

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

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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 available¹.

This paper begins with a summary of the texts 1. 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*'s² daughter. *Sigurðr*, son of *Sigmundr* son of *Völsungr*, 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 *Grímhildr* 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

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¹github.com/clemsciences/LaTeX-CLfL-2020-besnier

²ð is pronounced like th in 'this'.

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 *Jonakr* and her daughter *Svanhildr*, (that she got with *Sigurðr*), once grown up, is coveted by *Jörmunrekkr*, 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 fyrri*, *Helgaqviða Hiorvardzsonar*, *Helgaqviða Hundingsbana onnor*, *Gripisspá*, *Reginn* in *Reginismál*, *Fáfnir* in *Fáfnismál*, *Sigrídrifomál*, *Brot af sigurdarqviðu*, *Guðrún* (*Sigurðr* is her first husband, *Atli*, the second, *Jónakr* the third) *Guðrúnarqviða*, *Brynhildr*, wife of *Gunnar* who always loved *Sigurðr*, in *Helreid Brynhildar*, 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/iordanes1.html)

⁴Lex Burgundionum ([www.dmgh.de/mgh_ll_nat_germ_2_1/index.htm#page/\(III\)/mode/1up](http://www.dmgh.de/mgh_ll_nat_germ_2_1/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** (*Brünhild*, *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	6 th	123272/25270	10 books
NIB	Middle High German	12 th	81936/8008	39 chapters
VÖL	Old Norse	12 th	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 CLTK⁵ (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.
- **VOL** text comes from a manuscript written in the XVth century and now conserved in the Royal Danish Library⁶. 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 Nibelungenlied⁸ 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 **VOL**, 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

⁵github.com/cltk/lat_text_latin_library that gathers texts from thelatinlibrary.com/gregorytours.html

⁶Ny kgl. Saml. 1824 b 4to (digitalesamlinger.hum.ku.dk/Home/Samlingerne/34897)

⁷heimskringla.no/wiki/Main_Page

⁸www.hs-augsburg.de/~harsch/germanica/Chronologie/12Jh/Nibelungen/nib_c_00.html

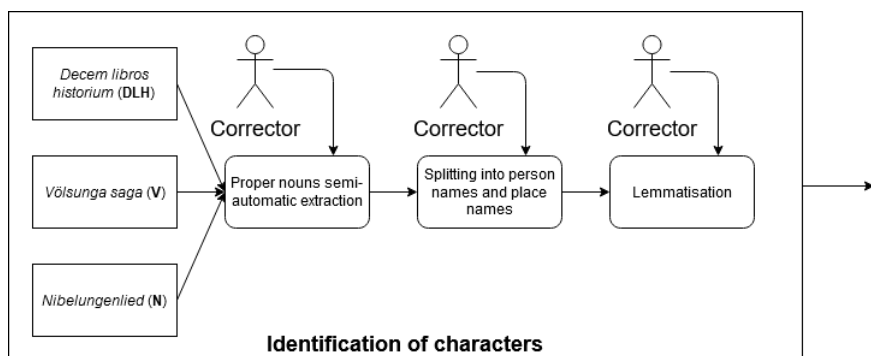


Figure 1: Character extraction

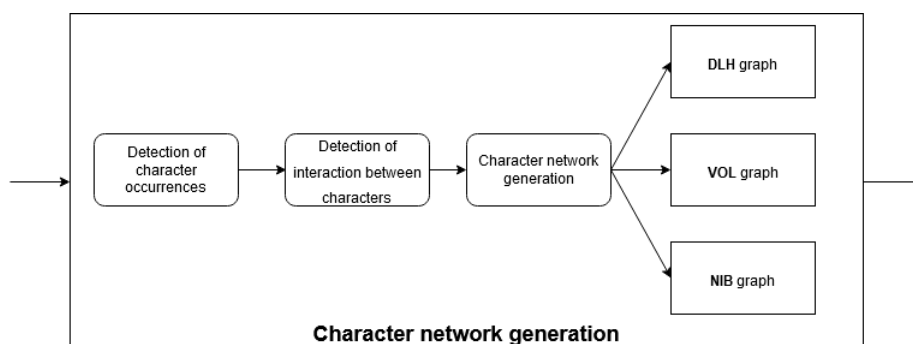


Figure 2: Interaction extraction

DLH (von Sali, 1892) and for **NIB** (Anonymous, 2011)). 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_{max} maximum of degrees.

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

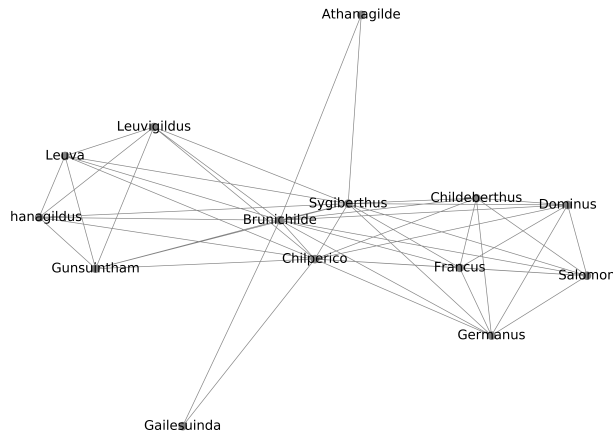


Figure 3: Brunichilde in **DLH**.

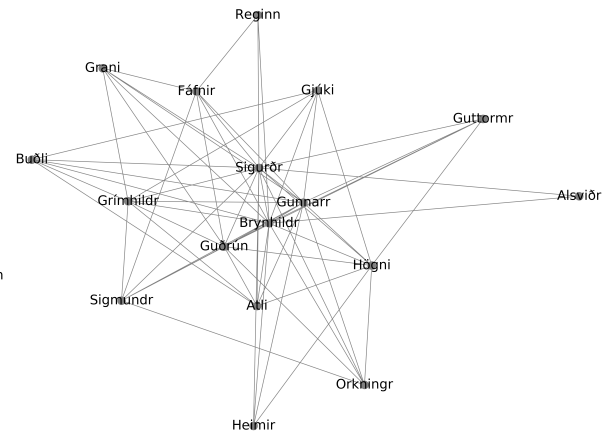


Figure 4: Brynhildr in **VOL**

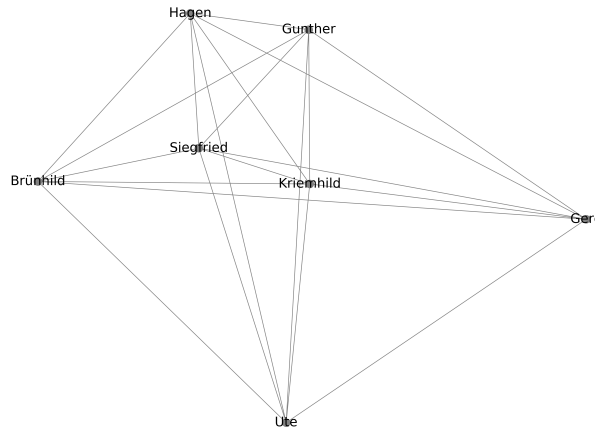


Figure 5: Brünhild in **NIB**

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,

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							VÖL						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	Sigurðr	0.44	0.38	0.55	0.34	24	1	Siegfried	0.44	0.26	0.60	0.04	22	5
Guntharius	0.08	0.13	0.43	0.02	28	24	Gunnarr	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	Brünhild	0.12	0.10	0.47	0.00	6	27
Sigimundus	0.02	0.04	0.36	0.00	8	104	Sigmundr	0.31	0.26	0.46	0.14	17	5	Siegmund	0.16	0.13	0.49	0.00	8	22
Attila	0.02	0.04	0.39	0.00	7	122	Atli	0.17	0.20	0.42	0.01	9	8	Etzel	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	-	-	-	-	-	-	Högni	0.31	0.25	0.46	0.17	17	4	Hagen	0.72	0.32	0.76	0.36	36	1
missing	-	-	-	-	-	-	Grímhildr	0.17	0.22	0.42	0.01	9	9	Kriemhild	0.52	0.28	0.64	0.08	26	2
Ragnacharius	0.02	0.04	0.37	0.00	6	144	Reginn	0.07	0.08	0.41	0.28	4	32	missing	-	-	-	-	-	-
Farro	0.01	0.03	0.36	0.00	4	195	Fáfñir	0.13	0.17	0.45	0.03	7	16	missing	-	-	-	-	-	-

2019). We used NetworkX⁹ (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 *Brünhild* 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. *Attila* 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 in **NIB** 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 *Thiðrekssaga* 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**.

Brünhild's ego-graphs (figures 3, 4 and 5) deserve some explanations. The closest characters con-

⁹networkx.org

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 3 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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