Assessing Michael Maier's Contributions to Francis Anthony's Apologia (1616) Using Stylometry

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Abstract

This article attempts to shed new light on the collaboration between the chymical authors Michael Maier (1568–1622) and Francis Anthony (1550–1632) using stylometric authorship attribution. Maier and Anthony were friends and we know that they worked together on the English and Latin versions of Anthony's *Apologie* or *Apologia* (1616) respectively. The question remains whether Maier was more than just a mere translator, as it has been claimed in the past – notably by Maier himself. Using `R-Stylo`, stylometric analyses are conducted. It is discussed what conclusions can be drawn from them given that we already know Maier and Anthony were working together and that Maier *was* the translator responsible for the Latin *Apologia* (1616) ascribed to Anthony. In the end, stylometry doesn't offer enough evidence for us to make any definite claims regarding the authorship situation under discussion. It can, however, offer certain insights into the stylometric proximity between Maier and Anthony.

Keywords

stylometry, authorship attribution, translation,
alchemy, Michael Maier (1568–1622), Francis Anthony (1550–1632)

1. Introduction and description of the problem

Scholarly literature on the German chymical author Michael Maier (1568–1622) [33, 17] has recently discussed Maier's contributions to the work of his English friend Francis Anthony (1550–1632) [18].[1] The latter has published an apologetical tract to defend himself against criticisms made regarding his first published work (*Assertio*, 1610 [2]), in English and Latin – *Apologie* and *Apologia* respectively (both published in 1616) [1, 3]. Originally, scholars had speculated that Maier's involvement hadn't extended past contributing to the frontmatter [29, 12]. Yet Lenke et al. contest, inspired by a letter of Maier's wherein he claims principal authorship of the tract, that Maier's involvement might have gone beyond mere translation [18]. Upon closer inspection, however, the English and Latin texts looked surprisingly similar to the author of this paper, apart from the different frontmatters.[2] The texts both consist of a frontmatter as well as three parts, the second and third of which are made up mainly of testimonies

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[1]I want to thank the reviewers for their thoughful and helpful comments. Thanks for feedback also goes to Martina Scholger and Sanja Sarić.

[2]The texts were compared side-by-side. No larger sections seemed to be missing. They were not translated in detail but from looking at them with a good knowledge of Latin, there didn't seem to be superficially visible differences in content. If there are any, they would be on the word level or so few that they easily escape notice. Especially in part one of the tract, the text seemed to be almost identical, if not even translated in detail. It is possible, however, that texts in hand-press print look visually very similar when the exact wording of texts

and suggestions for the use of Anthony's drinkable gold. The arguments made in the respective first parts seem identical upon cursory comparison. Thus, the differences investigated by Lenke et al. to establish who contributed what pertain mainly to the frontmatter. This assertion, however, is in stark contrast to the opinion of Lenke et al. that "[the Latin *Apologia* and the English *Apologie*] are, in fact, quite separate works with substantial variations in content" [18, p. 7]. The frontmatter, especially the dedicatory pages, were often subject to last-minute changes in times of hand-press print, as can been seen in alchemical book-making practices: Piorko shows on the example of a 'ghost issue' of Arthur Dee's *Facisculus Chemicus* (1631) that the exact wording of hand-press books wasn't necessarily fixed across different issues of the same edition [30]. Maier himself dedicated one of his books (*Jocus Severus*, 1617) to the Rosicrucians at a point where the content of the main matter was surely already fixed [24].[3] Thus it can be argued that the frontmatter and main content of a publication shouldn't be accorded the same value in our discussion. Only that the frontmatter of a book has changed doesn't necessarily imply that the main content has undergone the same number of changes. On the one hand, "Maier's claim to principal authorship of the Latin edition of the *Apologia* opens up a number of different possibilities as to how the two texts relate to one another", on the other, "[c]onsidering the context in which they are made – a desperate plea for patronage – we have good reason to be sceptical of these assertions of Maier's" [18, pp. 8, 6]. Determining compositional priority would be an almost impossible task given the complex situation, yet is is likely that both editions were created in parallel [18, pp. 7–8].

Consequently, this paper aims to offer a different approach to the problem outlined above. Rather than comparing the contents of the English and Latin versions of the apologetic tract, it sets out to compare both Latin works of Anthony's stylometrically – amongst each other and to a set of other works authored by Maier. Lenke et al. have suggested that, unlike the *Assertio* with its simpler language, the Latin *Apologia* corresponds to Maier's elegant prose [18, p. 6].[4] In contrast to the hard-to-determine question of compositional priority, the question of style can be tackled by digital stylometry. Accordingly, this short paper presents and discusses the results of authorship attribution algorithms run on the texts in question in a closed-game scenario.

2. Stylometric parameters and the corpus

The `stylo` R library was used. Given the highly inflected nature of the Latin language, Eder's Delta was chosen [32, 10, 11, 6]. However, the Würzburg Cosine Delta furnished virtually identical results. At first, no culling was done. Later it was discovered that 40–80% culling was the most successful at distinguishing the authors from the control group. Varying numbers of most frequent word settings were tested, ranging from 300 to 5000. The semantically most meaningful results in terms of historiographical interpretation and context were found between

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isn't considered but, in fact, pertain to print issues containing differences in wording in some parts of the book, as shown on the example of the 'Rosicrucian issue' of Arthur Dee's *Facisculus Chemicus* (1631) by Piorko [30].

[3]This is likely because the main matter doesn't engage with the Rosicrucians at all – it is an allegorical *Tierstreitgedicht*. The purpose of the preface is to frame the text as Rosicrucian even if the text itself might originally not have been intended as such.

[4]As an addendum it is important to note that 'elegant prose' is a quite vague notion used by Lenke et al. which is hard to quantify unless we establish a set of criteria for what counts as 'elegant' or not. It is questionable whether stylometry can trace or reproduce such categories in an adequate manner or whether they even make sense at all.

stylo
Principal Components Analysis

PC2 (19.3%)

augurelli-chrysopoeia-1515

anthony-assertio-1610
anthony-apologia-1616

maier-symbola-1617
maier-tripus-1618
maier-examen-1617
maier-arcana-1614
maier-civitas-1621

maier-de-circulo-1616 1609
maier-viatorium-1618
maier-septimana-1620

johnson-lexicon-chemicum-1657
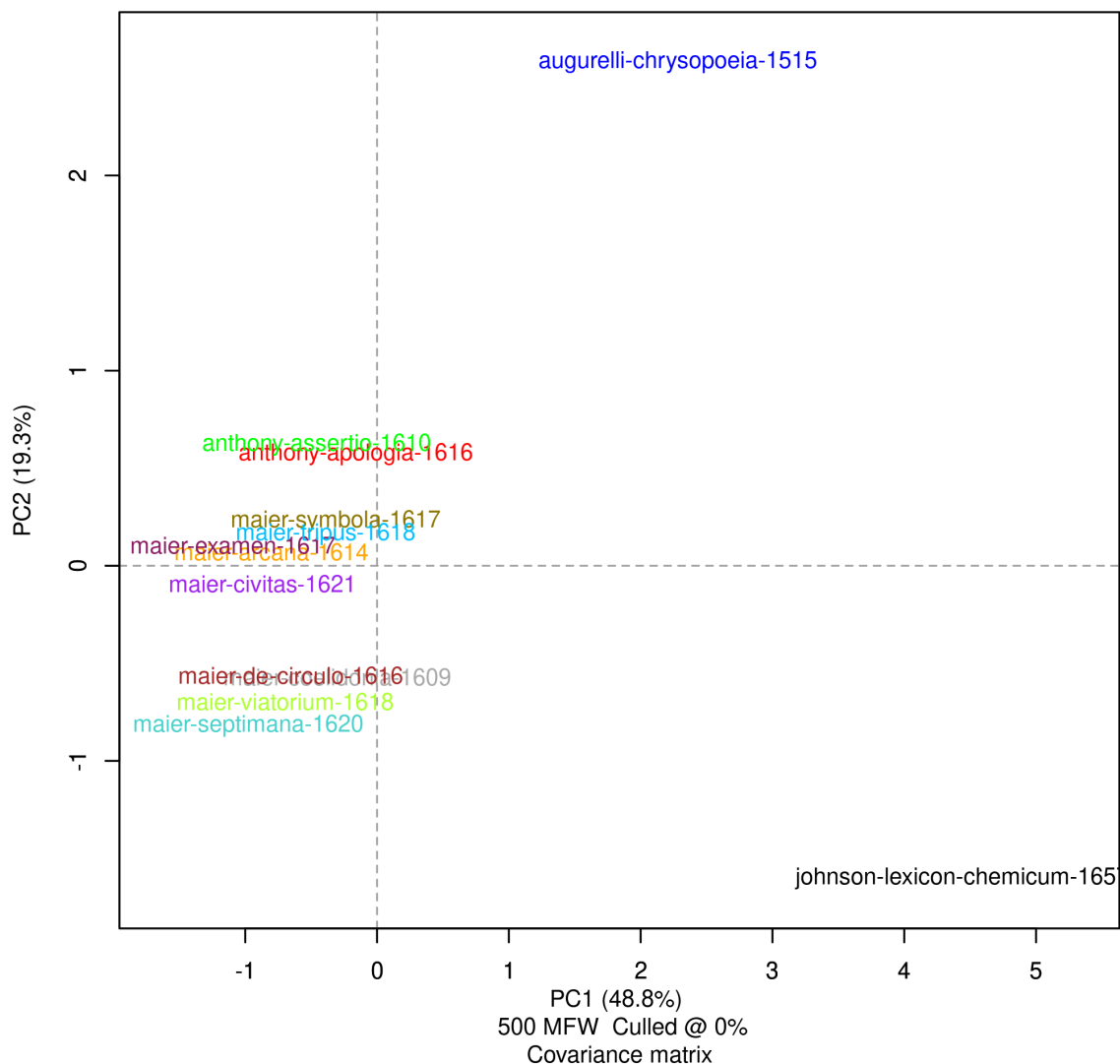
PC1 (48.8%)
500 MFW Culled @ 0%
Covariance matrix

Figure 1: Principal Component Analysis containing two works not authored by neither Anthony nor Maier, Augurelli's *Chrysopoeia* (1515) and Johnson's *Lexicon Chymicum* (1657).

500 and 3000 most frequent words. The results of both covariance Principal Component Analysis scatterplots as well as dendrograms resulting from the Eder's Delta analysis were taken into account for interpretation.

The corpus of works to be compared contained the *Assertio* (1610) which is clearly attributed to Francis Anthony, the Latin *Apologia* (1616) whose authorship remains to be investigated as well as a number of publications clearly authored by Michael Maier.[5] None of those texts is

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[5] These were: *Coelidonia* (1609), *Arcana* (1614), *De Circulo Physico Quadrato* (1616), *Symbola* (1617), *Examen Fucorum* (1617), *Tripus Aureus* (1618), *Viatorium* (1618), *Septimana* (1620) and *Civitas Corporis* (1621) [22, 19, 21, 26, 23, 27, 28, 25, 20].
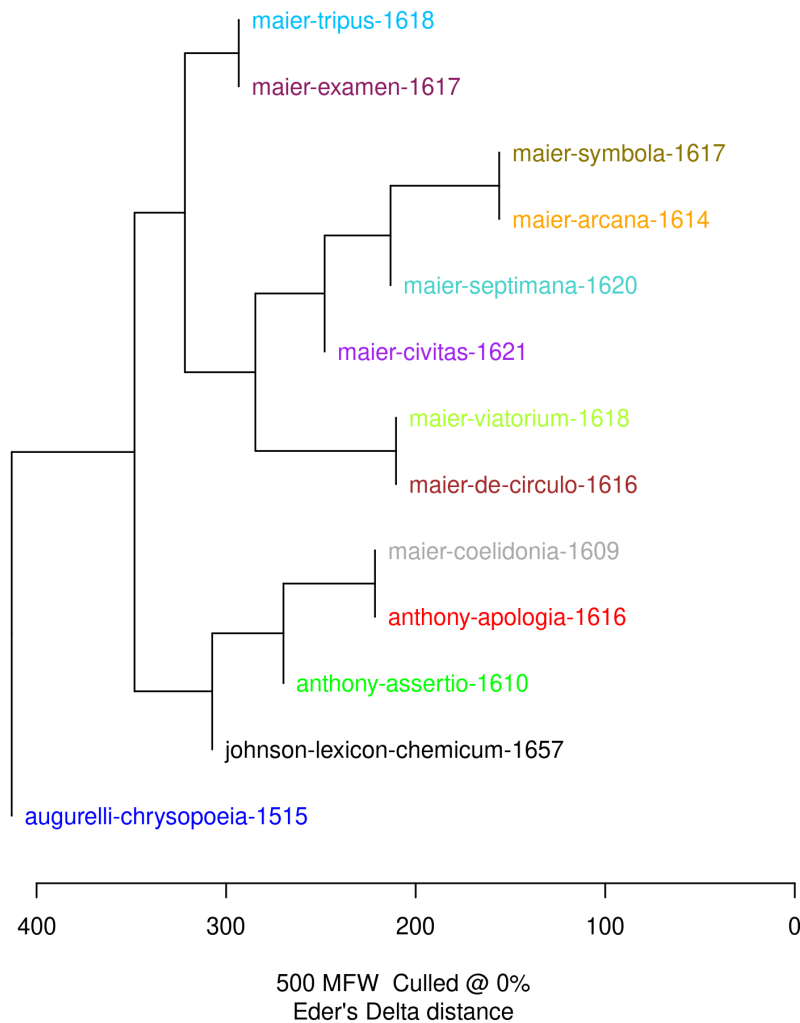
stylo
Cluster Analysis

Figure 2: Dendrogram using the 500 most frequent words with Eder's Delta, containing two works not authored by neither Anthony nor Maier, Augurelli's *Chrysopoeia* (1515) and Johnson's *Lexicon Chymicum* (1657).

shorter than 5000 words which is deemed to be a critical point for successful attribution [8].[6] The digital corpus was generated by running Transkribus machine transcription on digital fac-similes of the texts, using the NOSCEMUS GM (versions 3–5) which produces very convincing results on early modern Latin print [15].[7] Metadata and entirely garbled sections of text were

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[6]For Latin prose, Eder even found the minimal effective sample size to be as little as 2500 words.

[7]With a character error rate (CER) of 0.79% the NOSCEMUS GM4 is highly performant and will average between 1–5 errors per page of early modern print – which can be mere incorrect spaces. For the public model see https://readcoop.eu/model/print-latin-texts-15-th-19th-htr/ [last accessed 2020-09-18]. An article explaining the model in more detail will appear in [15]. It is thus on average far more correct than, for example the Grimm
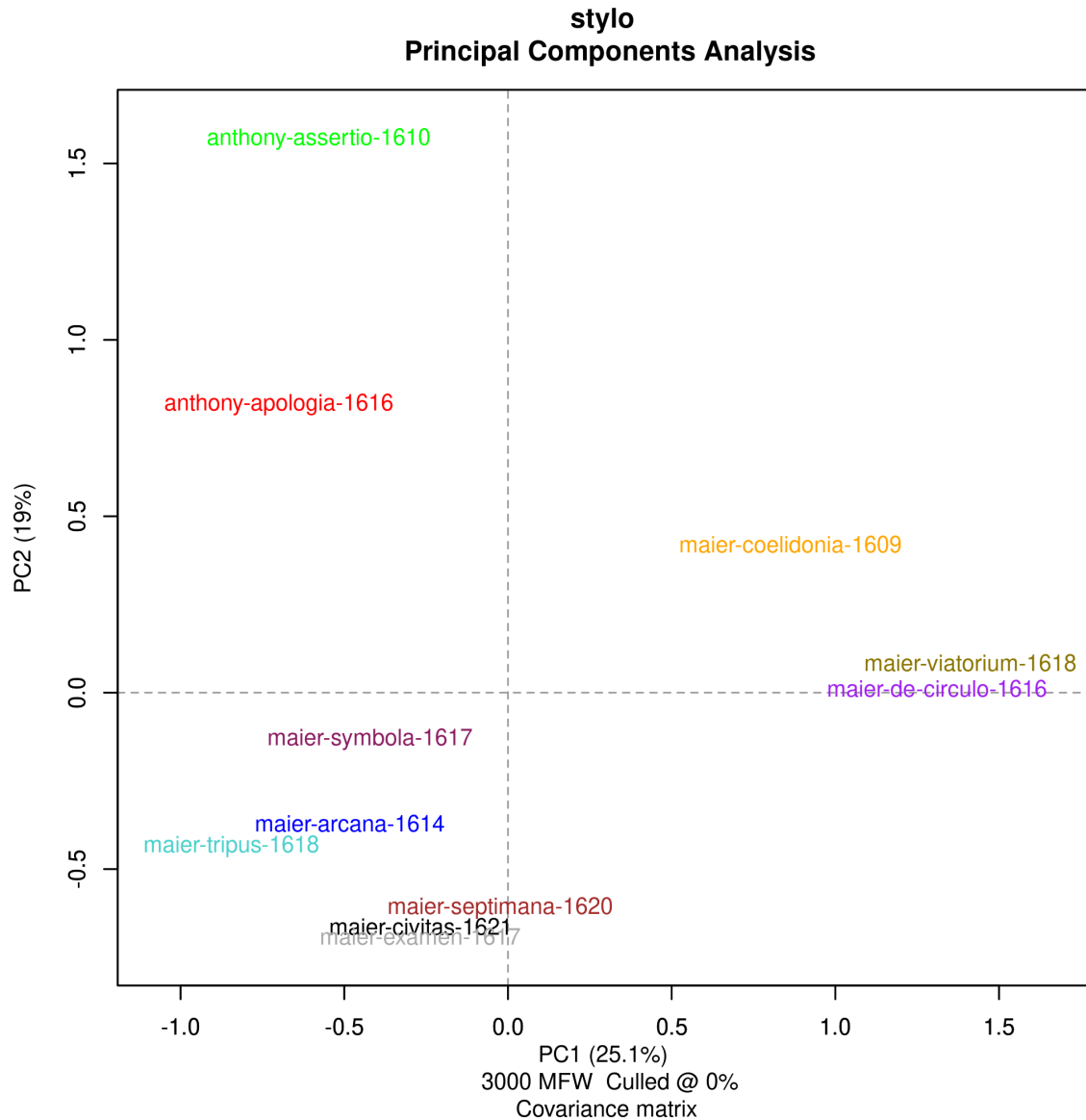
stylo
Principal Components Analysis

Figure 3: Principal Component Analysis without works authored by neither Anthony nor Maier.

manually removed from all texts.[8] On some texts, lines containing only one character were

letters corpus analyzed stylometrically in [14] which was created from manuscripts resulting in an error rate of 5%. Eder's study on artifically introduced noise also suggests that, given the high quality of the Noscemus HTR+ model, the performance of authorship algorithms shouldn't be significantly decreased compared to a perfect transcription [9, 6]. Furthermore, as Eder also points out, since all texts were transcribed with only slightly different versions of the same model (the later versions of the Noscemus model are more efficient but don't transcribe differently in terms of transcription conventions) which means that in case of OCR errors, at least the types of OCR errors should be similar [9, p. 612]. An imperfection which remains are the frequently irregular uses of u/v and i/j in the same words which often comes from the early modern print itself.

[8]The expression 'entirely garbled sections' refers to OCR artifacts produced in the NOSCEMUS model when ornaments in print are mistaken for text, often resulting in Ancient Greek junk text in the outputted

stylo
Cluster Analysis

maier-viatorium-1618

maier-de-circulo-1616

maier-coelidonia-1609

anthony-apologia-1616

anthony-assertio-1610

maier-examen-1617

maier-civitas-1621

maier-tripus-1618

maier-symbola-1617

maier-arcana-1614

maier-septimana-1620

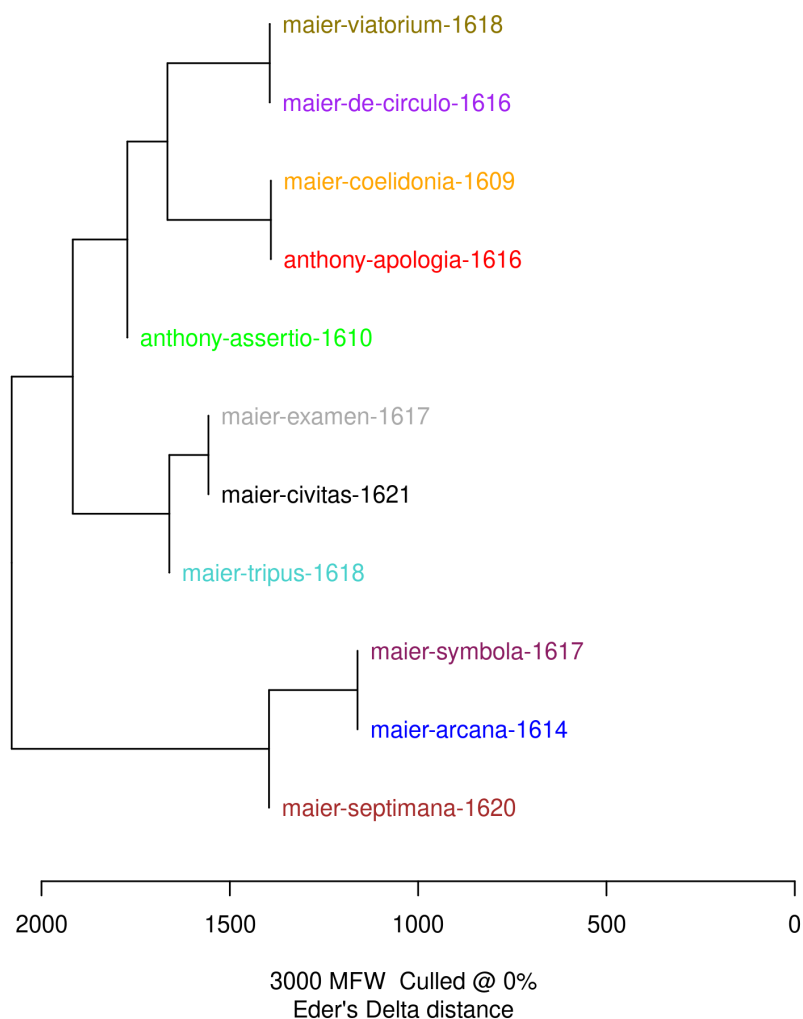| 2000 | 1500 | 1000 | 500 | 0 |

3000 MFW Culled @ 0%
Eder's Delta distance

Figure 4: Dendrogram produced by Eder's Delta using the 3000 most frequent words, without works authored by neither Anthony nor Maier.

removed, too, as these are highly likely to be junk.[9] However, the analyses were still run on mostly dirty OCR which, despite the high performance of the NOSCEMUS General Model, contains a number of imperfections and probably still affected the accuracy of the analyses in

transcription. This is to say that no actual text was lost in the analysis, except possibly for the occasional missed line in the Layout Analysis stage of the Transkribus process. This does not amount to any substantial loss of text material.

[9]These mainly come from (snippets of) catchwords, i.e. the first word or part of a word from the following page, set at the bottom of early modern printed books to facilitate book binding. These often come out incorrectly or are half-missing in transcriptions resulting from HTR+ with the Noscemus model. Since they aren't relevant to our analysis, they can safely be removed.
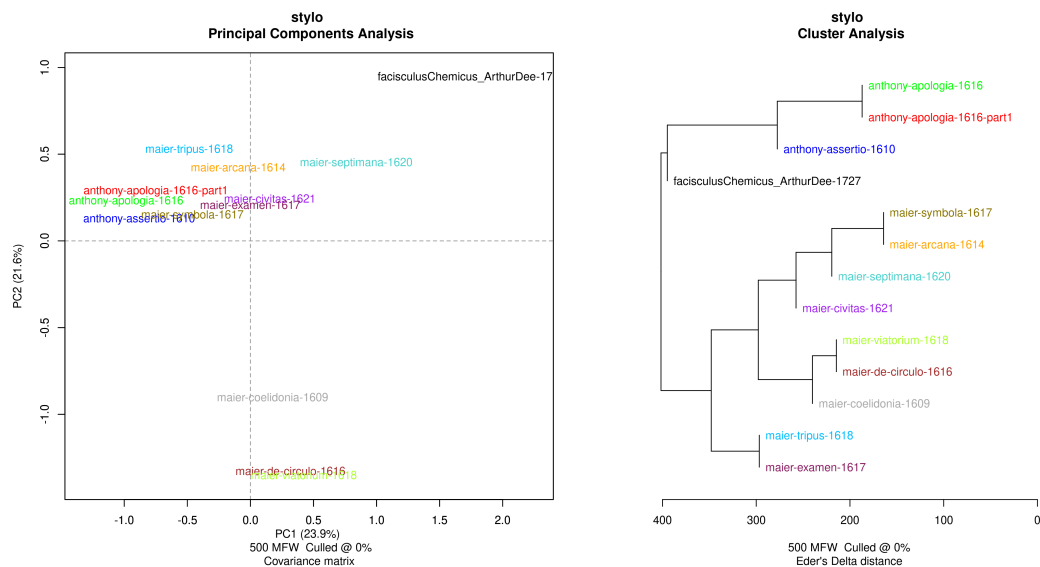
Figure 5: Principal Component Analysis and Dendrogram produced by Eder's Delta using the 500 most frequent words containing Arthur Dee's *Facisculus Chemicus* (1631).

one way or another. To counterbalance the effect of the dirty OCR which contains some non-existant words due to incorrect transcription, the decision was made to use a higher number of most frequent words than the 50–150 which are often cited to provide good results.[10]

Once the corpus had been prepared, Principal Component Analysis and Eder's Delta using the 500 most frequent words were first conducted on a corpus also containing two works not authored by neither Anthony nor Maier, Augurelli's *Chrysopoeia* (1515) [4] and Johnson's *Lexicon Chymicum* (1657) [16]. This step was included to check whether Anthony's publications are stylometrically close to Maier's at all. Compared to the two other chymical authors, Johnson and Augurelli, both of Francis Anthony's alleged works are quite close to Michael Maier's corpus (see figures 1 and 2). Since Augurelli and Johnson are classified as so very different from Maier and Anthony, the distinctions between the latter get blurred in the analysis. Consequently, those works were removed from the corpus in a second step to make differences in the 'inner circle' of Maier and Anthony's works more visible (see figures 3 and 4). Since it wasn't clear whether the genre differences – Augurelli's work is poetic, Johnson's is a lexicon – would negatively impact the analysis, a third foreign author was later introduced for evaluation purposes: Arthur Dee's *Facisculus Chemicus* (1631) [7] is another iatrochemical prose text which can be deemed comparable to those of Maier and Anthony in terms of genre and topic (see figure 5).[11]

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[10]While a typical amount of most frequent words taken into acount in the classical Burrow's Delta measure is about 50–150, the effectiveness of using a higher amount of words has been investigated in multiple studies. It remains unclear, however, if using more high frequency vocabulary is a good way of compensating for OCR imprecision or how much the slight OCR imprecision even affects the stylometric results – probably not at all according to Eder [9, p. 612]. Alchemical content words appear in our corpus starting at around the 400 most frequent words, so the decision was made to go with the 500 most frequent words to include some of those alchemical keywords which might indicate thematic tendencies. The texts under scrutiny are all fairly similar in terms of content after all.

[11]For the 'closed game' analysis without Dee, Augurelli and Johnson we are at 546083 tokens, with just Dee added at 563812 tokens and at 634390 tokens for the analysis with all authors included.

Tweaking the parameters of the analyses (like the number of most frequent words) causes the clusters of the PCAs and the branches of the dendrograms to shift around a little but the overall groupings remain similar irrespective of the number of most frequent words. Especially the mythalchemical and encyclopedic works in the style that Maier is famous for – *Arcana*, *Symbola* and *Septimana* – remain closely connected throughout all analyses. One can also observe that Maier's works wherein he is more dependent on other authors, such as his collection of three texts translated to Latin by Maier, the *Tripus Aureus* [27], and his *Examen Fucorum* [23] in which he reuses arguments by Heinrich Khunrath (1560–1605) from his *Trewhertzige Warnungs-Vermahnung eines getrewen Liebhabers der Wahrheit* (1597) tend to cluster together [5]. The same goes for works in which Maier discusses more practical matters, mostly concerning metals and iatrochymical medicines, such as *Coelidonia*, *De Circulo Physico*, *Viatorium* and *Civitas Corporis*. Those unsurprisingly also show up in closer proximity to Anthony's *Assertio*, a Paracelsian tract praising his golden medicine (*aurum potabile*).

Earlier it was stated that 40–80% culling has shown more promising results. This can be seen in the respective figures 6 and 7 which show the results of analyses run with Eder's Delta, 500 most frequent words and either with just Dee's text added or with all texts taken into consideration including the 'control group' of Augurelli and Johnson. In the analyses without culling, it was surprising that neither Maier's *Examen* – which contains substantial amounts of Latinized paraphrasing of Khunrath – nor his *Tripus Aureus* – a collection of three translations by Maier – were classified as substantially different from Maier's other works. If the translator really is invisible in stylometry [31, p. 231], why are Maier's translations (*Tripus Aureus* or the *Apologia*) not outliers to the rest of the corpus? Forsyth and Lam state that authorial discriminability should be preserved in translation and posit the "working hypothesis that both the author's and the translator's 'handprints' are present in a translated work and, with suitable tools, both can be revealed" [13, p. 213]. If we follow this hypothesis, we should see some effect of the original texts and their authorial handprints 'foreign' to Maier in both the *Examen* and the *Tripus*. In the analysis without culling, this was not noticeably the case. When re-run with the above-mentioned culling, however, the analysis shows these two texts to be more clearly separate from Maier's other works as well as better distinguishing the works foreign to Maier's corpus. This seems more reasonable from a historiographical perspective, despite the fact that an earlier text of Maier's, the 1609 *Coelidonia*, now gets mixed into the branch of other authors (see figures 6 and 7). Given that Maier's *Coelidonia* deals with iatrochymical medicine and chrysopoeia and thus being very close to Anthony in content, we may assume that content words – or maybe differences in style related to talking about certain topics – might have some sort of influence on the authorship attribution after all.

In figure 7 (PCA), we witness a difference in author signal between Anthony's *Assertio* – which is grouped in with some of Maier's texts focusing more on metals – and Anthony's *Apologia* which appears conspicuously close to Maier's texts authored around the same time. With the culling applied, Anthony's texts appear very close together and seem more separate from Maier's in the PCA, yet – unlike, for instance, Dee's text – still get grouped into the 'Maier branch' in the dendrogram (see figure 6). In the end, it has to be noted that all texts from the 'alchemical prose' group are fairly close together, so it's ultimately hard to tell whether we should draw strong conclusions from those results.
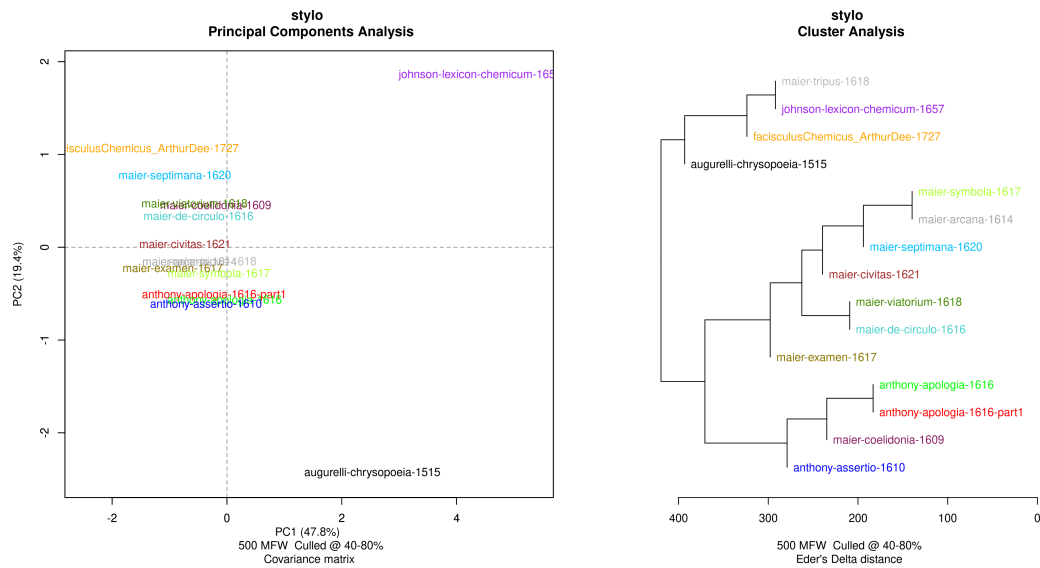
Figure 6: Principal Component Analysis and Dendrogram produced by Eder's Delta using the 500 most frequent words and 40–80% culling containing Augurelli's *Chrysopoeia* (1515), Johnson's *Lexicon Chymicum* (1657) and Arthur Dee's *Fasciculus Chemicus* (1631).
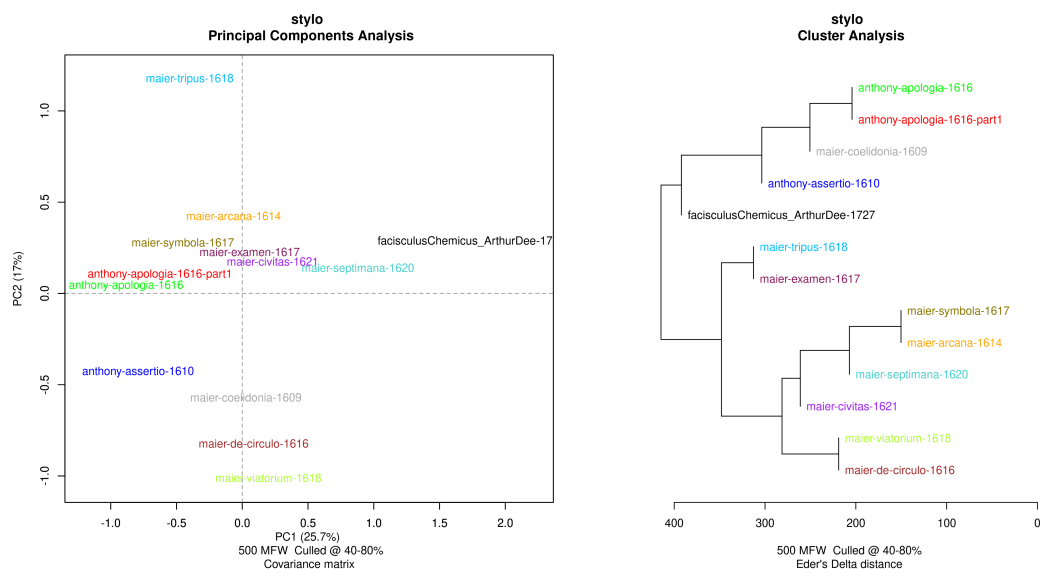

Figure 7: Principal Component Analysis and Dendrogram produced by Eder's Delta using the 500 most frequent words and 40–80% culling just containing Arthur Dee's iatrochymical prose work *Fasciculus Chemicus* (1631).

3. Discussion and interpretation of results

Initially we asked the question: How close is the Latin *Apologia* to Michael Maier's published works? Surprisingly close. However, given that Anthony's *Assertio* was also fairly close to Maier's other works stylistically, the question remains how meaningful this result really is for historical interpretation.

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Rybicki asserts that "Delta usually fails to identify the translator and identifies the author of the original instead" [31, p. 231]. It follows that the translator should be stylometrically invisible. However, in our case, the clusters of Maier and Anthony were quite close to each other. Could this indicate Maier's involvement in both books? The historical circumstances make this very unlikely in the case of the 1610 *Assertio*. What else then could be the reason for this stylometric result? Maier and Anthony were friends who bonded over their shared interests, primarily in drinkable gold as chymical medicine. It thus probably isn't surprising that they are grouped closely together in a stylometric analysis which is influenced by content or in the very least 'content-conscious' [31]. Yet "despite [its] shortcomings and uncertainties, Delta (and similar measures) is more often right than wrong" [31, p. 243]. Now what does this tell us about our historiographical problem?

On the one hand, Maier and Anthony seem to be overall quite close to each other in terms of content. On the other, the Latin *Apologia* (1616) – where Maier's involvement is suspected – is closer to Maier than the *Assertio* (1610). If we accept Rybicki's conclusion of the translator's stylometric invisibility [31, p. 246], it follows that the closeness of the *Apologia* to Maier's opus might indicate some kind of involvement on his part which goes beyond translating, irrespective of the dubious argument concerning the differing frontmatters outlined above. Further analyses need to be done if more certainty on this matter is to be achieved. However, it remains questionable if a clear demarcation of who contributed what can ever be attained, given the obscure situation of the source material. Future work should include a close reading of both texts and possibly an exact translation of the Latin *Apologia*, so that it can more easily be compared to its English version. This seems especially fruitful for the first part of the treatise since parts two and three do not contain any arguments, just testimonies and medicinal use cases. It seems unlikely at this point that stylometric analysis could shed further light on the matter at hand. Yet it remains a desideratum to re-run the analyses on manually cleaned and thus, less erroneous transcriptions. The results of these analyses are a good example of the great difficulty in evaluating stylometric results, specifically how strong an attribution is and what it really means in terms of authorial involvement.

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[25] M. Maier. SEPTIMANA PHILOSOPHICA, qua aenigmata aureola de omni naturae genere a Salomone Israelitarum sapientissimo rege, et Arabiae regina Saba, nec non Hyramo, Tyri principe, sibi invicem in modum colloquii proponuntur et enodantur: ubi passim novae, at verae, cum ratione et experientia convenientes, rerum naturalium causae exponuntur et demonstrantur, figuris cupro incisis singulis diebus adjectis. Frankfurt, 1620.

[26] M. Maier. SYMBOLA AUREAE MENSAE DUODECIM NATIONUM, Hoc est, Hermaea seu Mercurii Festa ab Heroibus duodenis selectis, artis chymicae usu, sapientia et authoritate paribus celebrata, ad Pyropolynicem seu Adversarium illum tot annis iactabundum, virgini Chemiae Iniuriam argumentis tam vitiosis, quam conuitiis argutis inferentem, confundendum et exarmandum, Artifices vero optime de ea meritos suo honori et famae restituendum. Ubi et artis continuatio et veritas invicta 36 rationibus, et experientia librisque authorum plus quam trecentis demonstrantur. Opus, ut Chemiae, sic omnibus antiquitatis et rerum scitu dignissimarum percupidis, utilissimum, 12 libris explicatum et traditum, figuris cupro incisis passim adjectis. (Nachdruck: Akademische Druck und Verlags Anstalt, Graz 1972.) Frankfurt, 1617.

[27] M. Maier. TRIPUS AUREUS, hoc est, Tres tractatus chymici selectissimi, nempe I. Basili Valentini, Benedictini ordinis monachi, Germani. Practica una cum 12. clavibus et appendice, ex scriptum, nunc ex Anglicano manuscripto in Latinum translatum, phrasi cuiusque authoris ut et sententia retenta; III. Cremeri cuius Abbatis Westmonasteriensis Angli Testamentum, hactenus nondum publicatum, nunc in diversarum nationum gratiam editi, et figuris cupro affabre incisis ornati opera et studio Michaelis Maieri. Phil. et Med. D. Com. P. etc. Frankfurt, 1618.

[28] M. Maier. VIATORIUM, hoc est, De Montibus Planetarum septem seu netallorum; Tractatus tam utilis, quam perspicuus, quo, ut Indice Mercuriali in triviis, vel Ariadneo filo in Labyrintho, seu Cynosura in oceano chymicorum errorum immenso, quilibet rationalis, veritatis amans, ad illum, qui in montinus sese abdidit De Rubeapetra Alexicacum, omnibus medicis desideratum, investigandum, uti poterit. Oppenheim, 1618.

[29] U. Neumann. "Michael Maier (1569–1622) 'philosophe et medecin'". In: *Alchimie et philosophie à la Renaissance. Actes du colloque international de Tours (4–7 décembre 1991)*. Ed. by J.-C. Margolin and S. Matton. Berliner Mittelalter- und Frühneuzeitforschung, Band 8. Paris: Librairie Philosophique J. Vrin, 1993, pp. 307–326.

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[31] J. Rybicki. "The great mystery of the (almost) invisible translator: Stylometry in translation". In: *Quantitative Methods in Corpus-Based Translation Studies. A practical guide to descriptive translation research*. Ed. by M. P. Oakes and M. Ji. Amsterdam/Philadelphia: John Benjamins Publishing Company, 2021, pp. 231–248.

[32] J. Rybicki and M. Eder. "Deeper Delta across genres and languages: do we really need the most frequent words?" In: *Literary and Linguistic Computing* 26/3 (2014). DOI: 10.1093/llc/fqt066.

[33] H. Tilton. *The Quest for the Phoenix. Spiritual Alchemy and Rosicrucianism in the Work of Count Michael Maier (1569–1622)*. Berlin / NY: De Gruyter, 2003.