

A Network Analysis of Figurative Topic Classification: The Case Study of *Timon of Athens*

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Abstract

This article suggests a computational method for the analysis of figurative language as a network, using methods from natural language processing (NLP), particularly topic classification and network analysis. The analysis of figurative language plays a major role in literary criticism and, to varying degrees, in other fields of the humanities and social sciences whose orientation is textual. The analysis of figurative language, rather than literal language, poses certain difficulties due to the very structure of figurative expressions. The suggested method in this articles offers a way to overcome these difficulties. By taking as a case study the play *Timon of Athens* by Shakespeare and Middleton, the article examines the method's ability to provide insights into the thematic concerns of a text, assess existing interpretations, and develop a close reading.

1 Introduction

In *The Arte of English Poesie*, George Puttenham demonstrates the abusive power of figurative language by referring to the ancient Athenian judges of the Areopagus, who had decided “to forbid all manner of figurative speeches to be used before them in their consistory of Justice, as mere illusions of the mind and wresters of upright judgment” [Puttenham 1968, 239]. Ironically, although the Areopagite judges condemn the use of figurative language as deceptive, they themselves use a metaphor of a carpenter in their condemnation, saying:

that to allow such manner of foreign and colored talk to make the judges affectioned were all one as if the carpenter, before he began to square his timber, would make his square crooked: inasmuch as the strait and upright mind of a judge is the very rule of justice till it be perverted. [Puttenham 1968, 239]

As much as the judges of ancient Athens wish to banish all figurative language from their midst, they prove to be susceptible to its power from within, unable to shake off the hold it has on their minds. The influence of figurative language is not only evident here through the metaphor of the carpenter, but rather it is the more subtle homonym senses of the words *upright* and *rule* that truly reveal the pervasive power of the figurative. In *Metaphors We Live By*, Lakoff and Johnson catalogue the word *upright* as part of the orientational class of metaphors, which rely on our most basic sense of space and physical concepts, so much so that “without which we could not function in the world – could not reason or communicate” [Lakoff and Johnson 2003, 61]. In this article I suggest a computational approach for the analysis of figurative language, which employs two main methods: topic classification and network analysis. Additionally, this article offers as a case study an interpretation of the play *Timon of Athens* by Shakespeare and Middleton on the basis of the suggested approach to the analysis of figurative language.

The results of such an analysis of figurative language can provide insights into the thematic concerns of a text and the forces that shape them, enabling us to return differently to a close reading. Unlike an analysis of literal language with natural language processing (NLP), there are certain difficulties that arise due to the very structure of figurative expressions. In the following section, I discuss the theory of figurative language, particularly in relation to my argument regarding the network structure of figurative language. The third section focuses on the computational methods. First, I address topic classification and modeling, as well as the process of training a classifier using a dataset of four tragedies. Secondly, I discuss network analysis and its application to the conceptualization of figurative language as a network. In the fourth section of this article, I test in two ways this method's ability to provide meaningful information on the analyzed text by applying it to the play *Timon of Athens*, first by assessing existing interpretations and secondly by combining the analysis with a close reading of the play.

In the end, computational methods and tools for research in the humanities are only as valuable as the value they bring to scholars in the field, and they are not the end in themselves. Simply using a computational tool and coming up with various quantifications is unlikely to prove useful, as Thomas Kuhn argues and Franco Moretti applies to digital humanities: “numbers gathered without some knowledge of the regularity to be expected almost never speak for themselves” [Kuhn 1961, 175].^[1] Without developing a critical interpretation of the text, corpus, or subject under research on the basis of the computational analysis, we run the risk that the work of digital humanists remains impenetrable and irrelevant to scholars in our field who are unfamiliar with the methods.

2 Theory: Figurative Language as a Network

A metaphor brings dissimilar worlds together into play, connecting one conceptual domain with another of a different kind. The connection between the tenor and the vehicle of a metaphor (i.e., the underlying subject and the transported meaning) is not a necessary one, but rather based on substitution and a relative freedom from any constraints that a given context may place on a word. After the occurrence of a metaphoric transference of meaning between two conceptual domains, it is as though the tenor and the vehicle simply go their separate ways and the contexts remain distinct. However, this does not entail that a metaphor is merely a temporary displacement of meaning, but rather that, as I. A. Richards argues in *The Philosophy of Rhetoric*, “fundamentally it is a borrowing between and intercourse of thoughts, a transaction between contexts” [Richards 1965, 100]. Although the two parts of the metaphor may remain distinct, they do not necessarily remain unchanged by the interaction, as each carries a residue of the other. When a word, which had previously taken part in a metaphor, takes on the role of either a tenor or a vehicle in a figurative expression, it brings along to the exchange its recently acquired significations. According to Richards:

The processes of metaphor in language, the exchanges between the meanings of words which we study in explicit verbal metaphors, are super-imposed upon a perceived world which is itself a product of earlier or unwitting metaphor. [Richards 1965, 108–109].

This process of meaning transference through metaphors, which takes place in relation to a previous unwitting layer of metaphors, I argue, has the structure of a network, a network that forms and reforms out of the various interactions between the metaphoric components. Accordingly, the two layers of metaphors in Richards' argument, the explicit and the unwitting metaphors, are two aspects of the same network, the latter being the existing state of the network while the former is the introduction of a new metaphoric instance.

The computational method that I propose in this article offers a way to systematize this conceptualization of metaphors as a network. This process is described by Moretti as “operationalization”, applying to digital humanities the work of Bridgman in the philosophy of science, *The Logic of Modern Physics*. The example that Moretti brings from Bridgman concerns length: “to find the length of an object we have to perform certain physical operations. The concept of length is therefore fixed when the operations by which length is fixed are fixed” [Moretti 2013, 1]. According to Moretti, regarding computational analysis and literary theory, this means that we are able to take a literary concept and transform it into a set of operations, “building a bridge from concepts to measurements, and then to the world [...], from concepts of literary theory, through some form of quantification, to literary texts” [Moretti 2013, 1]. In this research, I have devised a set of operations that builds a bridge between the concept of figurative language as a network, through a computational analysis, to literary texts, mapping in this way the interrelatedness of metaphors in a given text or corpus.

The idea of metaphoric exchange as a network is implicitly present in the works of various researchers, such as Lakoff and Johnson, Hans Blumenberg, and I. A. Richards, though each theorizes about this concept from a different angle. Lakoff and Johnson's theory of metaphors, in *Metaphors We Live By*, argue that metaphors are not simply a “rhetorical flourish”, but rather are constitutive of our perception of the world: “our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature” [Lakoff and Johnson 2003, 3]. They distinguish between three major types of metaphors: orientational, ontological, and structural. In certain cases, the latter is “based on similarities that arise out of orientational and ontological metaphors” [Lakoff and Johnson 2003, 152]. This substantiates my argument regarding the network structure of figurative language, since the first two types of metaphors serve as an underlying interconnected metaphoric structure, akin to Richards' unwitting metaphors, on the basis of which new and richer metaphoric exchange is possible.^[2] That metaphors have the structure of a network is arguably most evident in Lakoff and Johnson's notion of metaphorical entailment, according to which instances of a structural metaphor such as “time is money” (e.g. “time is a resource”, “time is a valuable commodity”), link between “all the instances of a single metaphorical structuring of a concept” [Lakoff and Johnson 2003, 96]. Furthermore, entailments do not just tie together instances of the same metaphorical structuring, but also create interactions between dissimilar metaphors, as Lakoff and Johnson state: “a shared metaphorical entailment can establish a cross-metaphorical correspondence” [Lakoff and Johnson 2003, 96].

Thinking about metaphors merely as a decorative art, as “colored talk”, as do the Athenian judges, according to Puttenham, ascribes the figurative with a secondary status, an optional addition to the

“real” literal meaning of our verbal expressions. In *Paradigms for a Metaphorology*, Blumenberg questions whether all metaphoric expressions are in fact translatable to a literal underlying meaning by introducing what he calls “absolute metaphors”:

Absolute metaphors “answer” the supposedly naïve, in principle unanswerable questions whose relevance lies quite simply in the fact that they cannot be brushed aside, since we do not *pose* them ourselves but find them already *posed* in the ground of our existence. [Blumenberg 2010, 14]

Blumenberg gives the “*terra incognita*” metaphor as an example of an absolute metaphor, grounding it in the historical experiences of the age of discovery, to which the metaphor provided an entire way of perceiving reality, “a relation to the world that imagines itself to be standing on the threshold of an immeasurable increase in knowledge” [Blumenberg 2010, 54]. Absolute metaphors are hence a part of a historical network of metaphoric exchanges, as they both originate in specific circumstances and they themselves have “a history” [Blumenberg 2010, 5]. Their absoluteness means that they are resistant to conversion into conceptuality, but “not that one metaphor could not be replaced or represented by another, or corrected through a more precise one” [Blumenberg 2010, 5]. In other words, absolute metaphors manifest in various metaphoric instances and they too take part in meaning transference, shaping other metaphors as well as being reshaped by the exchanges.

By mapping out the network of figurative language in a text, we construct a “diagram of forces”, to use Moretti’s application of Thompson’s idea (i.e., a diagram that discloses “the forces that have been at work” in shaping the network’s structure [Moretti 2005, 56]). These forces are a resonance of the social reality and ideological significations that underlie the production of a text, whether they are the result of a dominant factor, such as politics, religion, psychology, or of any combination of factors. An analysis of such a network makes it possible “to burrow down to the substructure of thought, the underground” [Blumenberg 2010, 5], indicating to us “the fundamental certainties, conjectures, and judgments in relation to which the attitudes and expectations, actions and inactions [...] of an epoch are regulated” [Blumenberg 2010, 14]. Unlike texts low on metaphors, such as legal documents or medical books, texts saturated with figurative language, such as poetry and early modern English drama, provide us with comprehensive networks of metaphors, making them especially instrumental for the analysis of this substructure of thought and the ideological forces that shape them.

3 Methodology

3.1 Topic Classification vs. Topic Modeling

In order to operationalize the network structure of figurative language, the first step that I suggest is to break down the figurative expressions into their components, such as the tenor and vehicle, and classify which words in a given instance carry a metaphoric meaning. For example, consider the following sentence from *Macbeth*: “Let’s make us medicines of our great revenge” [Shakespeare 2015, IV.iii.217]. The words “medicines” and “revenge” are essential in this figurative instance, while a word such as “great” does not carry a figurative significance. It could be argued that, in a sense, “great” is also metaphoric, since it ascribes size to an abstract idea (e.g., revenge), yet if the adjective of “revenge” was the word “monstrous”, there would hardly be a question as to its metaphoric status, and it too would have been included in the analysis. Separating the various figurative components enables us to trace the repetition of the components in other metaphoric instances, mapping in this way the multiple interactions that each component takes part in. However, constructing a network on the basis of words would yield an immense network and, moreover, it would not be efficient for capturing various manifestations of similar metaphors, such as in Lakoff and Johnson’s example, “time is money” and “time is a valuable commodity”. In order to overcome this difficulty, I have devised a system of classification (i.e., grouping together words into shared topics). Thus, words like “money” and “valuable commodity” are both classified under a topic titled “economy”. By using a computational method called topic classification, I have automated this step of the operationalization, a method which requires several other steps in order to complete it.

The idea behind topic classification is akin to another method called topic modeling, in which a computer divides a text or a corpus into groups of frequently reoccurring words by using a probabilistic calculation.^[3] The importance of the probabilistic approach is that words have various meanings depending on their context; thus, each word has a certain probability of appearing with certain words and another probability of appearing with others, accounting in this way for the multiple senses of a word.^[4] Topic modeling has applications in various fields, including biomedicine, cognitive science, anthropology, political science, journalism, social media analysis, and others.^[5] Although topic modeling algorithms have further advanced in recent years, such as the BAT model (bidirectional adversarial topic) in 2020 and TND (topic noise discriminator) in 2022^[6], so as to result in more accurate output, there are still major obstacles when it comes to the topic modeling of figurative language.

Unsupervised topic modeling is entirely automated, a process in which the computer analysis results in groups of words, the number of groups is predetermined manually, and each group is titled only numerically as topic 1, topic 2 and so on. It is important to note that both topic modeling and classification take into account the context of words, so that certain words appear in multiple groups. In topic modeling, however, discerning the titles of the groups of words remains a manual task that requires active and often subjective interpretation. A list of words considered as a topic by a topic modeling may include words that human interpreters recognize as belonging to distinct topics, a problem described by Chang et al. as “word intrusion”, as in following example: “{dog, cat, horse, apple, pig, cow}” [Chang et al. 2009, 3]. Although here the word “apple” is easily identified as the intruder, in certain cases the list of words is almost completely incoherent. This problem is related to the difficulty of predetermining the number of topics, an issue that affects the degree to which a topic modeling is successful in creating coherent topics. On the one hand, having a low number of topics may result in overgeneralizations (i.e., in broad topics, conflating two or more into one). But on the other hand, having a large number of topics is likely to result “in uninterpretable topics that pick out idiosyncratic word combinations” [Steyvers and Griffiths 2011, 441].

In general, unsupervised topic modeling works best when the analyzed corpus has a relatively small number of topics, with optimally few dominant ones per text in the corpus.^[7] Topic modeling of encyclopedias or scientific journals is hence highly effective, since each encyclopedic entrance has a relatively clear topic orientation with a small number of other possible contexts. For example, under “Theatre” in Wikipedia are names of playwrights, plays, theatres, and other related words, but one can also find words relating to various cultures and rituals. When it comes to a text highly saturated with figurative language, using topic modeling tends to result in collocations of unrelated words, forming incoherent topics in various degrees. This occurs since metaphoric components that appear frequently together (i.e., they present a high probability of belonging to the same topic according to the algorithm) nonetheless belong to distinct conceptual domains. And yet, since poetry and plays contain both figurative and literal language, it becomes possible, to a certain degree, to successfully conduct topic modeling, albeit without being able to discern which of the topics and words are the ones used figuratively. The possible benefit of applying topic modeling to poetry is in providing a thematic overview of a poem or a corpus, as shown in the work of Borja Navarro-Colorado, and yet this is not without qualifications. In his research, Navarro-Colorado applies LDA-topic modeling to a corpus of 5,078 Spanish sonnets, using various methods in order to reduce incoherent topics. Upon comparing 100 LDA-topics with the thematic reading of the sonnets by Rivers, he concluded that “we cannot find a clear or constant relationship between an LDA-topic and a theme out of this comparison” [Navarro-Colorado 2018, 7]. Navarro-Colorado recognizes the problematic character of figurative language with regard to topic modeling, stating that:

LDA topic modeling applied to poetry does not extract clear and defined themes as it does when applied to scientific texts. [...] In scientific texts there are words that are used exclusively in very specific contexts, related to specific topics. [...] The linguistic uses in poetry work in the exact opposite way. In poetry a word related with a specific topic can be frequently used to refer to other topics. [Navarro-Colorado 2018, 7–8]^[8]

As part of another research project attempting to use topic modeling on figurative language, Lisa M. Rhody analyzed 4,500 poems, arriving at the conclusion that “topic models of purely figurative language texts like poetry do not produce topics with the same *thematic* clarity as those in Blei’s topic model of *Science*” [Rhody 2012, 25]. This conclusion, however, did not deter Rhody from using topic modeling, but rather sparked a creative approach as to its application on figurative texts. Rhody argues that instead of thematic clarity, what topic modelling offers in the case of poetry is the ability to discern different kinds of discourses, thus leading to a close reading of poems “with high proportions of the same topic in order to check whether or not the poems are drawing from similar discourses, even if those same poems have different *thematic* concerns” [Rhody 2012, 33]. Hence, it is actually due to the imperfect results of the algorithm, she argues, that topic modelling of “highly-figurative language” is useful for literary criticism, since “poetry causes it to fail in ways that are potentially productive” [Rhody 2012, 33]. It is important to note, however, that Rhody treats the entirety of a poem as figurative, even though poems usually include literal parts as well. Although Rhody suggests a way to benefit from topic modeling in the analysis of figurative texts, this merely bypasses the difficulties rather than solving them.

A figurative sentence is in a sense antithetical to the idea of topic modeling as to determining the dominance of one topic in a document, since a metaphor brings together two components of equal importance from dissimilar contexts. Since the purpose of the operationalization that I suggest is to create a network of the interactions between metaphoric components, ascribing a dominant topic, even with one or two minor topics, to an entire poem cannot provide data about the metaphoric interactions. For that purpose, one must ascribe topics to individual words within a text and then analyze their interactions. However, not all words are relevant, as certain words are not indicative of topics, such as prepositions and articles, which are called “stop words” in NLP. In most cases, prior to topic classification or topic modeling, the text undergoes preprocessing that includes the cleaning of excess linguistic units, such as stop words, punctuation, and names of characters. Matthew Jockers, for example, in his topic modeling of 19th century novels, found that “highly interpretable and thematically coherent topics could be derived through a model built entirely from nouns” [Jockers 2013, 131]. Hence, all the adjectives, adverbs, verbs, pronouns and so on, were cleaned in the preprocessing. Since in many figurative instances there is significance to adjectives, adverbs, and verbs — for example when Timon says: “feast your ears with the music” (III.vii.32-3) — excluding such words would leave out valuable information from the analysis of figurative language.

Using topic classification instead of unsupervised topic modeling makes it possible to overcome the various problems posed by figurative language, such as the incoherency of topics and the dominance of a single or few topics in an entire text. In topic classification, the titles as well as the number of topics are predetermined by the researcher. Unlike topic modeling, automating topic classification requires pretraining an algorithm via machine learning on a manually classified dataset. Manual topic classification could suffice when researching a relatively small number of texts, but in the case of big data, training a topic classifier provides an alternative to topic modeling, one which is advantageous for the analysis of figurative language. Although my focus is on one case study, namely *Timon of Athens*, and hence a manual classification would have been enough to test this method's potential for textual analysis, I have trained a topic classifier both to demonstrate the computational automatization of topic classification and to provide a basis for future research on a large corpus.

In order to create the dataset for training a topic classifier, I have used four tragedies written around the same time as *Timon of Athens* (1607).^[9] The plays in the dataset are *Macbeth* (1606) by Shakespeare and partly by Middleton, *A Yorkshire Tragedy* (1605) by Middleton, *The Rape of Lucrece* (1607) by Heywood and *The Bloody Banquet* (1610) by Dekker and Middleton.^[10] Since plays contain both literal and figurative language, the first step was to extract all the figurative instances. Although there are methods in computer science for recognizing figurative language using algorithms that discern whether a sentence is figurative or not, these methods do not isolate figurative sentences from a whole text, but rather require the text to be parsed first into sentences in order to be applied.^[11] Parsing the plays automatically into sentences also proves unsuitable for the purpose of analyzing figurative language, since sentences can include more than one figurative instance, by which I do not mean simply that multiple words are used figuratively, as is the case in any metaphor, but that there are at times multiple unique metaphors in a sentence. For the time being, it seems there is no escape from extracting the figurative instances manually.

The number of figurative instances that I extracted from the four plays is 1,388: 146 from *A Yorkshire Tragedy*, 482 from *Macbeth*, 415 from *The Rape of Lucrece*, and 345 from *The Bloody Banquet*. The next step of creating the dataset was to determine the number of topics and the topics themselves before manually classifying each of the 1,388 instances into the topics. Since the topics should be as relevant to the corpus as possible, I did not decide in advance what they would be, but rather worked from the texts up, gleaning the topics from the figurative instances and slowly adding more topics. In this process, I experimented with various topics, observing, for example, that certain new topics were required, or that at times it would be better to split one topic into two, or that a certain topic was redundant and should be subsumed under a different one. The final result was 103 topics, such as "nature", "politics", "economy", "sexuality", and others (see full list in the appendix).

The next step was the manual classification of the 1,388 figurative instances in the dataset (see Table 1 for examples):

Play	Example — Figurative Unit	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
<i>Macbeth</i>	"Let's make us <u>medicines</u> of our great <u>revenge</u> , / To <u>cure</u> this <u>deadly grief</u> " (IV.iii.217)	Medicine	Violence	Death	Emotions	
<i>Macbeth</i>	"The <u>repetition</u> , in a <u>woman's ear</u> , / Would <u>murder</u> as it fell" (IV.iii.217)	Language	Women	Anatomy	Violence	
<i>The Rape of Lucrece</i>	"Thou hast to our <u>yoke</u> , / <u>Suppressed</u> the <u>neck</u> of a <u>proud nation</u> "	Agriculture	Violence	Anatomy	Character Traits	Politics
<i>The Rape of Lucrece</i>	" <u>Vow</u> and / <u>Swear</u> as you <u>hope meed</u> for <u>merit</u> from the <u>Gods</u> "	Language	Emotions	Economy	Recognition	Religion
<i>The Bloody Banquet</i>	" <u>Hunger</u> and <u>lust</u> will <u>break</u> through <u>flesh</u> and <u>stones</u> " (I.iv.27)	Food	Sexuality	Violence	Anatomy	Materials
<i>The Bloody Banquet</i>	"My <u>vengeance speaks</u> me <u>happy</u> " (III.iii.58)	Violence	Language	Emotions		

Table 1. Examples of manually classified figurative instances taken from the dataset.

Although determining the number of topics and their titles is partly subjective, the subjectivity of this process does not necessarily undermine the viability of topic classification. Rather, it shows that various classifications are possible depending on the researcher's orientation. For example, one might decide that "art" is a topic, while another may wish to distinguish between several topics pertaining to art, such as "paintings", "sculptures", and so on. Deciding on the topics depends both on the corpus and the purpose of the research; thus, if the corpus deals with art, it is more likely that the researcher would want to distinguish between various artistic media. The subjective decision regarding the topics, hence, yields an analysis of different levels of the corpus that are not contradictory.^[12]

Once I had completed the manual classification of the dataset, I experimented with various NLP methods in order to train a classifier that automatically assigns each word in a figurative instance to one of the 103 topics. After cleaning stop words and character names from the dataset, I trained a type of deep learning algorithm called neural network combined with DistilBERT, a version of the pretrained language model developed by Google.^[13] Since the original texts of the plays do not conform to standard spelling or punctuation, I have used contemporary editions in order to maintain consistency in the dataset and with DistilBERT, which was pretrained on contemporary English.^[14] The topic classifier currently achieves a promising result of 72.94% accuracy (the accuracy is the percentage of correct predictions of the classifier), which can be further improved for future work by fine-tuning the machine learning process.^[15] In the process of training the algorithm, the dataset is randomly split into two sets, a training dataset (66%) and a test dataset (33%), so that the algorithm can compare between its own predictions and the original ones made by the creator of the dataset, and accordingly the accuracy is calculated. After completing the topic classification of the text under research, the next step that I suggest for the operationalization of figurative language is to map the interactions between topics, applying for this purpose a method called network analysis.

3.2 Network Analysis

Network analysis is a branch of graph theory in mathematics that has various applications in sociology, economics, history, and medicine, among other fields. For example, in epidemiological research, network theory is used for determining the diffusion of diseases.^[16] Network theory is a highly developed field, rich with techniques and approaches as well as debates, but for the purpose of this research there are specific relevant concepts on which my discussion will focus. A network has two basic features: the nodes and the edges. The nodes, usually represented by circles in the visualization, can stand for various entities, such as individual human beings, numbers, places, words, topics, etc., depending on the objectives of the researcher. The edges, visually represented by lines connecting the circles, stand for the interactions between the nodes on the basis of what the researcher defines as an interaction. For example, a researcher working on cinema can define an interaction as the co-occurrence of two characters in a scene, while another researcher may define an interaction only when there is also a verbal exchange between the characters [Weng, Chu, and Wu 2009].

An important distinction in network analysis is between directed and undirected networks, each of which represents different relations between the nodes and is used for different purposes. Directed networks are used for "relational phenomena that logically have a sense of direction" [Borgatti, Everett, and Johnson 2013, 12], meaning that one node in the network leads to another and so on, as in cases such as contagious disease or the flow of information. In undirected networks, the relations between the nodes "must always be reciprocated, as in 'was seen with' or 'is kin to'" [Borgatti, Everett, and Johnson 2013, 12], as well as in the example of characters appearing in the same scene. In my construction of the network of figurative topics, I defined an interaction between two topics as their co-occurrence in the same figurative instance, entailing that it is an undirected network. For example, in "Macbeth does murder sleep" (II.ii.37), there is an interaction between the topic of "violence" and that of "sleep". The interactions between the nodes can be weighted, so that if a topic appears with another topic multiple times on different occasions, then the weight of their interaction is higher, being the sum of their co-occurrence, which is visually represented by a thicker line.

Another aspect of network analysis is calculating various kinds of centralities, the purpose of which is to measure how central different nodes are in the network in relation to other nodes.^[17] The four centralities which I will now discuss are degree centrality, weighted degree centrality, betweenness centrality, and eigenvector centrality. Degree centrality is the measurement of a node's unique interactions, indicating the number of nodes with which a node interacts.^[18] For example, if a particular node has a total of fifty interactions, but all of them are with just one other node, its degree centrality would be one. Weighted degree centrality measures the total amount of interactions of a node; thus, with regard to the previous example, the weighted degree of such a node would be fifty.

Before discussing the other two kinds of centralities, I will discuss another issue that is relevant to these centralities: the clustering of nodes as well as the core-periphery structure. There are various algorithms that detect clusters in a network, and although each works somewhat differently, in general they calculate the connectedness of nodes, clustering together nodes that have more

interactions between them.^[19] In a network that consists of two clusters, for example, each cluster has several nodes that interact amongst themselves repeatedly, but only one node from each cluster has interactions with the other cluster. Betweenness centrality measures exactly this sort of position that a node occupies between clusters; thus, nodes with high betweenness function as bridges between poorly connected clusters [Cherven 2015, chap 1 and 6] [Borgatti, Everett, and Johnson 2013, chap 10]. The core-periphery structure, unlike clusters, consists only of two blocks: the core in which the nodes are highly connected to each other and the periphery in which the nodes are connected to certain core nodes, as well as partially or not at all connected to other peripheral nodes. Core nodes, hence, have high degree centrality as well as high betweenness, presenting multiple unique interactions that keep peripheral nodes connected to the network [Borgatti, Everett, and Johnson 2013, chap 12] [Oldham et al. 2019]. High betweenness nodes might not be themselves highly connected; that is, their degree is not necessarily high, but they play a central role in maintaining the network as a whole, since without them the network would either split into distinct components or present weaker and less meaningful relations.

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The fourth kind of centrality is the eigenvector, which measures the influence of a node in a network by calculating the interactions of a node with other highly connected nodes, even though this node itself might not be well connected. In *Centrality and Network Flow*, Stephen Borgatti explains the eigenvector as follows: "The idea is that even if a node influences just one other node, who subsequently influences many other nodes (who themselves influence still more others), then the first node in that chain is highly influential" [Borgatti 2005, chap 61]. For example, consider node "A" has many interactions with just one other node, node "B", while node "B" interacts with many nodes in the network, meaning that it has a high degree centrality. In such a case, since node "A" has a significant relation with node "B", a well-connected node, node "A" is in an influential position in the network. One way of understanding this centrality is as a hierarchical system, in which a high-ranking individual communicates with just one lower ranking individual, while this second in command interacts with the rest of the group. Simply put, it is not just interactions with a high number of nodes that makes a node influential, but whether a node interacts with other well-connected nodes.

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To construct the networks of figurative topics, I used a software called Gephi, which includes many algorithms, statistics, and filters for analyzing data. When constructing the network with Gephi, I used one file which contains a list of all the nodes and another file which contains a list of all the interactions. Figures 1 and 2 show networks of the figurative instances that appear in Table 1, in which the size of the nodes represent the degree centrality and the colors of the nodes represent the clusters.

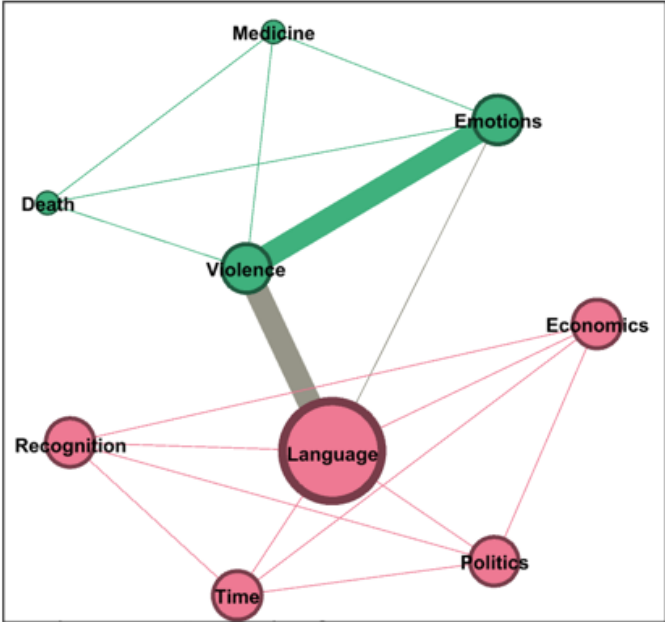


Figure 1. Network of the figurative instances 1, 6, 7, 8 taken from Table 1.

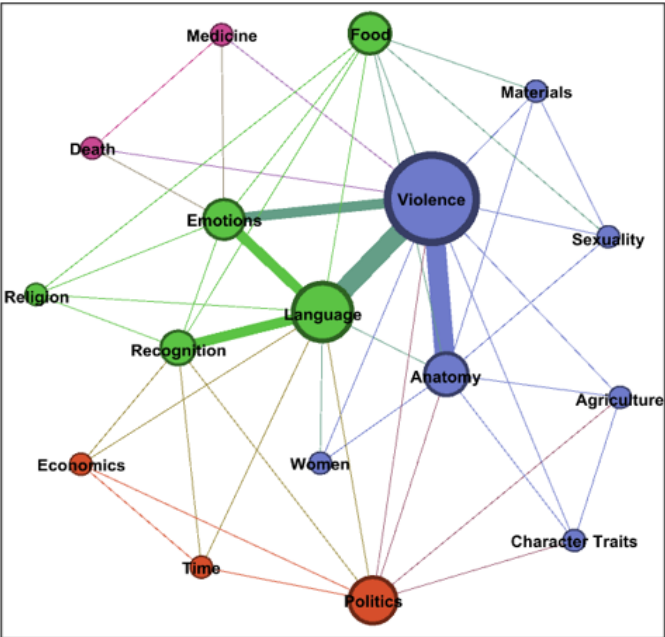


Figure 2. Network of the figurative instances 1-8 taken from Table 1.

It is important to note that Gephi initially provides a random layout of the network, to which the researcher can then apply various algorithms in order to detect clusters and organize the network's structure. Thus, when constructing the network of *Timon of Athens* for the analysis in the following section, Gephi first produced a random layout (see Figure 3) of the 4,715 interactions between the

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topics that appear in the 546 figurative instances extracted from the play. Figure 4 shows the network of the play after I applied algorithms for cluster detection and centrality measurements as well as ForceAtlas2, an algorithm that organizes the network by simulating gravity between the nodes [Jacomy et al. 2014].

The final step was to assess the usefulness of the text's network of figurative topics for interpretative criticism, whether by corroborating certain assumptions, challenging existing views, or providing new insights. Ultimately, the computational methods of distant reading used in this project are merely tools rather than an end in themselves. Topic classification and network analysis can be meaningful for literary studies in so far as we actively engage with the patterns they reveal and return differently to a close reading.

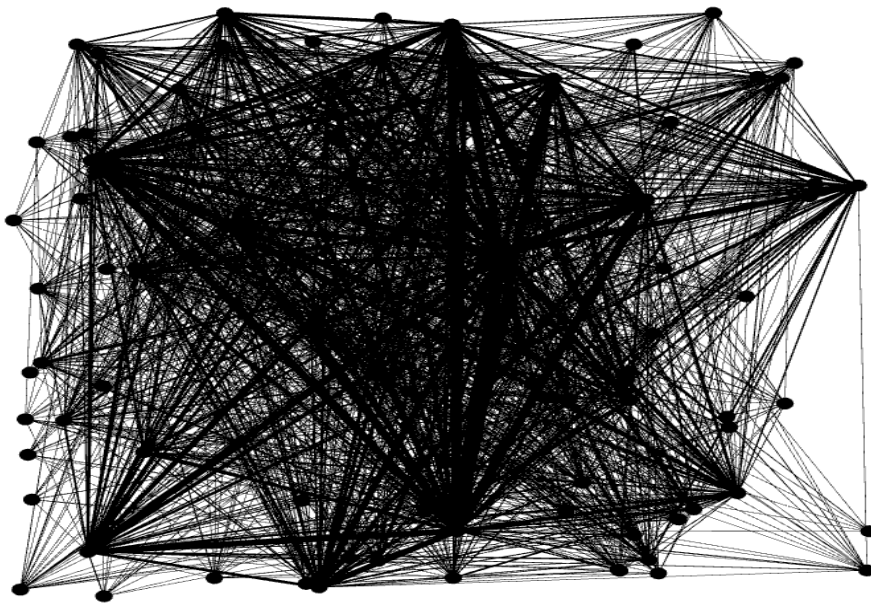


Figure 3. The initial random layout produced by Gephi to represent the network of *Timon of Athens*.

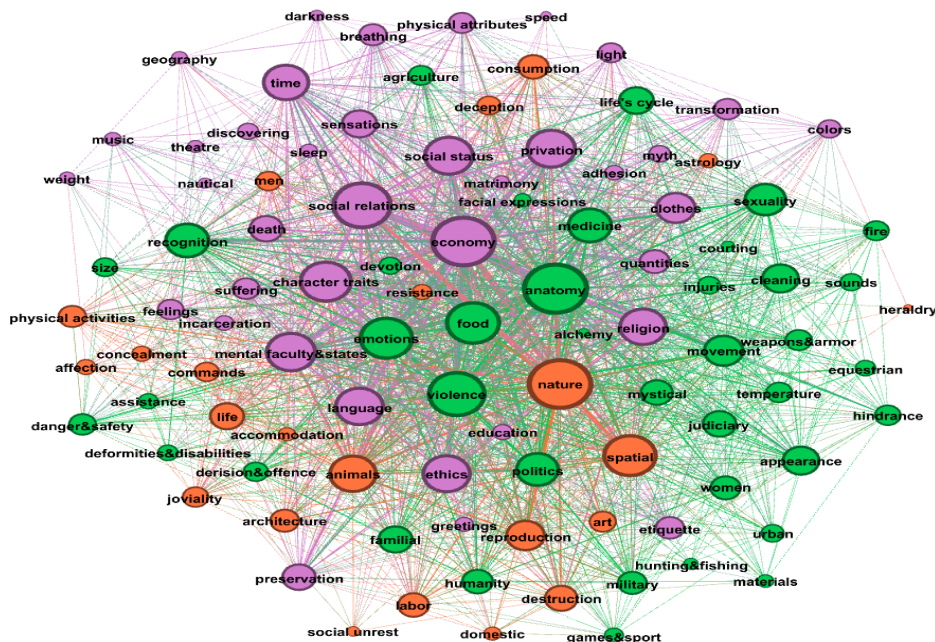


Figure 4. A visualization of *Timon of Athens*' network of figurative topics. Degree centrality is represented by the size of nodes, and the clusters are represented by the various colors.

4 Case Study: The Network of *Timon of Athens*

4.1 Initial Results and Assessments

Anyone who has read or been to a production of *Timon of Athens* knows that the main theme of the play pertains to economic issues, and yet it would not be obvious to say outright that the topic of “economy” dominates the play’s figurative language. Although it is unsurprising to find out that the figurative topic of economy has high centrality measures, the fact that *Timon of Athens* revolves around money, credit, and debt, does not necessarily mean that the figurative language does too. In the following interpretation of the play, my focus is, first of all, on the major figurative topics in the network, but this by no means entails that one cannot interpret the network differently and focus on other topics and their interactions. That at the heart of *Timon of Athens* beats a struggle with the rise of mercantile capitalism serves only as the starting point for many researchers, whose focus then varies widely, covering a range of auxiliary subjects such as gender, politics, religion, aesthetics, and others.^[20] Whether the isolation of phenomena into distinct domains, such as economy and politics, is rooted in our daily experiences, stems from a mental process, or only serves a discursive purpose for research does not mean that each phenomenon exists on its own, severed from an intricate network of ties with other phenomena.

According to the data of *Timon's* network, the three topics with the highest centrality measures are “economy”, “anatomy”, and “nature” (see Table 2). The various discrepancies between centrality measures, such as that “nature” has a relatively low number of weighted degree and a high eigenvector, are in themselves significant indicators prompting further investigation. Although subjects such as “nature” and “anatomy” have received critical attention, considering both together in relation to “economy” is usually anecdotal or at best indirectly discussed via related subjects, such as the

relation between reproduction and Mother Earth as an implicit conjunction of body and nature.^[21] Thus, inspecting the relations between the network's main topics already provides us with a potentially ripe plot that has been overlooked, which can serve for the development of a novel critical interpretation.

Topic ID	Label	Weighted Degree	Degree	Betweenness Centrality	Eigenvector Centrality	Modularity Class
32	Economy	619	89	239.3801601	0.991379817	1
6	Anatomy	585	90	259.0106383	1	1
72	Nature	395	89	252.8416508	0.994013164	2
88	Social Relations	362	82	179.4518861	0.934376098	1
100	Violence	321	79	135.7793867	0.935630458	0
34	Emotions	306	73	120.7243327	0.874253677	1
43	Food	289	74	113.3206956	0.887551213	1
66	Mental Faculties & States	264	68	73.47000376	0.851842598	1
14	Character Traits	237	71	95.3921954	0.87086153	1
57	Language	226	66	83.74412502	0.821104891	1
7	Animals	224	64	72.8268433	0.806842635	2
92	Spatial	217	73	99.47052828	0.889447093	2
89	Social Status	214	67	88.24516802	0.832449686	1
81	Religion	213	63	53.73627786	0.816770683	0
78	Privation	207	67	81.58954622	0.823603915	1
64	Medicine	205	59	46.00289961	0.77185223	0
36	Ethics	185	65	77.70044777	0.811462358	1
76	Politics	177	57	50.69770641	0.733018315	0
80	Recognition	153	59	65.39706131	0.737823402	1
97	Time	149	62	82.31792331	0.770353263	1
85	Sexuality	144	55	44.95838577	0.726327379	0
68	Movement	129	52	37.85089603	0.702173385	0
16	Clothes	122	52	32.44408435	0.695025214	1
82	Reproduction	122	51	31.74017266	0.680041164	2

Table 2. Centrality measures of the 21 top nodes in *Timon of Athens'* network of figurative topics.

Topic ID	Topic ID	Weight	Labels
32	6	38	Economy; Anatomy
32	88	37	Economy; Social Relations
88	6	27	Social Relations; Anatomy
43	6	26	Food; Anatomy
100	6	25	Violence; Anatomy
6	72	24	Anatomy; Nature
32	34	22	Economy; Emotions
34	6	22	Emotions; Anatomy
81	32	22	Religion; Economy
66	6	21	Mental Faculties & States; Anatomy
72	32	21	Nature; Economy
32	78	21	Economy; Privation
32	89	20	Economy; Social Status
32	100	20	Economy; Violence

Table 3. Data of the top 14 interactions between nodes in the network of *Timon of Athens*.

The network analysis, it is important to note, does not just indicate that the aforementioned topics are dominant in the play due to their high occurrence, but also reveals the interactions that these topics have with other topics (see Figure 5). A close reading of the play that integrates an analysis of the network should also closely read the network itself and consider the nuanced interactions between topics as well as the meaning behind the various centrality measures. *Timon's* network presents strong interactions between the topics of "economy", "anatomy", and "social relations", as the highest number of interactions that each of them has is with the two other topics. This core trio of topics at the center of the network branches out through "economy" and "anatomy" to other significant topics such as "food", "violence", "nature", and "emotions". The data in Figure 5 shows this branching out through the fact that both "economy" and "anatomy" appear multiple times with various topics, whereas "social relations" appears only with "economy" and "anatomy". Moreover, this is evidenced by the cluster analysis, as seen in Figure 4, in which "anatomy" belongs to one cluster, whereas "economy" and "social relations" to another. The dominant topic in the third cluster is "nature", the relatively high betweenness of which expresses its distinct place in the network.

Although the betweenness centrality of "nature" is quite similar to that of "anatomy" and "economy", relative to its weighted degree in comparison to these two topics, the high betweenness of "nature" stands out. This indicates that "nature" spreads throughout the network so as to become a dominant force across the play, vital for keeping the relation between core and periphery, thus maintaining the network as a whole. Timon's mock encomium to thievery expresses a stance regarding nature similar to the one in the network, as the medium or facilitator for the spread of corrupt economic self-interest:

The sun's a thief and with his great attraction
Robs the vast sea; the moon's an arrant thief
And her pale fire she snatches from the sun;
The sea's a thief whose liquid surge resolves
The moon into salt tears; the earth's a thief
That feeds and breeds by a composture stol'n
From general excrement. Each thing's a thief (IV.iii.431-7)

An important scholarly debate regarding *Timon of Athens* is how to explain the extreme shift that the character of Timon undergoes, from an altruistic paternal figure in Acts 1 and 2 to a misanthropic madman in Acts 3-5.^[22] Considering this problem through the play's network can be potentially rewarding, since by constructing networks that include only the figurative instances of Timon in each of the acts, we can compare them and look for distinct indicators on which to establish an interpretation. Even without scrutinizing the networks of Timon's first phase (Acts 1-2) and second phase (Acts 3-5) in search of differences, there is an unmistakable divergence in two major topics, namely the topics of "nature" and "social relations" (see Figures 5 and 6). In Timon's lines in the first two acts, "nature" barely appears at all and "social relations" is a dominant topic, whereas in the last three acts the centrality of "nature" increases and the topic of "social relations" drastically loses its

importance.

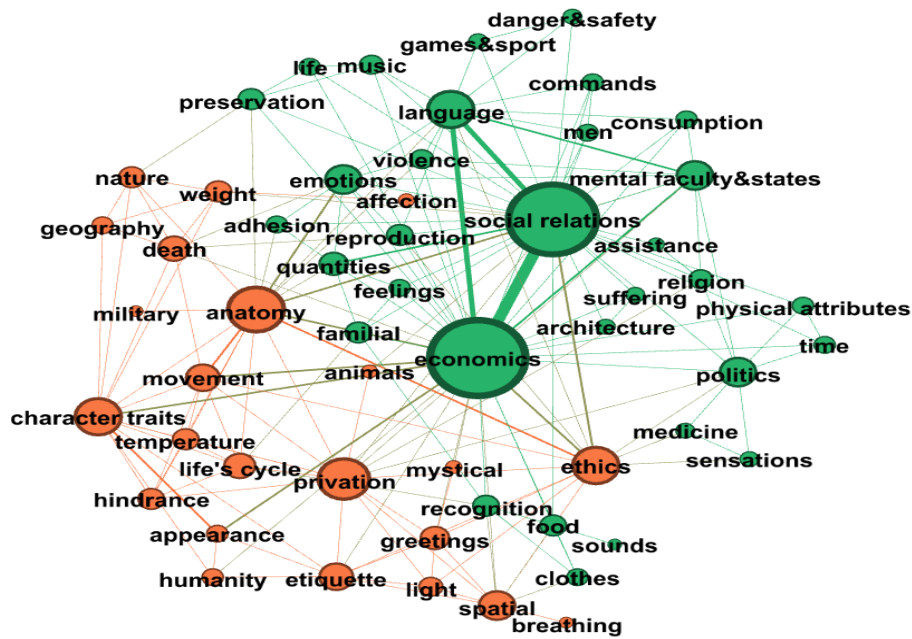
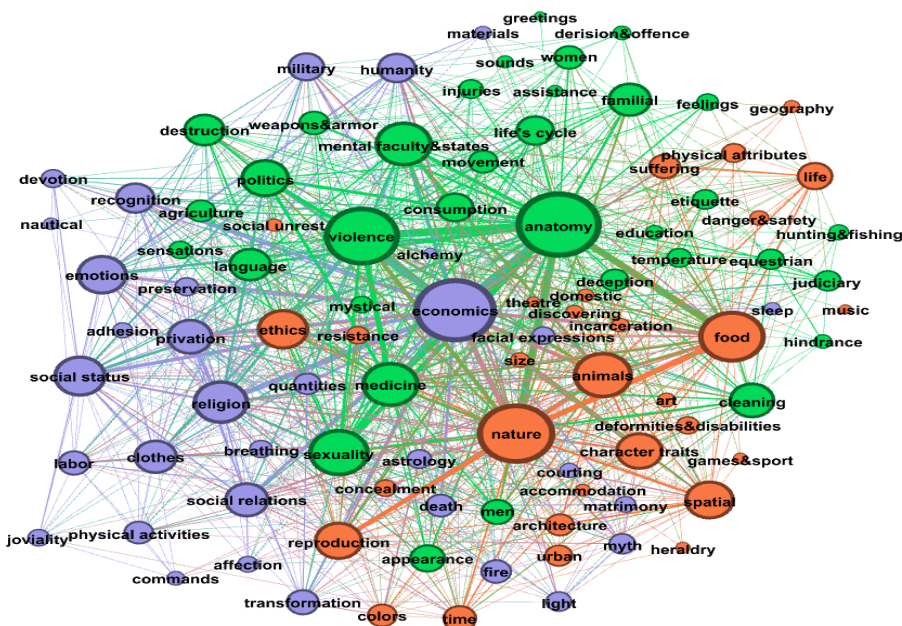


Figure 5. Network of the character of Timon in Acts 1-2 of *Timon of Athens*.

Topic ID	Label	Weighted Degree	Degree	Betweenness Centrality	Eigenvector Centrality	Modularity Class
32	Economy	50	34	483.9603896	1	1
88	Social Relations	44	31	405.9284632	0.880332721	1
6	Anatomy	23	18	146.2821429	0.675188214	0
57	Language	21	14	45.21991342	0.539625395	1
36	Ethics	17	14	100.9275974	0.557258446	0
14	Character Traits	16	14	71.79336219	0.44476479	0
78	Privation	16	16	100.6443001	0.554277757	0
66	Mental Faculties & States	12	10	12.79220779	0.476601138	1
34	Emotions	11	10	12.23888889	0.454674607	1
68	Movement	11	9	14.79408369	0.389479591	0
76	Politics	10	10	43.71904762	0.395413257	1
92	Spatial	10	10	71.79487734	0.328565309	0
38	Etiquette	9	9	16.77979798	0.34119935	0
24	Death	8	8	21.95440115	0.284557476	0
59	Life's Cycle	8	8	11.63333333	0.276058103	0
79	Quantities	8	7	5.152380952	0.337094561	1
46	Greetings	7	7	8.605591631	0.282619898	0
9	Appearance	6	4	0	0.180362901	0
40	Familial	6	6	8.871500722	0.267522668	1
43	Food	6	6	60.8234127	0.239925962	1
48	Hindrance	6	6	0	0.235413241	0
72	Nature	6	6	6.145238095	0.183843573	0
77	Preservation	6	6	10.39015152	0.293944982	1
80	Recognition	6	6	8.692893218	0.209711684	1
82	Reproduction	6	6	3.553607504	0.336879254	1
95	Temperature	6	6	0	0.235413241	0
102	Weight	6	6	21.83575036	0.185671487	0

Table 4. Data of the character of Timon in Acts 1-2 of *Timon of Athens*.



Topic ID	Label	Weighted Degree	Degree	Betweenness Centrality	Eigenvector Centrality	Modularity Class
6	Anatomy	244	76	606.3598252	0.985849569	2
32	Economy	244	73	428.9662156	1	0
72	Nature	191	68	351.8092412	0.961431577	1
100	Violence	167	66	340.4939345	0.922485712	2
43	Food	135	57	243.1157881	0.849680136	1
7	Animals	119	50	150.8315495	0.776809028	1
64	Medicine	118	48	85.78977267	0.770138187	2
85	Sexuality	111	51	89.66273749	0.825226509	2
81	Religion	102	46	66.54405658	0.770624169	0
66	Mental Faculties & States	89	48	90.1589271	0.77762441	2
76	Politics	85	39	60.69431132	0.664488522	2
89	Social Status	74	43	91.26195074	0.705198613	0
34	Emotions	71	41	60.97845472	0.684206861	0
78	Privation	70	36	45.4160434	0.613667472	0
82	Reproduction	69	39	51.68189421	0.659306452	1
36	Ethics	67	42	83.14964346	0.710693991	1
92	Spatial	62	40	101.5889494	0.637897675	1
14	Character Traits	60	38	54.23624899	0.653338824	1
88	Social Relations	60	35	47.35894261	0.623618466	0
15	Cleaning	57	36	56.61245122	0.587082881	2
57	Language	56	33	32.14238166	0.590324043	2
16	Clothes	54	34	40.62835777	0.572474363	0
40	Familial	48	34	60.87014636	0.568538294	2
80	Recognition	48	30	27.3187429	0.53847421	0

Another obvious difference between the two networks, which is immediately noticeable through their visualizations, is that the network of Acts 1-2 is significantly smaller and less dense than that of Acts 3-5. However, this cannot simply be attributed to the fact that one network consists of two acts and the other of three acts. Rather, this difference exists for two reasons: (1) there is a drastic increase in the total number of words spoken by Timon in Act 4; and (2) in Acts 3-5 there is an increase in the percentage of words used in the figurative instances in comparison to Acts 1 and 2 (see Table 6).

Act	Figurative Instances	Words in Figurative Instances	Words in Total: Literal & Figurative	% of Words in Figurative Instances from Total
Act 1	22	298	1206	24.70978441
Act 2	12	140	511	27.39726027
Act 3	29	294	562	52.31316726
Act 4	140	1865	3144	59.31933842
Act 5	26	370	918	40.30501089
Acts 1-2	34	438	1717	25.50960978
Acts 3-5	195	2529	4624	54.69290657

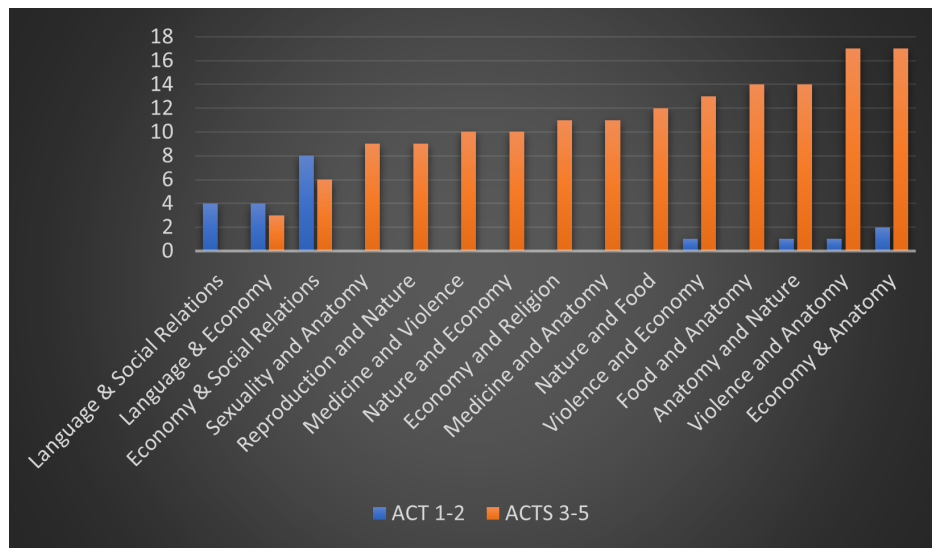


Figure 7. A comparison between Timon's top interactions in Acts 1-2 and Acts 3-5.

Both the shift in the two major topics, "nature" and "social relations", and the shift in Timon's use of figurative language corroborate that there is a pronounced split between the Timon of the first two acts and the Timon of Acts 3-5. Comparing the topic interactions in Timon's two phases reveals this split as well, as in Acts 1-2 the dominant interactions are between "economy", "social relations", and "language", whereas in the rest of the play, the dominant interactions are between "economy", "anatomy", and "violence" (see Figure 7). On the basis of the data from the play's network, it is possible to assess existing interpretations of the play and of Timon's split, as well as develop other possible interpretations. Interpretations of Timon's split and of the play as a whole are ultimately linked; hence, to develop or inspect interpretations of the former, a contextualization through the latter is vital.

Consider, for example, Finkelstein's interpretation in *Amicitia and Beneficia in Timon of Athens*, which focuses on nature mainly through Cicero's notion of sociality and friendship as relationships rooted in nature: "these relationships constitute the state, itself aligned with virtuous nature" [Finkelstein 2020, 805]. Though insightful and comprehensive, Finkelstein's in-depth contextualization of the benefits of friendship in *Timon* through the classical works of Seneca, Plutarch, Cicero, and others addresses nature's role in the play in the narrow sense of an underlying condition of a specific political system, "the republican state as a natural entity" [Finkelstein 2020, 806]. In the network of *Timon of Athens*, the topic of "politics" is relatively a minor one, ranking between #18-20 among the various centralities (see Table 2); hence, we may question the stress that Finkelstein puts on the political aspects of the play. Moreover, the main interactions of "politics" in the network are with "economy", "nature", "anatomy", and "violence", whereas "social relations" barely interacts with "politics" (see Table 7), suggesting that there is a certain degree of separation between these two domains, which qualifies Finkelstein's interpretation.

Topic ID	Topic ID	Weight	Labels
76	32	11	Politics; Economy
76	100	10	Politics; Violence
76	72	10	Politics; Nature
76	6	10	Politics; Anatomy
76	64	9	Politics; Medicine
76	36	7	Politics; Ethics
76	67	7	Politics; Military
76	66	7	Politics; Mental Faculties & States
76	81	6	Politics; Religion
76	92	6	Politics; Spatial
76	34	6	Politics; Emotions
76	28	5	Politics; Destruction
76	7	5	Politics; Animals
76	89	4	Politics; Social Status
76	88	4	Politics; Social Relations
76	78	4	Politics; Privation

Table 7. Data of the top 16 interactions of the topic "politics" in the network of *Timon of Athens*.

Regarding Timon's shift, Finkelstein focuses on the relations between economy, politics, the natural state, and social relations, arguing that in the first phase Timon acts "both like Cicero's friend, virtuously giving benefits without an expectation of favor, and like someone almost opposite: Seneca's strongman, aloof to his expectations of other's behavior" [Finkelstein 2020, 812]. Timon, however, cannot have it both ways; on the one hand, "the collapse of relationships in the second half feels like a violent breach in nature", and on the other hand, it "points to the need for a strong political will that can distinguish virtue from venality" [Finkelstein 2020, 817]. The argument regarding Timon's first phase could be seen as having expression in the networks through the shift from the topic of "social relations" to that of "nature". However, regarding the second phase, there is no indication that "politics" undergoes a change in position (see Tables 4 and 5) or gains a special significance in Timon's top interactions in either phases (see Tables 8 and 9).

Topic ID	Topic ID	Weight	Labels
32	88	8	Economy; Social Relations
57	88	4	Language; Social Relations
57	32	4	Language; Economy
32	14	2	Economy; Character Traits
32	9	2	Economy; Appearance
14	9	2	Character Traits; Appearance
34	6	2	Emotions; Anatomy
88	79	2	Social Relations; Quantities
88	6	2	Social Relations; Anatomy
36	32	2	Ethics; Economy
36	88	2	Ethics; Social Relations
36	6	2	Ethics; Animals
32	68	2	Economy; Movement
32	6	2	Economy; Anatomy
68	6	2	Movement; Anatomy
66	57	2	Mental Faculties; Language
66	32	2	Mental Faculties & States; Economy

Table 8. Timon's top interactions in Acts 1-2 of *Timon of Athens*.

Topic ID	Topic ID	Weight	Labels
100	6	17	Violence; Anatomy
32	6	17	Economy; Anatomy
43	6	14	Food; Anatomy
6	72	14	Anatomy; Nature
100	32	13	Violence; Economy
72	43	12	Nature; Food
32	81	11	Economy; Religion
64	6	11	Medicine; Anatomy
64	100	10	Medicine; Violence
72	32	10	Nature; Economy
85	6	9	Sexuality; Anatomy
82	72	9	Reproduction; Nature
78	32	8	Privation; Economy
89	32	8	Social Status; Economy
72	7	8	Nature; Animals
7	32	8	Animals; Economy
66	6	8	Mental Faculties & States; Anatomy
72	100	8	Nature; Violence
43	32	8	Food; Economy
64	85	8	Medicine; Sexuality

Table 9. Timon's top interactions in Acts 3-5 of *Timon of Athens*.

Another interpretation worth considering is Ken Jackson's influential reading of the play, which sees Timon's motivation for gift-giving in a positive Christian light, distinguishing his reading from the critical tradition of reading in a "negative (Johnsonian) view Timon's giving" [Jackson 2001, 39]. According to Jackson,

In creating the sudden split between the two Timons, Shakespeare actually reveals their proximity. Timon's misanthropy is implied in his giving. ... And so, too, his misanthropy is religious, a necessary renunciation of the circular economy of exchange. [Jackson 2001, 46]

For Jackson, Timon is a kind of Abrahamic figure, for whom in "responding to the call of the other, God, the impossible, 'a duty to hate is implied'" [Jackson 2001, 46]. Furthermore, Jackson argues, Timon is in a sense caught between the ethical and the religious, which explains his "confusing generosity, the way he simultaneously seems to love others but, in that love, to distance himself" [Jackson 2001, 51].

The main topics involved in Jackson's interpretation are "economy", "religion", "ethics", "social relations", and "emotions". Although in the entire play's network the topics of "religion" and "ethics" are somewhat more significant than "politics" (in comparison to Finkelstein's emphasis), they are also relatively minor ones (see Table 2). The topic of "emotions" is a significant topic overall, but in Jackson's interpretation it is not as emphasized as the other topics. A closer look at Timon's two networks (see Tables 4 and 5) reveals that in the first phase "ethics" is quite significant, while "religion" is in the background. Yet, in the second phase "religion" gains prominence, whereas "ethics" decreases. These shifts are not as pronounced as those of "nature" and "social relations" but they are significant enough to argue that the network expresses what is, for Jackson, a radical movement towards the religious in the second part of the play. In the following section, I develop a reading of the play and the problem of the two Timons on the basis of the computational analysis, examining whether the play's network provides information that can coalesce into a coherent interpretation.

4.2 Interpreting *Timon of Athens*

From the outset, *Timon of Athens* presents the relations between the characters as revolving around economic value, and throughout the play this remains the key element in defining the mode of existence of the Athenian society. Whether it is the appraisal of commodities, the patronage of art, the showering of gifts, or the collecting of debt, the play repeatedly foregrounds social relations through economic exchanges, so as to produce an almost fixed image of the market as "the constant model of human relations" [Rizzoli 2017, 22]. As earlier mentioned, the network analysis does not just support the interpretation that economic considerations and social relations are closely linked in the play (Table 3), but also provides insights into the nature of this relationship as perceived by Timon in comparison to the ruling mode of thinking in Athens.

On the basis of the network, I argue that the monetary economic form defines the social world of Athens, whereas Timon, in his first phase of the play, perceives the world through the economic form of barter. Building on Marx's definition of barter as a relation between commodities in which one converts "the bodily shape of that other commodity into the form of its own value" [Goux 1990, 37], Goux argues in *Symbolic Economies* that barter as a relation is equivalent to the social relations taking place in the formation of the ego, having "precisely the same structure as *the specular relationship with the other*" [Goux 1990, 13]. Identifying with another brings about the experience of the self, an "identification with the image of the *like*" [Goux 1990, 14]. Just like when two commodities in a relation of barter express "value in the body of the other", the social relations of identification create a process in which "in each other's presence, the two beings recognize each

other as similar" [Goux 1990, 13]. The three main topics in Timon's network in Acts 1-2 ("economy", "social relations", and "anatomy") are constitutive of the barter form as a mode of thinking and as an absolute metaphor, since it is the interactions between these topics that bring about the process of social identification as the symbolic economy of barter.

In his philanthropic phase, Timon experiences his own worth through an identification with the worth he ascribes to his friends, telling Apemantus: "what better or properer can we call our own than the riches of our friends?" (I.ii.100-1). However, Timon's identification is with his friends' collective worth. Thus, on the one hand, it is as though Timon places himself above each of them as individuals, and yet, on the other hand, his sense of self is fragmented and distributed among others like his gifts and fortune. Underlying Timon's understanding of both gift-giving and friendship is a desire for worth and meaning anchored in a concrete, bodily presence, one that affirms his personal relations. However, Timon does not live in a society dominated by barter but rather by the exchange of money, an economic form that splits between the intrinsic value and the extrinsic value, between the concrete materiality of a commodity and its value in the marketplace. Although Timon is not oblivious to the reality of money, he appears unwilling to accept and internalize it as a mode of thinking.^[23] It is important to note that Timon's barter perception of social relations is not free from economic considerations and self-interest, as he openly says to his so-called friends: "what need we have any friends, if we should ne'er have need of 'em? They were the most needless creatures living should we ne'er have use for 'em" (I.ii.94-6). And yet, Timon expects his gifts to be reciprocated with the friendship of those who receive them. Furthermore, from Timon's perspective, if the need for material reciprocation were to arise, it would be premised on this owed fraternity, not on a binding legal document of debt.

The culture of credit in early modern England that informs the play was, on the one hand, rooted in personal relations of trust and advanced communal bonds. Yet, on the other hand, at the end of the 16th century, credit became more and more anchored in legal contracts, turning into an impersonal system in which violent penalty became the mechanism of enforcement [Bailey 2011, 382]. Timon believes his credit network is one of personal relations, a communal body that breaks bread and shares "one another's fortunes" (I.ii.103). The transaction of credit opens up both a temporal and a spatial gap between those involved, as it postpones the end of the exchange. This gap, when mediated by trust, becomes a social force that ties a community together in personal relations despite physical distance. However, when legal mechanisms of penalty occupy the gap, it turns even social relations of close proximity into impersonal ones. To close this gap, as it were, the English law placed as collateral the body of the debtor in the hands of creditors, permitting them to "detain his debtor's indefinitely", and even to use "the objectionable conditions of prison as a means to exact revenge" [Bailey 2011, 378–379]. Although Timon is explicitly the prime source of nourishment and money to his false friends, as he is well-aware, it is as though he does not distinguish between the body of the community and his own. Thus, Apemantus's words ring true when he says: "what a number of men eat Timon, and he sees 'em not!" (I.ii.39-40). In this stage of the play, Timon believes that the "bond of men" (I.i.148) is a natural relation, that "we are born to do benefits" (I.ii.99-100), and yet this belief is but the result of the illusory appearance of an intrinsic value that exists naturally in the body of a commodity outside of its monetary value.

In Timon's second phase (Acts 3-5), he internalizes the economic forms of money and credit, which demystify his idea of a communal body and leads him to discover the inevitable self-interest of the individual body and its frailty in the face of the impersonal law. The rise in the interactions between "anatomy" and "violence" in Acts 3-5, as well as the interactions of "economy" and "food" (see Tables 8 and 9), shows that the physical reality of the body itself becomes a pronounced issue for Timon. When he is denied by his so-called friends, his disbelief derives from his belief in barter-like reciprocal social relations, according to which "reciprocal debts contracted between as many interested parties as possible over a number of months, or even years, would be 'reckoned' and cancelled against each other" [Muldrew 1998, 101]. As Timon experiences this breach in the equality of barter, the veil is lifted from his way of viewing sociality, revealing to him the natural state of man where previously there was simply no need to consciously consider it, since nature and social relations had been perceived as one and the same. The shifts in the centralities of "social relations" and "nature" in Timon's networks serve as the basis of this interpretation, as the high centrality of "social relations" and low centrality of "nature" in the first half express Timon's conflating of social bonds with the natural state to the point of disregarding the latter, while his private revelation of the natural state as distinct from the social reality turns the topic of "nature" into a visible and conscious matter for him, resulting in its rise in the second half of the play.

The nature that Timon discovers is not a nurturing earth that fosters "the bond of men" and breeds kinship, but rather the "common whore of mankind" that brings out "ungrateful man" and "teem with new monsters" (IV.iii.187, 189). As Rizzoli argues in *Shakespeare and the Ideologies of the Marketplace*, the play gestures towards "the 'naturalized' image of man and commerce which supports the mercantilist articulation of the market's laws" [Rizzoli 2017, 22]. For Rizzoli, the play shows that "market practices are thus justified as a natural fact; they are shown to be essential and incontestable as the acquisitive drives they aim to gratify" [Rizzoli 2017, 22]. Through the internalized monetary economic form, Timon now sees the natural man as an anti-social animal and yet as inherently economically-minded, driven by the "interested sophistry of merchants and manufacturers", as observed by Adam Smith in his analysis of mercantilism [Smith 2007, 380].

When living in isolation in the wild, Timon clings to the mere idea of intrinsic value, of the material body of money and commodities as in barter, exactly because it no longer functions as a symbolic currency for Timon's social relations of identification and because he takes no part in Athen's money economy. Unlike money and credit, food functions for Timon as the ultimate barter commodity, a paradigm of natural materiality, as it necessitates the immediate physical presence of those feasting together. Looking closely at the topic of "food" reveals that it becomes much more dominant for Timon in the second half of the play, and its topic interactions are with "anatomy", "nature" and "economy" (see Table 10). In the second phase, the distinction between the intrinsic value of gold and that of food finally becomes unmistakable for Timon, and yet they are still inextricably linked for him. Digging in the earth in search of roots to satisfy his hunger, Timon exclaims, "Who seeks for better of thee [the earth], sauce his palate / With thy most operant poison" (IV.iii.24-5). However, instead of nourishing food he finds gold, the poison of society. Even though gold in its natural state does not provide the immediate presence of value, but rather a social promise of future sustenance, Timon still associates it with a consumable substance, with poison.

Moreover, in Timon's network, "food" and "animals" share strong interactions with "violence", "economy", and "nature" (see Table 10), whereas for the other characters the topic of "animals" is much less intertwined with "food". Instead, the network I have constructed for the rest of the characters combined shows that for them the topics of "social relations" and "food" are the ones sharing significant interactions, namely with "economy", "anatomy", "emotions", and "nature".

	Weight	Animals	Weight	Food	Weight	Social Relations
Timon	4	Animals; Character Traits	4	Food; Temperature	4	Social Relations; Mental Faculties & States
	4	Animals; Men	4	Food; Social Relations	4	Social Relations; Food
	5	Animals; Reproduction	4	Food; Violence	4	Social Relations; Animals
	5	Animals; Violence	5	Food; Medicine	4	Social Relations; Privation
	6	Animals; Mental Faculties	7	Food; Animals	4	Social Relations; Language
	7	Animals; Food	9	Food; Economy	4	Social Relations; Religion
	8	Animals; Nature	12	Food; Nature	5	Social Relations; Anatomy
	8	Animals; Economy	14	Food; Anatomy	14	Social Relations; Economy
	Weight	Animals	Weight	Food	Weight	Social Relations
Others	4	Animals; Violence	5	Food; Character Traits	8	Social Relation; Privation
	4	Animals; Language	5	Food; Animals	9	Social Relations; Time
	5	Animals; Character Traits	6	Food; Violence	9	Social Relations; Food
	5	Animals; Economy	7	Food; Nature	11	Social Relations; Emotions
	5	Animals; Social Status	9	Food; Social Relations	11	Social Relations; Character Traits
	5	Animals; Food	9	Food; Economy	12	Social Relations; Nature
	5	Animals; Nature	10	Food; Emotions	22	Social Relations; Anatomy
	5	Animals; Mental Faculties & States	12	Food; Anatomy	22	Social Relations; Economy

Table 10. A comparison between the figurative speech of Timon and the other characters, as pertaining to the topics of "animals", "food", and "social relations". The cells that are colored and bolded or italicized indicate shared interactions with "food".

Once Timon has internalized the monetary economic form, he no longer sees friendship as a natural physical bond, but rather as inextricable from bestial self-serving drives. Reminiscent of Hobbes's *Leviathan*, for whom only the coercive power of the state can inhibit the natural state of man as *Homo homini lupus*^[24], Timon sees violent intervention as the only option against the natural greed of the man-wolf. But, unlike Hobbes, for Timon there is no remedy in the authority of the state's law, and the only real solution is the total destruction of Athens, which he encourages Alcibiades to execute. The inevitable course of events for the self-devouring wolf, according to Timon, is the self-annihilation of mankind, since, as Timon poses, "if thou wert the wolf, thy greediness would afflict thee and oft thou shouldst hazard thy life for thy dinner" (IV.iii.332-4). Although Alcibiades fights for what he considers to be Timon's cause, he ultimately stands for the Hobbesian solution of coercive law. In contrast to all of the other characters in the play, Alcibiades is the only one for whom the topic of "judiciary" is significant (see Figure 8).

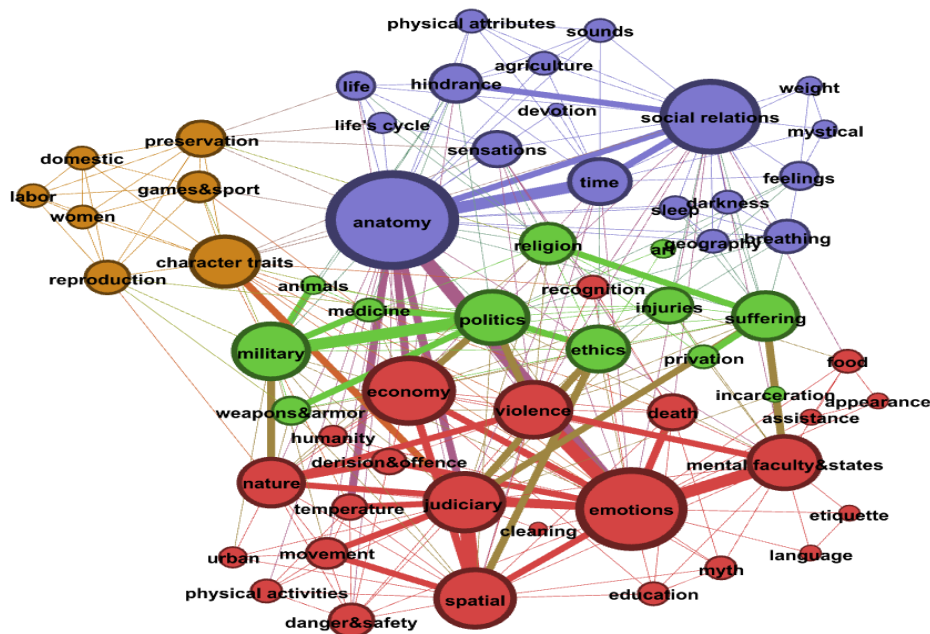


Figure 8. Network of Alcibiades' figurative topics.

Topic ID	Label	Weighted Degree	Degree	Betweenness Centrality	Eigenvector Centrality	Modularity Class
6	Anatomy	42	34	351.9583	1	1
34	Emotions	40	28	292.5043	0.852493	2
55	Judiciary	29	20	99.77756	0.650205	2
88	Social Relations	28	25	201.1335	0.700449	1
32	Economy	27	23	87.78421	0.819049	2
92	Spatial	26	20	64.12568	0.71438	2
76	Politics	25	18	89.31931	0.621671	3
67	Military	24	19	78.63068	0.653487	3
100	Violence	24	19	43.2469	0.723853	2
66	Mental Faculties & States	22	18	82.87052	0.609653	2
72	Nature	20	16	33.68336	0.596832	2
94	Suffering	20	16	44.88906	0.550108	3
14	Character Traits	18	17	117.898	0.550649	0
36	Ethics	18	15	43.37255	0.561572	3
97	Time	18	15	75.28469	0.481597	1
81	Religion	14	13	25.92245	0.45406	3
48	Hindrance	13	12	28.486	0.389575	1
24	Death	12	11	10.88241	0.426802	2
53	Injuries	11	11	18.04168	0.397426	3
68	Movement	11	9	4.331087	0.327932	2
77	Preservation	11	11	29.46892	0.269156	0
84	Sensations	11	11	16.09438	0.399564	1

Table 11. Data of Alcibiades' network of figurative topics.

Rizzoli's reading of the play as showing the "dominance of the market and its autonomous laws over any political institution" privileges the perspective of the Athenian senators over others in the play, subsuming Alcibiades under their power "by applying to their political actions the contingent strategies of the market" [Rizzoli 2017, 20, 21]. And yet, that the Athenian society is not in utter chaos, despite the all-against-all nature of man that Timon depicts, testifies that a system of law is in place, albeit one that sanctions exploitation through the abuse of credit practices, favoring the economic self-interest of the individual over social and personal bonds. It is against this kind of judicial system that Alcibiades wishes to take revenge, as he faces the Athenian senators with his army and accuses them of making their "wills the scope of justice" (V.v.4-5). According to Bailey's interpretation, Alcibiades animates "the restorative principal of equivalence in exchange". Thus, his conflict with the senate transforms "the quasi-legal brutality of debt bondage into a state-sanctioned means of affixing relative worth" [Bailey 2011, 397]. Alcibiades is not free from economic considerations, but his acceptance of the senators' surrender does not entail that he unwittingly falls prey to their economic and judicial logic.

Although in the end it seems for a moment that Timon finds solace in the idea of a return to nature in death, making his "everlasting mansion / Upon the beached verge of the salt flood" (V.ii.100-1), this daydream is quickly shattered by the "turbulent surge" (V.ii.103), as nature and men alike keep disturbing his gravestone. Even in death, Timon is unable to escape the by-now internalized economic form of money and the economic nature of sociality that accompanies it. In his final words, "Graves only be men's work and death their gain, / Sun, hide thy beams, Timon hath done his reign" (V.ii.107), the ultimate split takes place between an intrinsic value of materiality, the living body, and an extrinsic value, a gain possessed only in death, in the absence of and external to life.

5 Conclusions

In this article I have explored a method for operationalizing the idea that figurative language can be studied as a network, and I have tested the potential of this theory on the play *Timon of Athens*. The construction of a network from the topics of figurative instances has proved to be an effective method for the analysis of a text, enabling us to closely interpret the network relations between conceptual domains. Focusing on small units for topic classification (i.e., figurative instances, rather than an entire text) makes it possible to create a network of the interactions between topics and analyze the figurative language. To further develop this method for the analysis of figurative language, it could be beneficial to turn the network into a directed one in order to explore the relations and directionality between tenors and vehicles. This, however, introduces a variety of challenges, such as figurative cases in which the tenor is absent textually and only implied. Though the automatic classification of topics in figurative instances has shown promising results, there are still improvements that can be made. Several recommendations can be made based on training the classifier to reach better results, starting with reducing the number of topics and enlarging the dataset, which will allow the algorithm to have more data and less ambiguity regarding topics.

Moreover, instead of using DistilBERT, experimenting with other large language models, such as Llama, Gemini or ChatGPT, could potentially yield a better topic classifier.

Testing the method suggested in this article on *Timon of Athens* has been constructive in assessing existing interpretations, for revealing nuanced patterns that contribute to a fruitful close reading of the play, and for interpreting various issues that have long occupied scholars. However, it is important to note that although assessing existing interpretations via this method can corroborate certain assumptions and question others, it does not necessarily detract from their overall value. Focusing on subjects that have minor significance in a text's network is not inherently incorrect, since any subject that is of importance to a researcher is worthwhile. That a certain topic appears a low number of times does not necessarily mean it is not meaningful, as it could appear in crucial parts of a text. In the end, whether certain subjects are significant is a question of the purpose of a given project and the subject that the scholar wishes to focus on. The network of topics is, after all, but a graph representation of the text, and it could be mined, as it were, for insights on the various topics that it represents. Thus, any interpretation could potentially benefit from examining the interactions between the topics with which it is concerned.

By focusing on the main figurative topics of the play, as well as those of specific characters and acts, it is possible to form an interpretation that ties together the various strands of data presented by the network analysis. And yet, the network of the play's figurative topics still holds undiscovered riches, veins of information waiting to be dug up, as each and every topic and interaction in the network could potentially reveal new insights. To conclude, the network of a text's figurative topics can provide us with a new perspective that brings to light previously unnoticed aspects of a text, drawing our attention to discrepancies that make us raise questions and rethink what we know.

Appendix: Full Topic List

1. Accommodation
2. Agriculture
3. Affection
4. Alchemy
5. Adhesion
6. Anatomy
7. Animals
8. Architecture
9. Appearance
10. Art
11. Astrology
12. Assistance
13. Breathing
14. Character Traits
15. Cleaning
16. Clothes
17. Colors
18. Commands
19. Concealment
20. Consumption
21. Courting
22. Danger & Safety
23. Darkness
24. Death
25. Deception
26. Deformities & Disabilities
27. Derision & Offence
28. Destruction
29. Devotion
30. Discovering
31. Domestic
32. Economics
33. Education
34. Emotions
35. Equestrian
36. Ethics
37. Ethnicity & Nationality
38. Etiquette
39. Facial Expressions
40. Familial
41. Feelings
42. Fire
43. Food
44. Games & Sport
45. Geography
46. Greetings
47. Heraldry
48. Hindrance
49. Historical
50. Humanity
51. Hunting & Fishing
52. Incarceration
53. Injuries
54. Joviality
55. Judiciary
56. Labor
57. Language
58. Life
59. Life's Cycle
60. Light
61. Luck
62. Matrimony
63. Materials
64. Medicine
65. Men

66. Mental Faculties & States
67. Military
68. Movement
69. Music
70. Mystical
71. Myth
72. Nature
73. Nautical
74. Physical Activities
75. Physical Attributes
76. Politics
77. Preservation
78. Privation
79. Quantities
80. Recognition
81. Religion
82. Reproduction
83. Resistance
84. Sensations
85. Sexuality
86. Size
87. Sleep
88. Social Relations
89. Social Status
90. Social Unrest
91. Sounds
92. Spatial
93. Speed
94. Suffering
95. Temperature
96. Theatre
97. Time
98. Transformation
99. Urban
100. Violence
101. Weapons & Armor
102. Weight
103. Women

Notes

[1] See [Moretti 2013, 4].

[2] See [Lakoff and Johnson 2003, 61].

[3] See [Blei, Ng, and Jordan 2003].

[4] One of the earliest examples of topic modeling was introduced as pLSI (probabilistic latent semantic indexing) by Thomas Hofmann in 1999. PLSI was later developed into the more advanced technique called LDA (latent dirichlet allocation) by [Blei, Ng, and Jordan 2003].

[5] See [Liu et al. 2016], [Boyd-Graber, Hu, and Mimno 2017], [Landauer et al. 2011], and [Marwick 2014].

[6] See [Churchill and Singh 2023] and [Wang et al. 2020].

[7] See [Igantow and Mihalcea 2016].

[8] It was only when Navarro-Colorado further reduced the 100 topics to 81 and then manually classified the rest into 13 classes, thus considering several LDA-topics as belonging to one theme, that the topic modeling was able “to group together texts with the same theme” [Navarro-Colorado 2018, 10].

[9] The rationale behind choosing plays from the same genre and that were written around the same time, though by various playwrights, is to create a domain-specific dataset with a range of examples and to minimize outliers (See [Brownlee 2020]).

[10] The exact dating of these five plays is a debatable issue, but in all likelihood they were written between 1605-1610. For the sake of consistency, I follow the datings suggested by Martin Wiggins in [Wiggins and Richardson 2015].

[11] See [Mao et al. 2022] [Babieno et al. 2022] [Potamias, Siolas, and Stafylopatis 2019].

[12] Another subjective aspect pertains to the classifying process itself. Given the same set of topics and figurative instances, two interpreters might still choose different topics for a word in certain cases. The inter-annotators agreement (IAA) is a method by which the agreement between interpreters can be measured, providing a status of consensus, in varying degrees, to the classifications. Tthis procedure requires certain resources and hence will be implemented in a future study.

[13] See [Sanh et al. 2019].

[14] Initially I experimented with training the classifier on the original texts taken from EEBO (Early English Book Online), without spelling standardization, but the results were better with the contemporary editions. The source for *A Yorkshire Tragedy* and *The Bloody Banquet* is [Middleton 2016], the source for *Macbeth* is [Shakespeare 2015], and the source for *The Rape of Lucrece* is EEBO, with manual spelling standardization) [Heywood 1608].

[15] The F-Score that was achieved was 71.12. F-score is another important measure of predictive performance, achieved by calculating two factors called precision and recall (see [Derczynski 2016]).

[16] See [Cherven 2015]. For the influence of network theory in humanistic research, see [Ahnert et al. 2021].

[17] For a discussion on other centrality measures and their role in humanities see [Ahnert et al. 2021, chap 5].

[18] See [Cherven 2015, chap 1] and [Borgatti, Everett, and Johnson 2013, chap 10].

[19] Examples of such algorithms are Clustering Coefficient, Modularity Class, Chinese Whispers, Link Communities, Hierarchical Clustering. See [Cherven 2015, chap 6], [Borgatti, Everett, and Johnson 2013, chap 11], and [Barabási 2016, 9].

[20] See [Grady 2009], [Kaytor 2012], [Prendergast 2000], and [Jackson 2001].

[21] Works with affinity to the subject of the body in *Timon of Athens* include, for example, [Raducanu 2020], [Austin 2020], [Bailey 2011], and [Chalk 2009]. Works with affinity to the subject of the nature include [Rizzoli 2017] and [Ng 2011].

[22] See the introduction to *Timon of Athens* by Anthony B. Dawson and Gretchen E. Minton in [Shakespeare 2017, 52–54] and [Jackson 2001, 47].

[23] According to Marc Shell in *The Economy of Literature*, “there is a theoretical necessity for, as well as the historical fact of, the internalization of economic form in language. Unlike specific *topoi*, this internalization is general; it invades and pervades everything” [Shell 1978, 15].

[24] For Hobbes, “before the names of Just, and Unjust can have place, there must be some coercive Power, to compel men equally to the performance of their Covenants, by the terrour of some punishment” [Hobbes 1965, 110].

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