History to Myths: Social Network Analysis for Comparison of Stories over Time

Clément Besnier
clem@clementbesnier.fr

Abstract

We discuss on how related stories can be compared by their characters. We investigate character graphs, or social networks, in order to measure evolution of character importance over time. To illustrate this, we chose the Siegfried-Sigurd myth that may come from a reinterpretation of events that occurred in the fifth and sixth centuries in the Merovingian dynasty. The Nibelungenlied, the Völsunga saga and the History of the Franks are the three resources used. Annotations are made available for future research.

Dans ce papier, nous discutons de la manière dont des histoires apparentées peuvent être comparées. À travers des graphes de personnages, ou de réseaux sociaux, nous mesurons l’évolution de l’importance de personnages au fil du temps. Pour illustrer cela, nous traitons le mythe de Siegfried-Sigurd qui pourrait venir d’une réinterprétation d’événements qui ont eu lieu au cinquième et sixième siècles sous la dynastie mérovingienne. La Chanson des Nibelungen, la saga des Völsung et l’Histoire des Francs sont les trois ressources utilisées. Les annotations sont rendues publiques pour de futures recherches.

1 Introduction

The legend of Siegfried-Sigurd had a major place in the Germanic tradition. The best-known extant texts of the legend are the Norse Völsunga saga (VOL) and the continental Germanic Nibelungenlied (NIB). These two texts present similar sets of characters and events. They are often seen as reporting historical events that occurred in the 5th and the 6th centuries. This period was largely told in Decem Libri Historiarum (DLH). In this paper, we use the DLH as a historical source to quantify borrowings into NIB and VOL. To encourage further study in this domain, we made annotations and graphs available.

This paper begins with a summary of the texts. Next, in 3 we review recent analyses of these texts as well as methods to extract information from social networks. In 4 we present in detail the data used in subsequent analyses. The construction of character networks for our and the comparison between texts are explained in 5. Finally, results will be discussed in 6.

2 The legend of Siegfried, the dragon-slayer

2.1 Völsunga saga

VOL tells the destiny of a family from Sigi, an offspring of Odin himself, to Svanhildr, Sigurðr’s daughter. Sigurðr, son of Sigmundr son of Völsung, later kills a dragon named Fafnir after events involving gods becomes possessor of cursed gold. He later wakes Brynhildr up (a myth similar to the tale Sleeping Beauty) and they promise to marry each other. Yet Sigurðr marries Guðrún, daughter of Gjúki and Grí姆hildr and Brynhildr marries Gunnar, Guðrún’s brother, after a treason permitted by magic use. When it is unveiled, Brynhildr orders Gunnar to kill Sigurðr, so Gunnar incites Guttormr to kill...
Sigurðr, what he does. Brynhildr regrets and kills herself. Later Guðrún marries Atli, king of the Huns. The cycle of revenge leads Atli to kill Gunnar, Guðrún to kill Atli. After she tried to kill herself, Guðrún is married by force to Jónakr and her daughter Svanhildr, (that she got with Sigurðr), once grown up, is coveted by Jörnumrekkur, king of the Goths. Once again, jealousy and revenge lead Svanhildr and Guðrún to be killed. Finally, all Sigi’s lineage was killed.

2.2 Nibelungenlied

NIB has two main parts. The first focuses on Siegfried’s exploits on the marriages between Siegfried with Kriemhild, a Burgundian princess, and Gunther, who is Kriemhild’s brother, with Brünhild, a distant queen. A betrayal is at the origin of the second marriage and Brünhild allows Hagen to murder Siegfried. In the second part, Kriemhild seeks vengeance against Hagen. She marries Etzel, king of the Huns, thinking his power could help her. They invite the Burgundian court to their castle for a feast. Kriemhild and the Burgundian dynasty are at last killed.

2.3 Similarities in these stories

These two medieval texts present a similar set of characters, with similar names, and the plots are comparable. The question of common origins has been controversial: did they come from a long oral Germanic myth or were they built up from scholarly matter? Both proposed origins for NIB and VOL stories are manifest when we see historical characters who lived in the 5th and 6th centuries with e.g. Brünhild (NIB) and Brynhildr (VOL) corresponding to Brunichildis, queen of the Merovingian dynasty; Etzel (NIB) and Atli (VOL) corresponding to Attila, king of the Huns, an Asian people

We are in possession of a historical text that relate events that occurred in the Merovingian dynasty: the Decem libri historiarum (DLH), the Ten Books of History, more known as the History of the Franks).

2.4 History of the Franks

DLH was written by Gregory of Tours, a bishop who was a witness to the Frankish dynasty events. He first retells the history of the world from a Christian point of view, starting from God’s creation of the cosmos to the death of Saint Martin of Tours, who was also a bishop of Tours. He then recounts in detail events that happened to Clovis and his offspring up to author’s death.

2.5 Other sources

Other sources might have been used for this work, but will be left for further work. We mention them here because of their relevance from mythological and historical points of view.

- Poems of the Poetic Edda contain many heroic poems that display characters present in VOL. Such characters are Helgi in Helgaqviða Hundingsbana in fyrrí, Helgaqviða Hiordazsonar, Helgaqviða Hundingsbana onnor, Gríspíspá, Reginn in Reginsmál, Fáfnir in Fáfnismál, SigríÓrfrófr, Brot af sigurdarqviðo, Guðrún (Sigurðr is her first husband, Atli, the second, Jónakr the third) Gudrúnaqviða, Brynhildr, wife of Gunnar who always loved Sigurðr, in Helreid Brynhilder, and Atli in Atlaqviða, etc.

- Gesta Danorum was written in Latin by Saxo Grammaticus. He recounted the story of Denmark’s kings. The first part is on legendary kings and the second part is on historical kings.

- Historical sources like Getica by Jordanes ³, Lex Burgundionum ⁴ that give more information concerning the Burgundian dynasty.

3 Related work

3.1 Philological investigations

Germanic mythology gives rise to many questions about its origins and its forms. Karl Lachmann believes that NIB is a coherent work made up of a collection of 20 songs, and he proposed such a recon-

³JORDANIS DE ORIGINE ACTIBUSQUE GETARUM (www.thelatinlibrary.com/jordanes1.html)
⁴Lex Burgundionum (www.dmgh.de/mgh_l1_l1_nat_germ_2_l/index.htm#page/III/mode/1up)
struction. In contrast, Andreas Heusler states that NIB is a creation of a single poet, working from a deliberate choice of sources.

Similarities of narrative elements in other Scandinavian and in continental Germanic sources, e.g. reported in (Thorp, 1937; Thorp, 1938), show that NIB and VOL could not only be purely unconditioned creations of poets at one time. Kratz (1962) advances the idea of an amalgamation between different oral traditions in the Germanic area. No philologist denies that there is a link between NIB and VOL to the Merovingian and Burgundian dynasties (Fichtner, 2004; Schütte, 1921) and that DLH was an available source at the time of composition. Fichtner (2004) also shows correspondences between the four main characters of NIB (Brünißl, Kriemhild, Siegfried and Gunther) and historical characters, e.g. Kriemhild was inspired by Brunichilde, Fredegunde and Chrodechilde’s lives. The author also found new evidence that justify supernatural features like Siegfried’s invulnerability.

3.2 Character graph analysis

Characters are persons or person-like entities (gods, speaking animals) that are present, or just mentioned, in a plot. Over the past twenty years or so, scholars of fictional works have employed character graph analysis, or social network analysis, for story analysis (decomposition, summarisation) and classification of such works. Broadly, as analysed in (2019), these methods can be broken down into three steps:

1. identification and extraction of characters in the text,
2. identification and extraction of their interactions,
3. generation of the corresponding graph.

Such networks have already been used to support literary theories as in (Jayannavar et al., 2015). Questions about the historicity of stories have been investigated (Mac Carron and Kenna, 2013). However, this is only seen as plausibility by looking at whether social networks in stories are similar to networks constructed from historical sources. Historicity is either assumed or not mentioned.

3.3 Character network for mythological analysis

Mythological networks have common features, as summarised in (Kenna and MacCarron, 2017). They usually involve small-worlds, and are structurally balanced. This means that they have features found in graphs of real persons’ interactions.

Character networks may describe stories at the level of character as well as at the level of the whole story. The best well-known Indian epic, the Mahabharata, was studied in English translation in (Das et al., 2016). The aim was to give an overall analysis in terms of sentiment and emotion, and on the roles played by its characters.

Scandinavian culture and texts have been investigated using comparable methods, such as the analysis of Icelandic settlement in (Mac Carron and Kenna, 2013). The authors gathered a large set of sagas, that contain overlapping elements, and produced analyses of the individual sagas and a single network from a merge of all sagas. They found common features and dissimilarities in the graphs, and concluded that social interactions found in the sagas are realistic.

An overall study of myths was accomplished in (Mac Carron, 2014), in which the NIB and VOL, among others, were analysed. The authors were able to extract communities structured as generations and other dynasties from VOL, whereas NIB did not reveal such structure, because it focuses on one generation of characters, and maintains the same set of characters throughout the story.

3.4 Works on historical characters

Contrary to works of fiction, historical texts present characters in a less clearly defined way. Social networks in aid of historical analysis in a language other than English was employed in (van de Camp and van den Bosch, 2011). The historical period is relatively recent, in the sense that the language (Dutch) used is close to contemporary Dutch. They studied interactions between people in a sentiment analysis perspective.
Table 1: Texts used for experiments

| Name | Language            | Estimated date of composition | Number of tokens/unique tokens | Main constituents |
|------|---------------------|------------------------------|--------------------------------|------------------|
| DLH  | Vulgar Latin        | 6th                          | 123272/25270                   | 10 books         |
| NIB  | Middle High German  | 12th                         | 81936/8008                     | 39 chapters      |
| VÔL  | Old Norse           | 12th                         | 26779/4631                     | 41 chapters      |

3.5 Myth comparison and reconstruction

The research thread in computational story comparison closest to the present work is myth comparison and reconstruction, such as (Thuillard et al., 2018). Further out, but with similar methods, we have studies on meaning change or sound change analysis. All these tasks use methods largely used in bioinformatics for phylogenetic reconstruction. This helps build family trees of genes, which in return, helps analyse evolution through time and space. These methods will not be used in this paper, but they can be useful for future work on the subject.

4 Data

- **DLH** text was retrieved using the CLTK\(^5\) (Johnson and Burns, 2014). The original manuscript is lost, but several Carolingian manuscripts remain. The author, Gregory of Tours, considered that his own Latin was poor, despite his high literary studies. It is often considered as a Late Latin text.

- **VÔL** text comes from a manuscript written in the XV\(^{th}\) century and now conserved in the Royal Danish Library\(^6\). This was digitised by Heimskringla\(^7\), a project whose aim is to gather normalised texts of medieval Scandinavia. The author is unknown. The text is split into 41 chapters.

- **NIB** text comes from the manuscript C of the Nibelungenlied\(^8\); this is often seen as the most representative of available manuscripts and is the oldest codex (UNESCO, 2008), however, it seems not to be the most archaic concerning the content. The text is split into 39 chapters.

5 Character network analysis

According to the generic process of character analysis sketched out in subsection 3.2, this work is on fiction for **NIB** and **VÔL**, and **DLH** is historical, yet most of processes are similar.

Figures\(^1\) and\(^2\) summarise the workflow followed in the present work. The three main processes are described more precisely in the following subsections.

5.1 Character extraction

Characters can represent women, men, gods, and creatures. From all proper nouns in the texts, we removed place names, and for identification reasons, we did not keep devices (like swords that were given names in Germanic myths) and categories of people like the inhabitants of cities or countries, or names of peoples. Characters in texts appear as proper nouns, nouns and pronouns. However, in this work, only proper nouns were used to find occurrences of characters.

During data preparation, proper nouns were extracted by means of a semi-supervised method.

First, tokenisers for Latin, Old Norse and Middle High German from CLTK (Johnson and Burns, 2014) were applied; then, as texts are normalised, tokens with a first capital character were considered as potential proper nouns. Next, we removed proper noun candidates that were also found with a lower case as first character. Finally, translations were used in parallel with the original texts to manually check if they were proper nouns. An index of proper nouns were also used when they existed (it was the case for

\[^5\] github.com/cltk/lat_text
\[^6\] ny.kpl.Saml.1824 b 4to (digitalesamlinger.hum.ku.dk/Home/Samlingerne/34897)
\[^7\] heimskringla.no/wiki/Main_Page
\[^8\] www.hs-augsburg.de/harsch/germanica/Chronologie/12Jh/Nibelungen/nib_c_00.html
The issue was that they were in German and in French (for NIB, the lemmas of proper nouns were given in Middle High German). Finally proper nouns were split into three categories: names of persons, gods and creatures; names of places; and names of objects. Only the first category was used. The rest might be useful for future work.

5.2 Character interaction analysis

Once characters in the three texts were found, whether and how they interact to each other was determined, the very nature of interactions may be captured by analysing syntactic and semantic features of sentences where at least two characters appear. This approach was unfortunately not possible due to the lack of corpus analysis tools for Old Norse and Middle High German.

The easiest and fastest way to pick out interactions between characters is to capture their co-occurrences in a relatively narrow textual window. It was not possible to plan annotations of interactions for the whole texts in the way that Agarwal (Agarwal et al., 2012) did. The window size was chosen according to the nature of the texts. NIB is a poem whose basic structure is the stanza that contains four long verses. A window size of 3 stanzas was employed to capture interactions. For VOL and DLH, the smallest unit is the sentence, and the window size was set at 5 sentences.

5.3 Graph extraction

The procedures described in the two previous subsections (subsection 5.1, subsection 5.2) yielded respectively the set of characters for each text, and the set of their interactions. These were modeled as the set of nodes and the set of edges for each text. We did not keep characters that are not linked to any other characters.

Such graphs can be generated from the whole text or from a chapter. Smaller text units may lack information due to the sparse distribution of character occurrences in texts. Generating a graph from a whole text gives a static overview of character interactions. A contrario, generating a graph for each chapter returns a dynamic view of the relations between characters (Agarwal et al., 2012).
Table 2: Character graph features: $n$ number of characters, $N$ number of nodes, $E$ number of edges, $\bar{D}$ average of degrees, $D_{\text{max}}$ maximum of degrees.

| Name | $n$ | $N$ | $E$ | $\bar{D}$ | $D_{\text{max}}$ |
|------|-----|-----|-----|------------|------------------|
| DLH  | 784 | 332 | 1011 | 6.09       | 83               |
| NIB  | 67  | 50  | 202  | 8.08       | 35               |
| VÖL  | 115 | 55  | 163  | 5.93       | 24               |

Figure 3: Brunichilde in DLH.  
Figure 4: Brynhildr in VÖL.  
Figure 5: Brünhild in NIB.

5.4 Comparison of graphs

Comparing graphs is still an open task, especially when they do not have the same size (Wills and Meyer, 2020).

Fortunately, we can still compare their global features, such as degrees, betweenness and closeness centrality (Mac Carron and Kenna, 2013; Kenna and MacCarron, 2017).

Our aim is to find features that are similar and different in the three stories. Similarities may show us what has been preserved in character relationships and differences may show what has evolved over time.

We chose features that show importance of characters. They are degree centrality (normalised number of characters connected to a character), eigenvector centrality (shows influence of a character with help of eigenvalues of adjacency matrix), closeness centrality (reciprocal of the average shortest path distance between a character and its reachable characters), betweenness centrality (number of shortest paths passing through a character). For more details concerning definitions of these features, see (Labatut and Bost, 2007).
Table 3: Graph features for 10 characters that occur at least in two of the three studied texts. Here d is for degree centrality, e for eigenvector centrality, c for closeness centrality, b for betweenness centrality and n for the number of neighbours (i.e. the degree), r for the rank of highest degrees.

|       | DLH | VOL | NIB |
|-------|-----|-----|-----|
| Name  | d   | e   | c   | b   | n  | r   | Name  | d   | e   | c   | b   | n  | r   | Name  | d   | e   | c   | b   | n  | r   |
| Sygiberthus | 0.15 | 0.19 | 0.48 | 0.08 | 50 | 7   | Sigurn | 0.44 | 0.38 | 0.55 | 0.34 | 24 | 1   | Siegfried | 0.44 | 0.26 | 0.60 | 0.04 | 22 | 5   |
| Guntarius  | 0.08 | 0.13 | 0.43 | 0.02 | 28 | 24  | Gunnart | 0.33 | 0.33 | 0.47 | 0.07 | 18 | 3   | Gunther  | 0.46 | 0.27 | 0.62 | 0.06 | 23 | 3   |
| Brunichilde | 0.04 | 0.06 | 0.40 | 0.01 | 13 | 55  | Brynhildr | 0.30 | 0.31 | 0.50 | 0.11 | 16 | 6   | Brünihildr | 0.12 | 0.10 | 0.47 | 0.00 | 6  | 27  |
| Segimundus | 0.02 | 0.04 | 0.36 | 0.04 | 8  | 104 | Sigimund | 0.31 | 0.26 | 0.46 | 0.14 | 17 | 5   | Segimundr | 0.16 | 0.13 | 0.40 | 0.00 | 8  | 22  |
| Amila   | 0.02 | 0.04 | 0.39 | 0.00 | 7  | 122 | Atli    | 0.17 | 0.20 | 0.42 | 0.01 | 9  | 8   | Ezel    | 0.44 | 0.25 | 0.64 | 0.16 | 22 | 6   |
| Alaricus | 0.08 | 0.16 | 0.46 | 0.02 | 28 | 22  | missing | -   | -   | -   | -  | -   | -   | Alberich | 0.10 | 0.08 | 0.47 | 0.00 | 5  | 29  |
| Theodoricus | 0.13 | 0.17 | 0.48 | 0.08 | 44 | 8   | missing | -   | -   | -   | -  | -   | -   | Dietrich | 0.32 | 0.22 | 0.58 | 0.05 | 16 | 10  |
| missing | -   | -   | -   | -   | -  | -   | Höggn | 0.31 | 0.25 | 0.46 | 0.17 | 17 | 4   | Hagen  | 0.72 | 0.32 | 0.76 | 0.36 | 36 | 1   |
| Ragnacharius | 0.02 | 0.04 | 0.37 | 0.00 | 6  | 144 | Reginn | 0.07 | 0.08 | 0.41 | 0.28 | 4  | 22  | Kriemhild | 0.52 | 0.25 | 0.64 | 0.08 | 26 | 3   |
| Frearo  | 0.01 | 0.03 | 0.36 | 0.00 | 4  | 195 | Fafnir  | 0.13 | 0.17 | 0.45 | 0.03 | 7  | 16  | missing | -   | -   | -   | -  | -   | -   |

2019. We used NetworkX\[9\] (Hagberg et al., 2008), a Python library for modeling graphs and computing metrics.

In this paper, we used main characters that are common to at least 2 texts and compared to each other. Common characters were found in (Schütte, 1921). A second criterium is to keep characters from 2 different texts if they are phonologically similar. It let us study 10 characters presented in table 3.

More precisely, similarities between DLH and VOL and between DLH and NIB show us what has been preserved over the six centuries that approximately separate these works. Differences, however, are more tricky to analyse because they can be due to evolution, innovations or borrowings.

As it is visible in table 2, the DLH has too many characters compared to the other texts. Then it is opportune to just keep books that contain our characters of interest. For comparison between stories, we only kept the second, the third and the fourth chapter of DLH because this is where the main similar characters found in NIB and in VOL are. With this social network, we extracted features and got results visible in table 3.

6 Interpretation

Sygiberthus remained a main character and even got a strong importance in VOL (high rank of degrees as well as other measures) despite the fact that he was killed at the middle of the story. Guntharius appears as a main character that is in the shade of other more prominent characters (high closeness and relatively low other measures). As a king or prince at the court of Burgundy, Gunnar and Gunther got a stronger role (higher measures and rank) compared to Guntharius. This is because the plot was more centered onto the Burgundian kingdom. Brynhildr and Brùnhild has almost a similar role to Gunnar, Gunther although her role is more limited because she disappeared at the middle of NIB and VOL (see below for a deeper analysis of her ego-graphs). Sigimundus got a higher role in the Germanic tradition. Atila got a more important role in the Germanic tradition with poems with his name. His name was feared for centuries after his death. Alaricus plays a one-time role in DLH that may explain why his fate in the myth was not equal (he is not mentioned in VOL and he plays a role but was transformed into a dwarf). A contrario, Theodoricus plays a central role without being at the top. He has a small influence on events but often participates. His tradition remained in some texts only. He has his own saga Thiodrekkssaga and is also called Dietrich von Bern in the continental Germanic tradition. Hagen and Högni do not play exactly the same role in NIB and VOL. His role is essential in NIB where both his influence and importance are very high, but his place does not make him a protagonist because of his attitude. This is a feature that is not captured by graph metrics, but could be analysed by sentiment analysis. Ragnacharius and Farro are anecdotal in DLH while VOL made them important (they are mythical beings) in regard to the hero, whereas they simply do not appear in NIB.

Brùnhild’s ego-graphs (figures 3, 4 and 5) deserve some explanations. The closest characters con-
nected to her are her relatives and her husband for the three texts. DLH have many characters of a small interest in the story. VOL. Some characters did not find correspondences in table because they have names without phonetic similarities with other characters of the other texts. An other fact that shows the limit of our approach is that, for example, a character like Chilperico does not appear directly in VOL and NIB because their features were transferred to other characters like Gunther in NIB. Such transfer is not always analysable with tools we used, because, for example, Brünhild in NIB and in VOL has features from many characters in DLH like Gailswintha (Fichtner, 2004), who is not in Brunichilde’s ego-graph. Distant characters in one text may have their features merged in one of the characters in an other text six centuries later.

7 Conclusion

This work provides an annotated (named-entities) corpus of a related myth. A character-based graph was used to analyse similarities and differences between the texts. Some characters got more importance while others vanished. Future research can include an analysis of phonetic evolution for such proper nouns so that it is a marker of common characters. More sources could be included in the analysis because some characters do not appear in all mythical texts of the Germanic tradition. Characters may appear in texts but not directly with same names and same features: role and name reassignments are quite common in these texts and need better models of characters in a myth to be detected and quantified.

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