methodology, instead of inspecting the whole corpus as one batch and calculating the

[8]https://www.rdocumentation.org/packages/stylo/versions/0.7.4/topics/rolling.delta

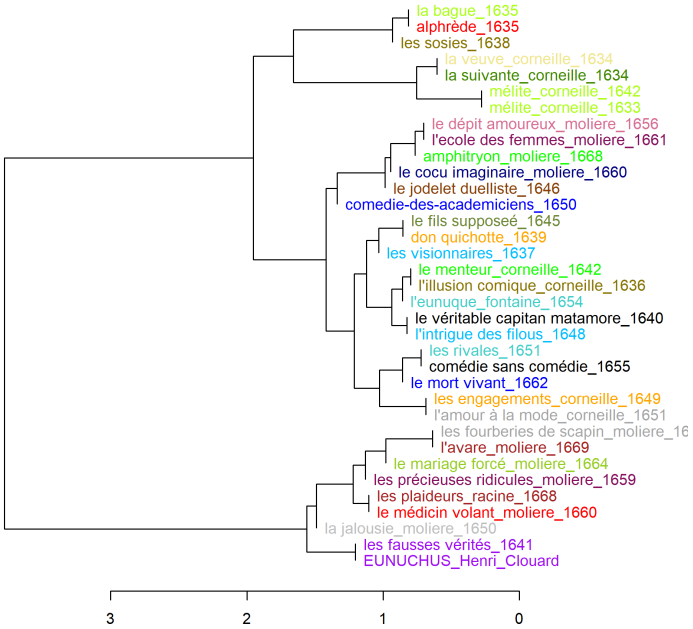

Figure 3: Cluster analysis of the French sub-corpus, Classic Delta distance, 300 Most Frequent Words. Plays are clustered together in branches based on their similarity, with ancestors reuniting them at the root. The score on the x-axis at the bottom indicates the level of Delta (distance) between branches, the lower this score (and the shorter the distance between the texts) the more similar the plays are between themselves.

Delta distance from the sum frequency of two texts, subdivides every text into equal-sized windows, following the evolution (in words) of the reference set text, and then compares each of these windows for every text in the corpus. This is particularly useful to track stylistic shifts along the evolution of a text's length.

First, each text is divided into samples, or "windows". Then the centroid (C) is computed for the mean relative frequency of the n most frequent words of each window. The centroid C then consists of a one-dimensional vector composed of 3 elements: the mean frequencies (μ_i) computed against the relative frequencies (w_i) of the window samples, and enriched with the standard deviation for each of the n's (most frequent words) relative frequencies for each window sample. Finally, the standard Delta is computed for each window (W) and its relative reference C (centroid), calculated as above as shown by Equation 2.

$$\Delta(C, W) = \sum_{i=1}^{n} \frac{1}{\sigma_i(C)} |\mu_i(C) - f_i(W)| \tag{2}$$

After having "rolled" through each window, the result is the plotted Delta in an x,y axes space, where the x-axis corresponds to the evolution (in words) of the texts, and their relative window samples, against the reference set (the *Eunuchus*) and the y-axis to the Delta distance. Thus, the closer to the x-axis, the higher the similarity; the further away from the x-axis (= higher Delta), the lower the similarity. This methodology was originally developed for authorship

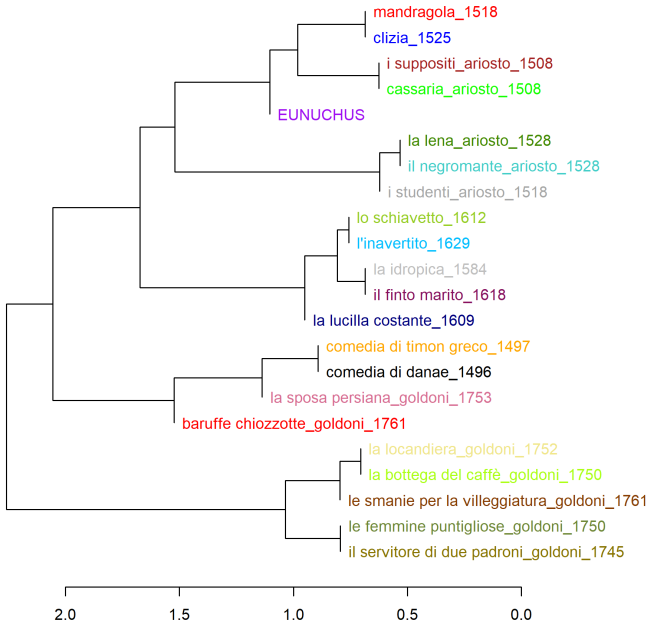

Figure 4: Cluster analysis of the Italian sub-corpus, Classic Delta distance, 300 Most Frequent Words. Plays are clustered together in branches based on their similarity, with ancestors reuniting them at the root. The score on the x-axis at the bottom indicates the level of Delta (distance) between branches, the lower this score (and the shorter the distance between the texts) the more similar the plays are between themselves.

attribution and detection [5, 20, 8, 19], but the underlying tenets can be assimilated in our case. Normally, "if the curve for a text shows a sudden drop, this may indicate a stylistic change in the test text, caused, for instance, by one author taking over from another" [27]: in our case, it indicates takeovers in an author's style, therefore *loci* where an author is closer to Terence and actually re-using parts of his style (or the contrary, in case of high spikes on the y-axis).

4.3. SSA - Sequential Stylometric Analysis

The second experiment focuses on the use of Sequential Stylometric Analysis [10], which takes the previous method of calculating distances between texts in regards to their evolution in words (hence "sequential"), and combines it with the application of a machine-learning algorithm, such as *k*-Nearest Neighbor, Support Vector Machine, Naive Bayes, and Nearest Shrunken Centroid (NSC).

We chose the NSC algorithm as it is already widely and successfully used in the field of Stylometry [30, 22, 29, 28]. As this classification methodology is also primarily used for authorship attribution and detection tasks, we here start from Burrows' assumption of a 'closed game' [3], i.e. the situation in which we know for certain that the author (or one of the authors) in the test set is the certain and true one amongst the candidates to be evaluated in an authorship detection task: our environment then shifts from an identification environment of one sample among others, to the next level of analysing an author's stylistic imprint on the

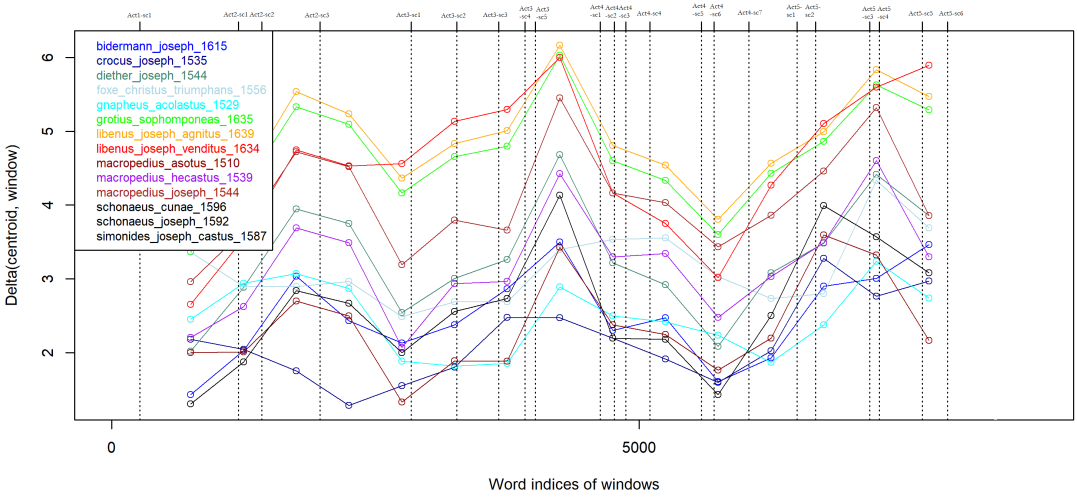

Figure 5: Rolling Delta Analysis of the Latin sub-corpus. Different visualisation of Figure 2: the Delta here is plotted in an x,y axes space where the x-axis corresponds to the evolution (in words) of the texts, and their relative window samples, against the reference set, and the y-axis to the Delta distance.

other candidates.

The NSC algorithm is a form of feature selection and evaluation: it performs the evaluation of a sample, extracting classes of features and shifting them towards the more central ones (centroids, interpreted as the geometric centre of a data distribution set and calculated as the mean average value of each feature) and removing the more distant ones as noise (shrinking) until only a few classes of features have an actual impact on the classification. The algorithm calculates the centroid for each class group in the dataset, thus assigning a model label to each class group based on its relative centroid; after the shrinkage, the remaining centroids are the ones composing the general model on which the Delta distance is calculated. For an in-depth mathematical analysis of the NSC classifier applied to stylometry, see [29].

The NSC algorithm, built in the R package Stylo [12] for the "Rolling" function, produced 4 different visualisations of our analysis, in which the bottom (bold) horizontal line indicates the first set of most probable candidates (i.e. the highest scoring "closest" authors to the *Eunuchus*), while the second (lighter) one corresponds to the second set of most probable overlapping authors, based on the different class calculations from the algorithm. The thickness of the line also contributes visually to the analysis: a thicker line indicates more overlapping sets of features (thus closer stylistic similarity), and a thinner line marks a decreasing degree of similarity.

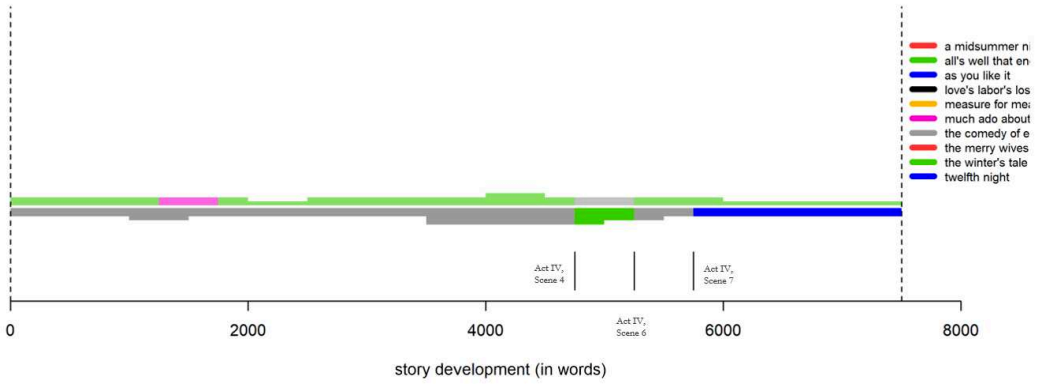

Figure 6: Sequential Stylometric Analysis ("Rolling Stylometry" methodology) of the English sub-corpus. Here each text from the test set is chunked into windows and analysed sequentially against the reference set (the Eunuchus). The x-axis corresponds to the evolution of the latter, the y-axis accounts for the usual Delta distance (expressed in the thickness of the horizontal line), while the different colours correspond to the different texts that are given as the most probable candidates for similarities.

5. In-depth Analysis

In this section, we present and discuss the results from our experiments and combine them together to have a general framework of the authors' preferences towards a model, thus gaining more insights on the general process of *imitatio*. First we discuss each sub-language corpus separately, followed by a summary of the general tendencies that stand out from our analysis.

5.1. Italian

From the clustering part of the experiment (4) we note a clear closeness between earlier works (16th century) and the *Eunuchus*, despite its translation being closer to Goldoni. This similarity is especially evident for the works of Machiavelli (*Mandragola* and *Clizia*) and Ariosto: they were both notorious connoisseurs of Terence, the former even producing one of the first Italian translations of some of its works, while the latter was responsible for numerous re-enactments of Terence's comedies (especially the *Eunuchus*), both in Latin and Italian, when he was in Ferrara at the Este court.[9]) We can therefore assume that Terence's style was deeply rooted in their own, while the *Eunuchus* had little to no influence in the later stages of Italian comedy production. The clear-cut distance between two texts closely related to Terence and the Este court, that was a the forefront of the revitalisation of Latin drama (especially Terence) at the end of the 15th century.[10] Both *Comedia di Timon Greco* by Galeotto del Carretto (who dedicated his work to Beatrice d'Este) and the *Comedia di Danae* by Baldassarre Taccone (who was patronised

[9]For an overview on Ariosto's life and production and the literary role of the Este court in Italian late Renaissance, see [15]

[10]For a more in-depth analysis on the matter [31]

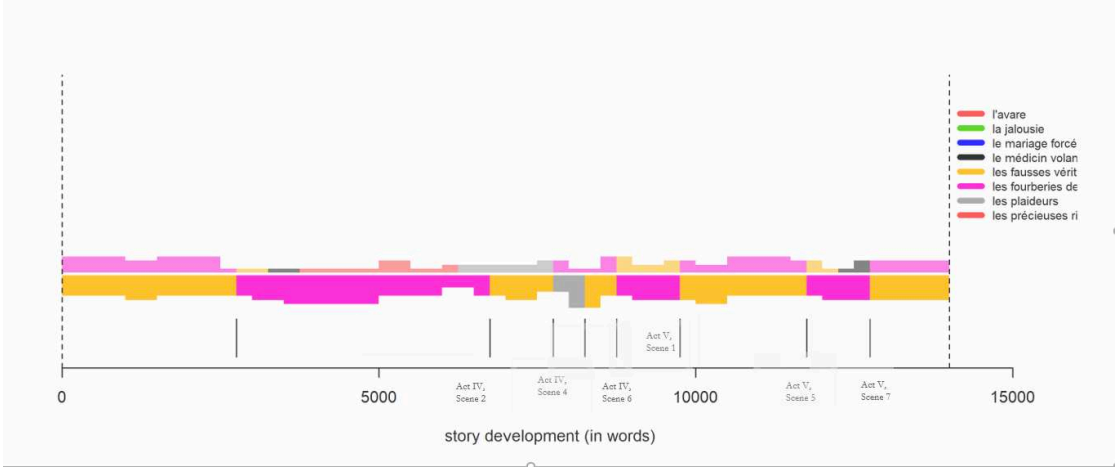

Figure 7: Sequential Stylometric Analysis of the French sub-corpus. Here each text from the test set is chunked into windows and analysed sequentially against the reference set (the Eunuchus). The x-axis corresponds to the evolution of the latter, the y-axis accounts for the usual Delta distance (expressed in the thickness of the horizontal line), while the different colours correspond to the different texts that are given as the most probable candidates for similarities.

by the Este in Mantova), while very close, are kept strictly separated from Terence. Therefore, the style of the *Eunuchus* does not seem to have had a particular influence on their works, where one would expect so.

From the SSA experiment (Figure 8), the closest relative to the *Eunuchus* appears to be *I Suppositi*, in the largest part, being closest to Terence's play at the start and at the end. Both works are a switching doubles comedy, and in both many of the characters go undercover. We interpret this in the lights of the fact that the start and ending of a switching doubles comedy are especially important in the setting-up of the disguise and the final resolution of the misunderstanding at the very heart of the comedy, while the actual central plot of scheming and deception is left to the invention of the author (being the central part, up until the very end of the piece, the most interpolated section). The turning point between the end of act IV and the start of act V, right before the final resolution, is instead taken by Ariosto's *Cassaria*, a plautine-inspired comedy.

5.2. Latin

The clustering algorithm automatically drew two very distinct clusters (see Figure 2), separating the 16th century works from the 17th century ones, and the Eunuchus is the clear dominant model in the first 16th century cluster. This is confirmed by literary scholars in for example [26] and [2].

One exception is in the 1615 text by Jacob Bidermann. A possible explanation is that Bidermann is the only Jesuit in our 17th century cluster: our previous paper ([26]) confirmed the general tendency of 16th century catholic authors, such as Macropedius, Crocus, Diether,

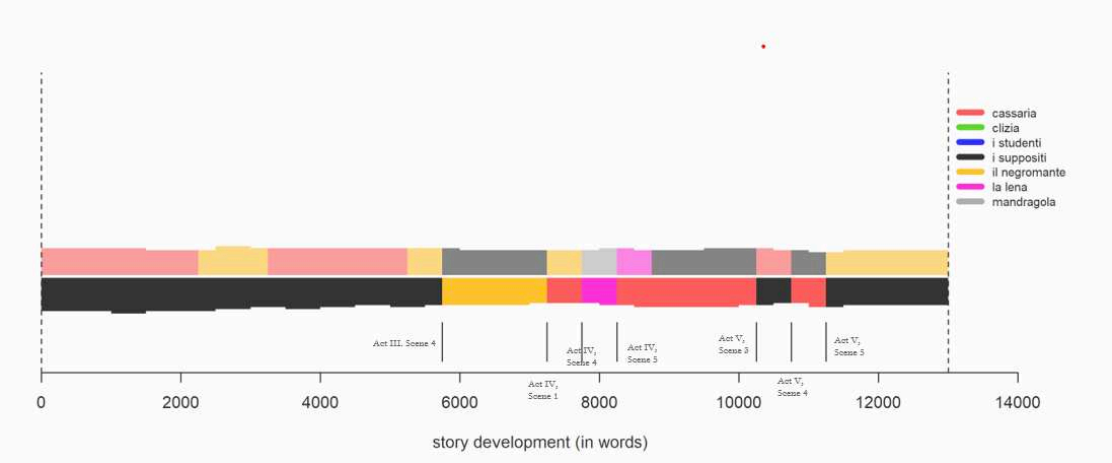

Figure 8: Sequential Stylometric Analysis of the Italian sub-corpus. Here each text from the test set is chunked into windows and analysed sequentially against the reference set (the Eunuchus). The x-axis corresponds to the evolution of the latter, the y-axis accounts for the usual Delta distance (expressed in the thickness of the horizontal line), while the different colours correspond to the different texts that are given as the most probable candidates for similarities.

Simonides and Schonaeus, to heavily favour Terence as a literary model (before switching to Seneca).

From the sequential analysis (Figure 9), the closest overlapping relatives to the Eunuchus are Crocus and Macropedius, which take more than half of the work's body. This is an already well-estabilished parallel, in line with the start of the 16th century's widespread passion for terentian drama. As a general note, the Latin sub-corpus appears to be the one with the heaviest and most varied influences from the Eunuchus, with the least branching in the clustering and the most numerous switches in author similarity in the SSA analysis. This confirms the heavy usage of textual instances from Neo-Latin authors towards their models, rather than an underlying echo of influence: Neo-Latin authors read, copied, transcribed, imitated, staged, and taught ancient authors on a daily basis [2].

5.3. French

From the cluster analysis (Figure 3) we can observe the almost complete preponderance of Molière, the very minor presence of Corneille and complete absence of Racine, Fontaine and other minor authors. Furthermore, the complete distance of Fontaine's *Eunuque* from the original model on which it is based stands out. Even though Fontaine's work is based upon Terence's, his style is apparently very different (a consideration perfectly in line with the chosen methodology, stylometry, which is in most cases considered independent of content and semantics).

From the sequential analysis (Figure 7), the absolute winners of this *imitation game* with Terence are *Les Fourberies de Scapin* by Molière and *Les Fausses Vérités* by Antoine d'Ouville. Both are comedies of love intrigue and infatuation of a man for a young girl that are stylistically

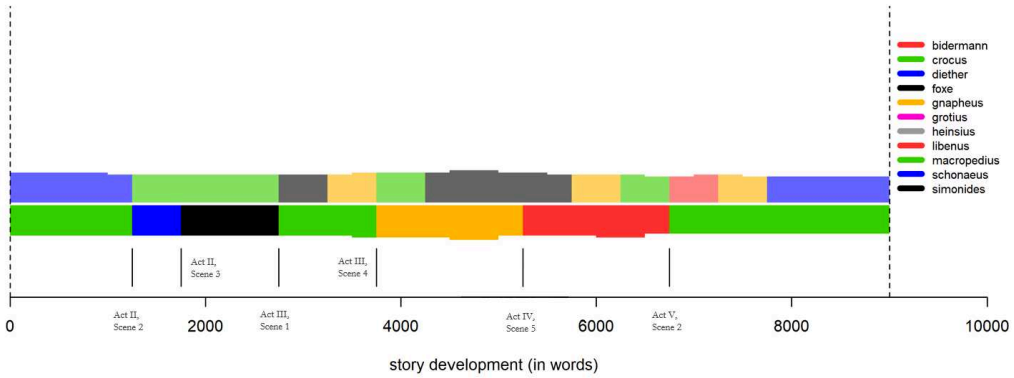

Figure 9: Sequential Stylometric Analysis of the Latin sub-corpus. Here each text from the test set is chunked into windows and analysed sequentially against the reference set (the Eunuchus). The x-axis corresponds to the evolution of the latter, the y-axis accounts for the usual Delta distance (expressed in the thickness of the horizontal line), while the different colours correspond to the different texts that are given as the most probable candidates for similarities.

influenced by the prior Italian comedy, which is in turn heavily Terentian. As for Ariosto, one particularl work (*Les Fausses Vérités*) takes the parts of *I Suppositi*, gathering heavy influences from the very start and end of the *Eunuchus*; for the remaining part of the play, *Les Fausses Vérités* and *Les Fourberies de Scapin* battle themselves for predominance, continuously switching primacy for the influence within the *Eunuchus*. Again, the most interpolated part seems to be the second half of Terence's work, with act IV displaying the heaviest influences.

5.4. English

The English sub-corpus presents a different situation, because all the results are negative. From the clustering experiment (Figure 1) we note a clear-cut distance between the *Eunuchus* and the Shakespearean comedy corpus. This poses the following questions: could this distance be due to the translation not being contemporary to Shakespeare? although it is the oldest and the closest to the test corpus out of all the languages inquired? This also poses a question about style and language that deserves further investigation: is it the diachronical variation of language or is it Shakespeare's style that sets them apart? Is this issue due to the language of Colman's translation or is it entirely to be attributed to Shakespeare's notoriously idiosyncratic and peculiar style, so that even a contemporary translation would not be sufficient to track similarities between his corpus and Terence's works? This renders necessary a digitisation of Webbe's translation (1638), which is, to our knowledge, the closest to Shakespeare's times done by a "professional"[11] and, at the time of our experiment, not freely available.

[11] In our experiment, at first, we used William Heming's 1602 translation, but the results were even worse: the delta distance between Heming and Shakespeare's comedies more than tripled relative to our current test Colman.

Finally, From the sequential analysis (Figure 6), the closest candidate is The Comedy of Errors, but it is a result that cannot be trusted: the overlapping line is almost negligibly thin, thus the score of Delta distance is comparably quite high.

5.5. General considerations

From our experiments, and by looking at the results shown by the Rolling Delta visualisation on the primary sub-case study of Neo-Latin (Figure 5), we can draw some conclusions about the influence of Terence's Eunuchus on the Modern Era drama production, that give us some insights on the underlying process of imitation towards ancient authors.

- Act IV seems to be the most interpolated and reused, as shown from the high coincidence of overlaps in the SSA. This indicates a preference, by modern authors, for taking inspiration from a specific *topos* in classical theatre writing, as the fourth act always corresponds to an escalation in the web of intrigues and a turning point in the general plot before the final settlement: we can then assume that a particularly animated style of narration is at work and modern authors tend to be close to it;
- Act I and V, the opening and closing of the comedy, are always taken by a specific work, from the modern perspective. Act I and V are inextricably tied to the specific play's plot and are usually made up almost exclusively of fast-paced spoken dialogues (monologues and reported speech, typically from serfs, taking up the middle of the play): the new characters are presented (Act I) and their misadventures are resolved in a turning of events (Act V), so it makes sense that only works with a similar story could tie to their specific style, mimicking in particular the new characters' exchange of gags and blows.

From the Rolling Delta analysis, applied to the sub-case study of Neo-Latin against the original *Eunuchus*, we can note some clear patterns:

- The imitation game follows a rough ups-and-downs style, with two clear areas of low and high delta, respectively: the end of act II, act III scene 5, the end of act IV, and the ending of the play;
- The first low delta (= high similarity and overlap with the original) corresponds to the end of the initial story set-up and character presentation, where usually the characters starts to get into the thick of the machinations, confirming again that the usefulness of the original play stops when the plot overcomes the possible usage of styloms (that is, when modern plays' stories become too distant from the *Eunuchus* to justify the re-use of style);
- The first high delta (= low similarity) perfectly overlaps with the most famous of Terence's scenes: the rape scene of act III scene 5. Although in reported speech, this scene goes into details of the rape, and it is surprising that the Neo-Latin authors do not make use of the seduction and emotional violence styloms of Terence's scene;

This is probably due to Heming's very loose translation: he was a playwright and a poet, not a translation expert, grammarian and language teacher as Webbe was.

- The second low delta corresponds to the end of act IV, and it ties in to the aforementioned turning point in the comedy's structure;
- The second, and last, high variation section coincides with the near-end of the play, but it shows a very interesting pattern: on the one hand, plays that originally turned out to be very close to the *Eunuchus* from the other parts of our experiment, at that point plunge even further down, reaching a new low delta and confirming their similarity in the important ending section of the play; on the other hand, works that originally turned out to be distant, sport an opposite fashion, going ever upward in their delta distance and reaching the second highest point of dissimilarity.

6. Conclusion and Future Work

In this paper, we described a case study for the application of computational methods on the issue of assessing the process of *imitatio* between authors from the Early Modern Period and classical models. We started by gathering a corpus, consisting of one of Terence's works as a case study, the *Eunuchus*, its translations in another three languages (English, Italian and French), and four sub-corpora of drama from the Early Modern Period, in the four respective languages, that served as the proper test set. We then explained the methodology we employed for our experiment and the two different and complementary analysis it enabled us to perform: Cluster Analysis through Delta measures, and Sequential Stylometric Analysis. We then proceeded to the in-depth analysis of the results for each of the 4 languages, evaluating the peculiarities of each sub-corpus and the broader patterns that stood out. Finally, we drew some general conclusions on the process of modern authors' imitation of classics within theatrical writing.

By this, we achieved our initial, more general, aim of describing the methodology for multi-language literary studies that can be used for other case studies beyond Terence, for example: 20th century authors reusing Renaissance authors). Furthermore, provided the correct parameters (such as the act-scene subdivision for drama or the verse-stanza structure for poetry), our methodology can be used not only for inquiring drama, but any other genre. The combinations coming out of the possibilities given by such methodology are copious, as many other studies showed in the past (Section 2).

However, the chosen methodology has limitations. Stylometry only tackles issues of style in a purely "formal" way, that is by only taking most frequent words,[12] it is by no means a methodology for semantic analysis, and it only provides tools for a distant reading environment. Furthermore, it showed its internal limitations in the analysis of the English sub-corpus (Subsection 5.4), when it yielded poor results both in the Cluster Analysis and the SSA. Conversely, Stylometry can often catch hidden patterns especially thanks to its core features (distant reading environment and function words analysis): Stylometry has proven successful and useful when analysing literary corpora with the aim of building networks of common and dissimilar features, often handling quite large sets of these features at the same time. To us therefore,

[12] MFWs are often going to be function words in a traditional literary work, but for other cases this depends on the type of input text. There is also no consensus on the exact definition of function words.

Stylometry is not to be taken on its own, but to be combined with other methodologies that can complement its structural flaws, and in turn be enriched by Stylometry's unique take.

It is with these caveats in mind that we plan to expand our methodology with implementations from other methods, primarily semantic analysis. Internally, one critical step to cement our findings would be to access to proper contemporary (to the Modern Era) translations of the *Eunuchus*, to get rid of every possible imprecision due to the distance between the author's language and the translation's very own, while one entire sub-project could devoted to comparing different translations and how they perform. Furthermore, we deem a mandatory step to expand our reference corpus of classical drama writers to the point of including every Latin play and replicating our methodology on each one of them. Finally, enriching our corpus with new data from the copious drama production of the Modern Era would be a natural next step. This would bring our the ultimate goal of accounting for the complex issue of *imitatio* within Modern Era drama writing closer.

Acknowledgements

This research is conducted within the framework of the TransLatin project funded by the Dutch Research Council (NWO).

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