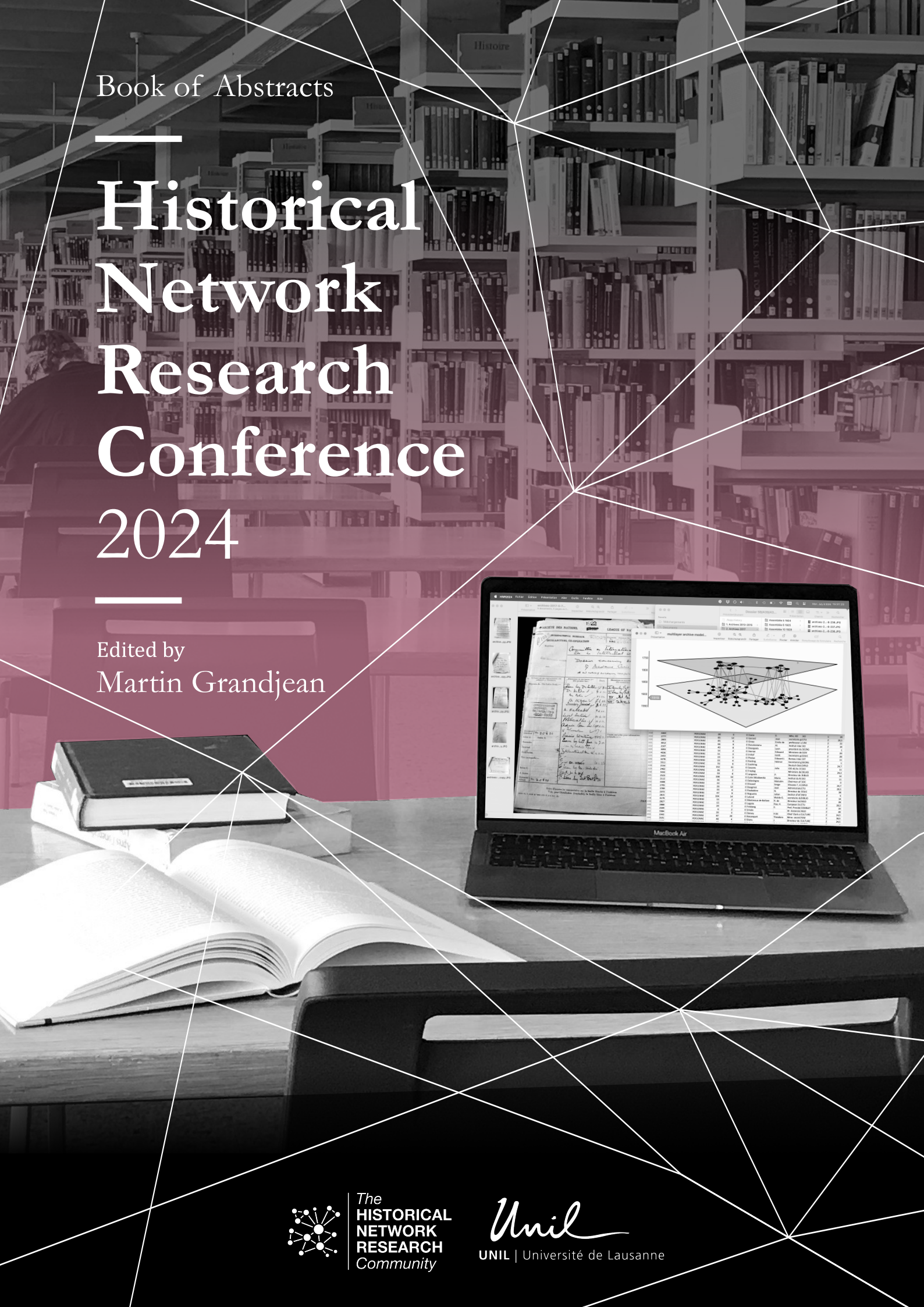
Book of Abstracts

Historical Network Research Conference 2024

Edited by
Martin Grandjean



The HISTORICAL NETWORK RESEARCH Community

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About the Book of Abstracts

This book of abstracts is a compilation of texts provided by the authors for the Historical Network Research Conference 2024. The conference took place at the University of Lausanne, Switzerland, on July 8-10, 2024.

The abstracts are listed alphabetically.

Each paper can be referred to independently with its respective citation and DOI or as a whole:

Grandjean Martin (ed). *Historical Network Research Conference 2024*, Lausanne, 2024, 141 p. DOI: 10.5281/zenodo.12665443

Conference website:
https://historicalnetworkresearch.github.io/lausanne/

Illustration: Image taken at the Lausanne University Library (Martin Grandjean)

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About the conference

The State of Historical Network Research: A Perspective from the 2024 Conference

Martin Grandjean [1]
1: University of Lausanne, Switzerland

Introduction to the conference

Grandjean Martin. 2024. "The State of Historical Network Research: A Perspective from the 2024 Conference", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12664647

A community around historical network analysis

The phenomena studied by the historical sciences are, by their very nature, complex situations: they involve, for example, interwoven personal relationships, collective dynamics that structure social and cultural space, or political and economic systems that operate at local and global levels. The network metaphor is frequently used to describe this entanglement. In recent decades, however, historians have begun to think about ways of formalizing this approach, appropriating the concepts and tools of graph theory to provide a new perspective on archives. The application of formal network analysis to history is now a highly fertile field of experimentation and research. It can be used to analyze the geographical logics of major circulation networks, to highlight brokers in affiliation networks, to compile family trees to reveal their points of contact, to study the occurrences and co-occurrences of concepts in serial texts, to show the evolution of personal social networks, etc. And through a great deal of empirical work, the specific features that historical disciplines bring to network science become apparent: particular attention to the modeling of data that is often incomplete and uncertain, the need to take account of temporality in all its finesse, the necessity to find a language that allows mathematical results to be interpreted in a qualitative narrative.

In 2009, following a workshop dedicated to the application of social network analysis to history, a small community of practice, the Historical Network Research community was created.[1] It evolved into a series of workshops and then an international conference, of which the present edition is the 9th to date, after conferences in Hamburg (2013), Ghent (2014), Lisbon (2015), Turku (2017), Brno (2018), Luxembourg (2020, 2021) and Mainz (2023). 2013 saw the creation of the HNR Collective Bibliography, a central tool for sharing the community's scientific output.[2] In 2017, the first issue of JHNR, the Journal of Historical Network Research was published, allowing everyone to share their research in Open Access.[3] Other resources include a YouTube channel[4] with recorded lectures and a newsletter.

The Historical Network Research Community remains, however, a modest initiative, a group of people with vaguely defined boundaries who all share a common research practice: applying the concepts of graph theory and network science to history and reflecting on the impact of such methods on our disciplines. Around a thousand people took part in an HNR conference, of whom around 300 presented a paper (Figure 1). More widely, several thousand people have already attended training courses in historical network analysis given by people involved in HNR. And for which results? The several hundred abstracts from HNR conferences and the first issues of the young JHNR journal give us a first idea of the contours of this research community, just as a slightly broader panorama can be drawn from the thousand titles contained in the shared bibliography. This overview shows a very diverse field, both in terms of subjects and ways of using network analysis. Above all, it shows the great heterogeneity of our practices, and the highly variable degree

[1] https://historicalnetworkresearch.org/

[2] https://www.zotero.org/groups/209983/historical_network_research

[3] https://jhnr.net/

[4] https://www.youtube.com/channel/UC2QFG7uIVxkFQ3xZbohKl-Q

to which these analyses have been integrated into more traditional historical research. What emerges is an impression of great vitality, of the gradual standardization of these methods, which are still often considered too new to be fully accepted by our peers. At the same time, however, the fragmentation of a field that has not yet really established a common frame of reference is a source of fragility. Now that we seem to have passed the phase where these methods were "fashionable" and reached a plateau of normalization, we need to build on these achievements to make them standard procedures and avoid having to reinvent the same models over and over again.

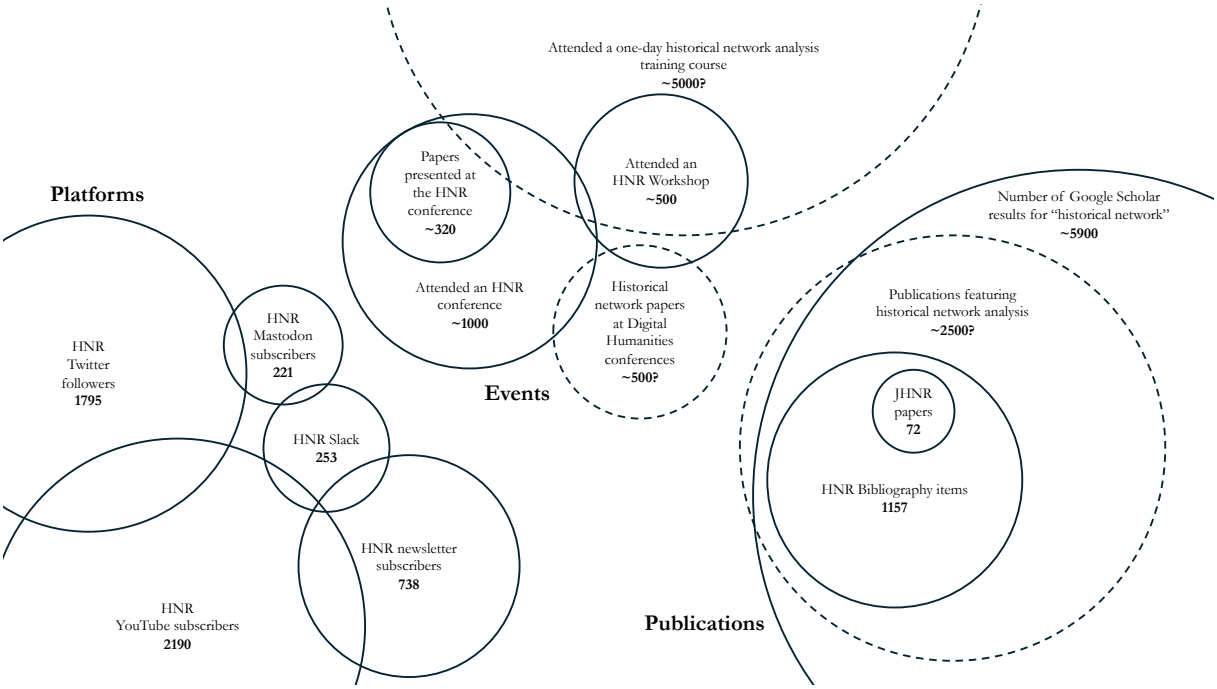

Figure 1. Rough attempt to quantify the HNR community. The dashed circles indicate imprecise estimates.

The HNR2024 Conference

The HNR2024 conference is a continuation of the development of this small community. As such, it is a place where we can observe current trends in our field and identify some of its protagonists. While the previous edition focused on the question of temporality, this year we're particularly interested in our network visualization practices.

Network visualization is often the first thing to be seen, whether it's an illegible but colorful node-link diagram, an elaborate sociogram, an austere matrix or a fancy flow map. Because of our discomfort with basing our interpretation on an object apparently built on somewhat subjective foundations, because they are very likely to be influenced by a graphic bias, we often relegate visualizations to a minor role in our exploratory approaches, preferring the cold (apparent) scientificity of graph metrics. But just because we see naive uses of network visualization doesn't mean it can't be a highly effective tool for understanding, exploring and communicating our research data. One of the ambitions of the conference is therefore to question our use of network visualization in history, a concern that is reflected in particular in the workshops and keynotes.

As for the 45 papers accepted for this conference, they present a colorful and original panorama of what is being done today in historical network analysis. They testify to the diversity of our disciplines and the heterogeneity of our toolbox, while showing varying degrees of sophistication and craftsmanship. A quick tour of the program shows, for example, that in terms of periodization (figures 2 and 4), the more recent the period, the more it is represented: 4 papers for Antiquity, 7 papers for Medieval History (7th-15th centuries), 13 papers for Modern History (16th-18th centuries) and 20 papers for Contemporary History (19th-20th centuries). This indexation is very partial: as it is based on abstracts only, it does not reflect the temporal complexity of the objects covered by these contributions, but it does allow us to take a quick pulse

of our community. The same can be said of the main geographical areas covered by this year's program. Western Europe dominates overwhelmingly, especially around the Italian, French, British and German geographical areas. Switzerland is particularly well represented compared to previous conferences, due to the location of this year's event. And while Northern and Eastern Europe also find their place in the program, there are only a few contributions dealing with the Middle East, but hardly any mention of the rest of Asia, Africa or South America.[5] So it seems clear that one of the challenges for the HNR community is to build bridges beyond Western academic circles.

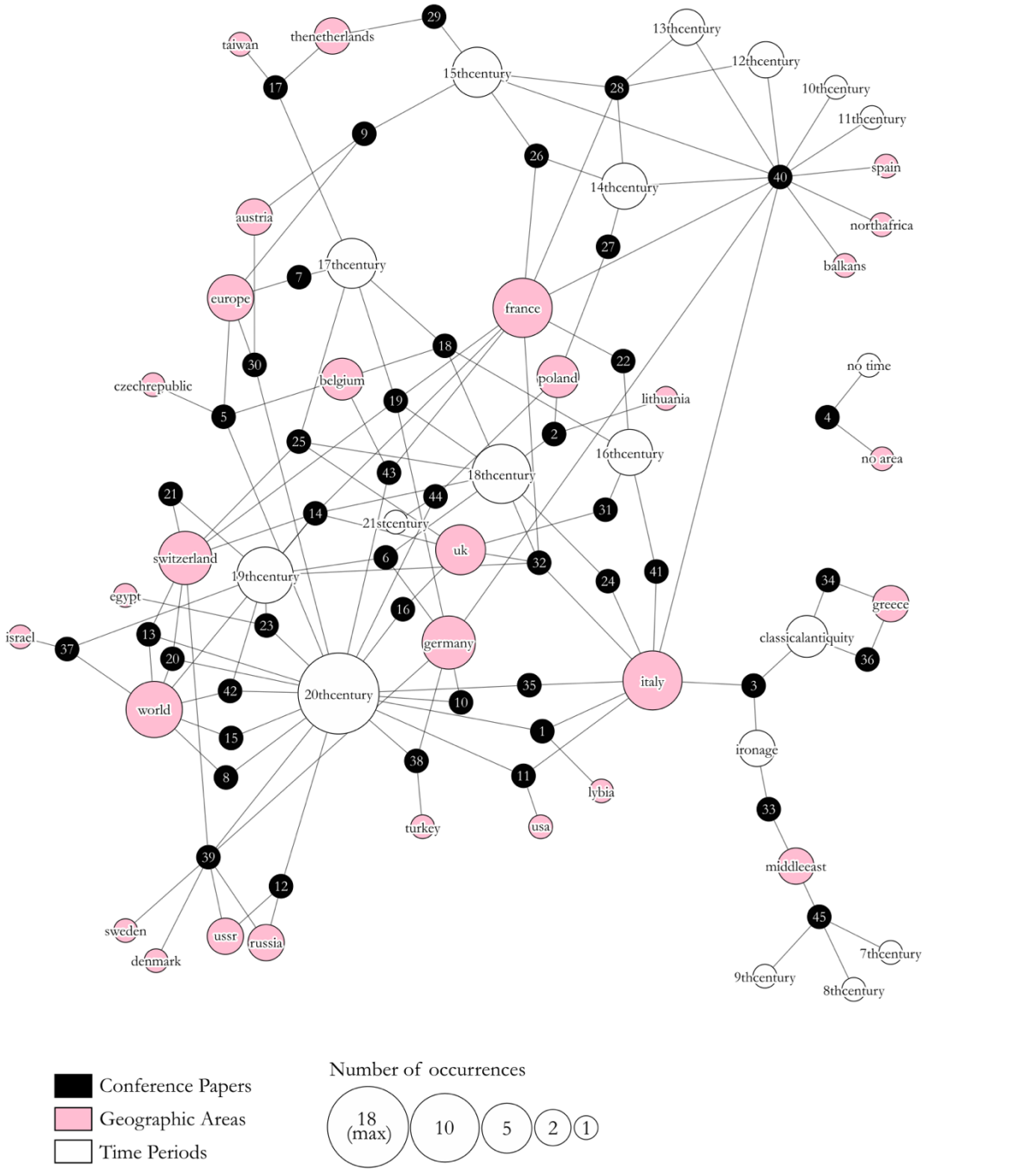

Figure 2. The bipartite network of papers presented at the HNR2024 conference (black), tagged by geographic region (pink) and time period (white). The network has been created on the basis of the abstracts as a subjective exercise to illustrate the diversity of the conference. It is not a faithful representation of the content of the papers themselves.

[5] It should be noted that the diversity of authors and participants is much greater than the diversity of regions covered by the abstracts.

1	Agir et documenter : la double action du vicaire apostolique de Tripolitaine pendant la Seconde Guerre mondiale
2	Analysing artistic network of the Basilian order in Eighteenth-Century Poland-Lithuania: a digital humanities approach
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15	High Density = High Citations? Approaches for Tracking Knowledge Evolution
16	Shaping British Digital Art: The Global Network of the Computer Arts Society, 1968-1985
17	Inclusive institutions? Access to political power in the city of Tainan (Fort Zeelandia) in Dutch Formosa (1655-1662)
18	Integrating library and prosopographical data in the publication network of the Old University of Louvain
19	Interactive Visualization of Linked Open Data Networks Representing Historical Writings
20	L'analyse de réseaux pour l'étude des coopérations intergouvernementales : le cas du Bureau International d'Éducation (1929-1952)
21	Le marché foncier à Lausanne au 19e siècle. Mutations et réseaux des protagonistes.
22	Les réseaux urbains lyonnais pendant la guerre civile (1589-1594)
23	Levantine Transitions. A Social Network Approach to Elite Formation in Urban Egypt, 1890-1914
24	Mapping the networks of the Accademia dei Nobili della Giudecca: a sous-champ of the 18th Venetian Reforming Era
25	Mapping Anglo-Swiss Travel Writing in the 17th and 18th Century
26	Modéliser les réseaux de pouvoir de la fin du Moyen Âge
27	Network hermeneutics: exploring the meaning of a source using network analysis, case of inquisitorial protocols from 14th century Stettin
28	Networks and textual production during the Middle Ages (12th-15th centuries)
29	Networks of Confessional Affiliation: Religious Choice and the Schism of Utrecht
30	Networks of Displacement: Spatial and Temporal Dynamics of Post-WWII Migration and Resettlement
31	Our Maist Speciall Freindis: Using historical network analysis to study clan structures in early modern Scotland
32	Radical translators (Britain, France and Italy, 1789-1815) through the lens of a network visualisation
33	Religious Networks in Late Babylonian Period (RelNet)
34	Representing discourses as networks: potential applications of TheSu XML in network analysis for the history of ideas and science
35	The assistance of the Church to the Jews in Milan during the Second World War
36	The diplomatic networks of ancient Athens: the evidence from the decrees
37	The networked geography of a newspaper
38	The transfer of German pedagogical knowledge to Turkey through Turkish educators in the Early Republican Era: A historical social network study in the field of transnational education
39	Tracing the Network Continuity: From the Socialist to the Communist Women's Movement (1907-1934)
40	Using citation networks for viewpoint plurality assessment of historical literary corpora: The case of the Medieval Rabbinic corpus
41	Viewsari: New Perspectives on Historical Network Analysis in Giorgio Vasari's The Lives Using Knowledge Graphs
42	Visual Exchanges as a Network: The Case of Avant-Garde Periodicals
43	Visualiser le micro-ordinateur DAI par le réseau d'amateur qui l'a fait vivre.
44	Visualising Bibliographical Data on Polish Literature after 1989
45	Visualization of Early Islamicate Scholars' Network

Table 1. Numbering of the papers shown in figures 2, 3 and 4.

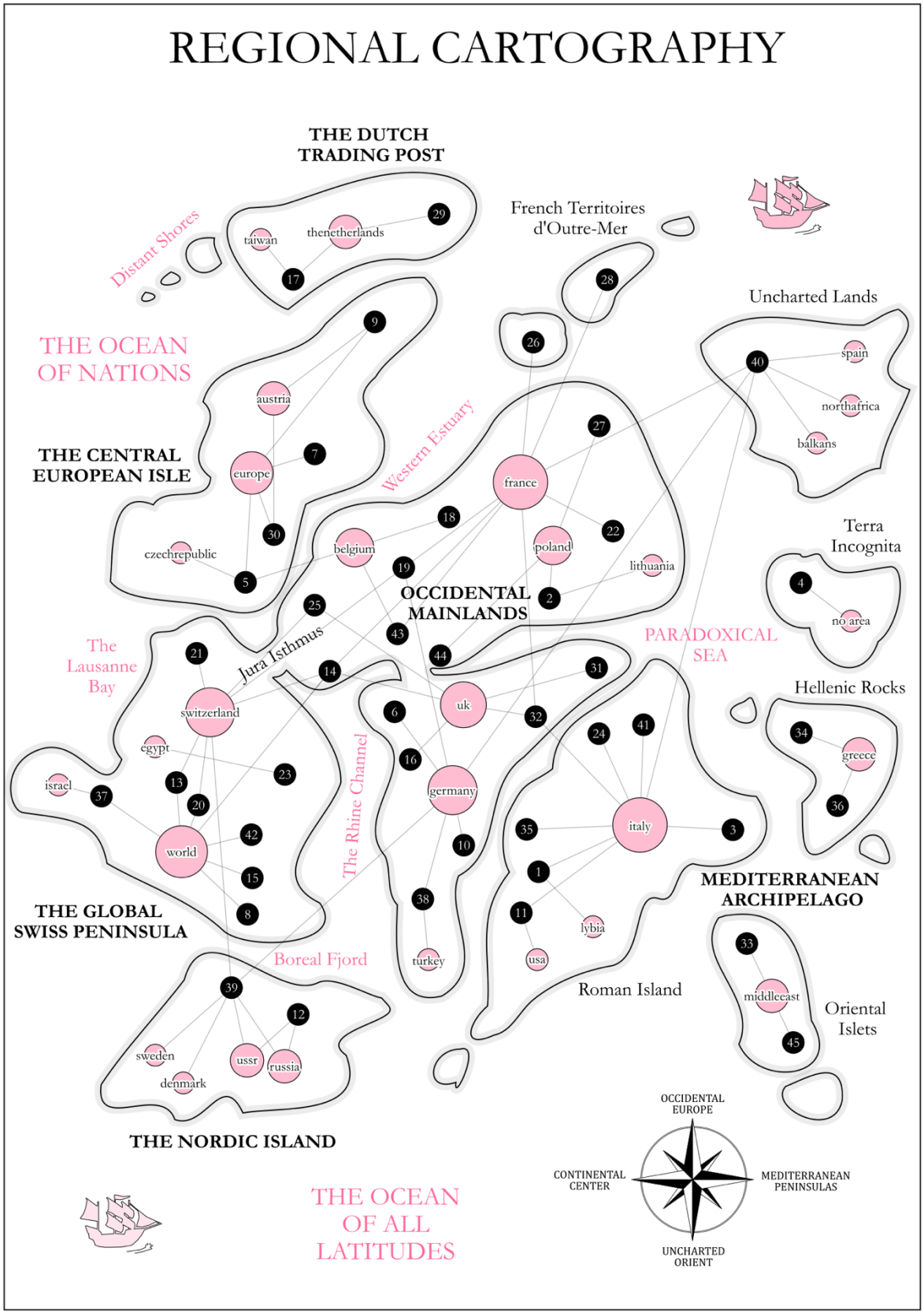

Figure 3. Symbolic "Geography "of HNR2024 conference papers.

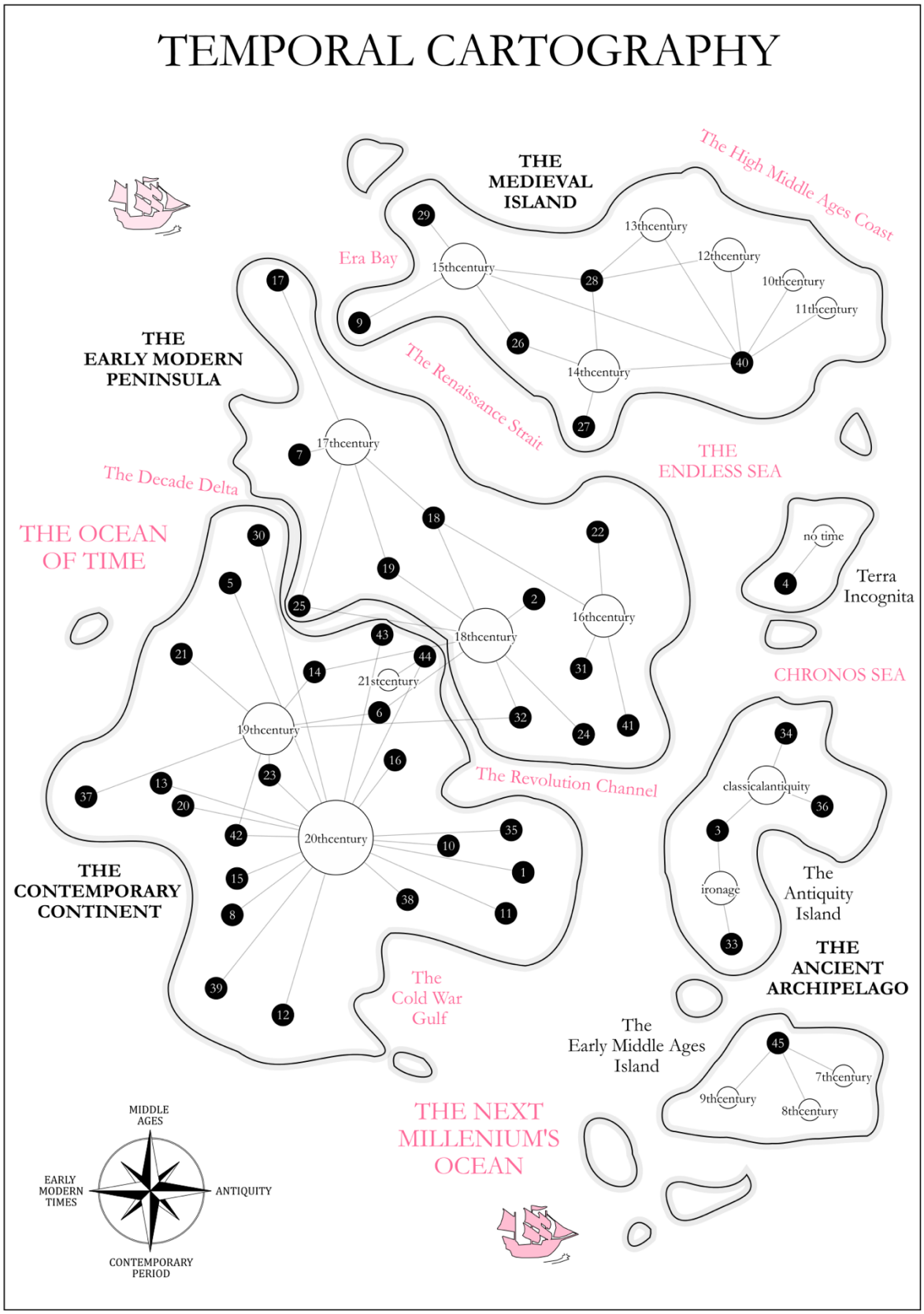

Figure 4. Symbolic "Temporal cartography" of HNR2024 conference papers.

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Bernd Wurpts, Postdoc in Sociology (University of Lucerne, Switzerland)

Keynote speakers

Claire Lemercier

Research Director CNRS, SciencesPo Paris (France), see also quanthum.hypotheses.org. Claire Lemercier will give the closing plenary keynote, where she will react to the various presentations in an attempt to highlight the contributions of the conference and assess how far we have come (and how far we still have to go).

Mathieu Jacomy

Assistant Professor at the University of Aalborg in Copenhagen (Denmark), see also reticular.hypotheses.org. After giving a pre-conference workshop, Mathieu Jacomy will open the conference with the first keynote. He will discuss our network visualisation practices and show where they fit into our hermeneutic engagement with our data.

Marten Düring

Assistant Professor at the University of Luxembourg (Luxembourg), see also martenduering.com. As founder of the Historical Network Research Community, Marten Düring will open Tuesday's debates by showing how much our community has evolved since its earliest beginnings.

Other speakers

Pim van Bree and Geert Kessels

Founders of nodegoat.net. The creators of a tool designed for research into historical networks, Pim van Bree and Geert Kessels will be leading a pre-conference workshop to demonstrate its potential.

Martin Grandjean

Senior Researcher at the University of Lausanne (Switzerland), see also martingrandjean.ch. As conference organizer, Martin Grandjean will chair the opening plenary.

Long papers

Analysing artistic network of the Basilian order in Eighteenth-Century Poland-Lithuania: a digital humanities approach

Tomasz Panecki [1], Melchior Jakubowski [1]
1: Institute of History, Polish Academy of Sciences

Panecki Tomasz and Jakubowski Melchior. 2024. "Analysing artistic network of the Basilian order in Eighteenth-Century Poland-Lithuania: a digital humanities approach", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12598468

The research project, titled "Jesuits of the East? Artistic Network of the Basilian Order in Eighteenth-Century Poland-Lithuania" employs Geographic Information System (GIS) and Social Network Analysis (SNA) to explore the connections within and surrounding the Basilian order, encompassing individuals, events, objects, and locations. SNA and GIS offer novel avenues for collecting, storing, and analysing multidimensional data, unattainable through conventional historical methodologies (Wetherell, 1998; Gregory & Ell, 2007). Religious orders present significant analytical opportunities among historical social organisations due to their distinct internal structure, extensive network connections, and abundant written sources (McShane, 2018). The Uniate (Greek Catholic) Basilian order, as one of the largest monastic communities in Poland-Lithuania, comprised over 150 (their number was changing) monasteries and more than a thousand monks, playing a pivotal role in Western-Eastern cultural exchange (Lorens, 2014). Basilians took care of the most important sanctuaries, provided pastoral and educational care, developed modern printing houses; from within them the Uniate bishops were recruited. Therefore, the changes implemented in Basilian monastic complexes depict well the modernising aspirations and social roles of the most influential Uniate actors.

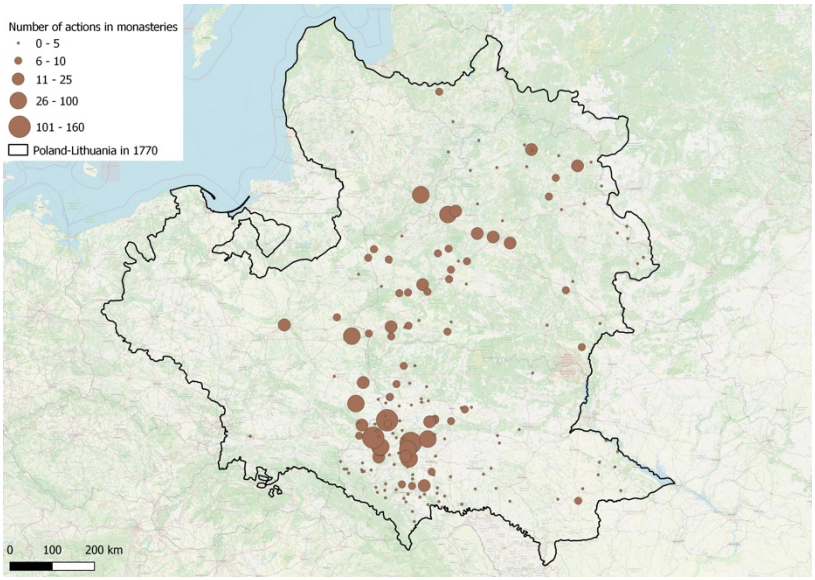

Figure 1. Map depicting number of actions (related with artistic activities) taking place in Basilian monasteries in 18th-century Poland-Lithuania. Number of actions can be understood as granularity or resolution of collected data. Accordingly, for 28 monasteries there is no information about artistic activity, and for almost 50% we have between 1 and 5 actions. Only for 3 monasteries (i.e. Krechów, Podhorce, Krystynopol) there are more than 100 actions. Differences are due to the nature of historical sources: mostly their availability and scope of content. Source: own elaboration in QGIS based on various archival queries.

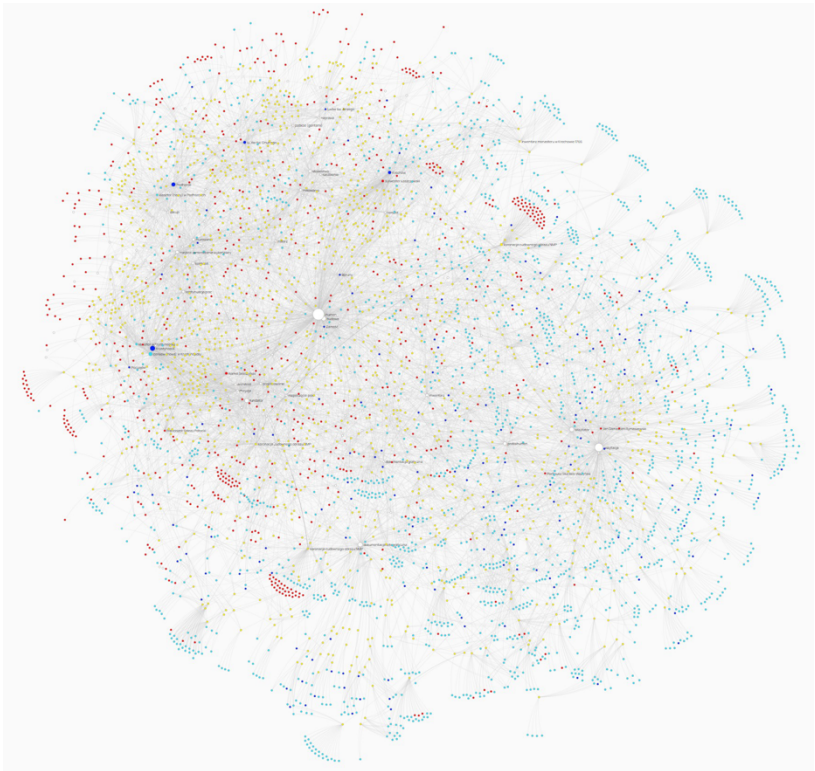

Figure 2. Graph depicting all possible connections between 700 human actors, 190 monasteries, and 1900 artistic objects collected in the study. Connections represent actions between these entities. Source: Own elaboration in Nodegoat based on various archival queries.

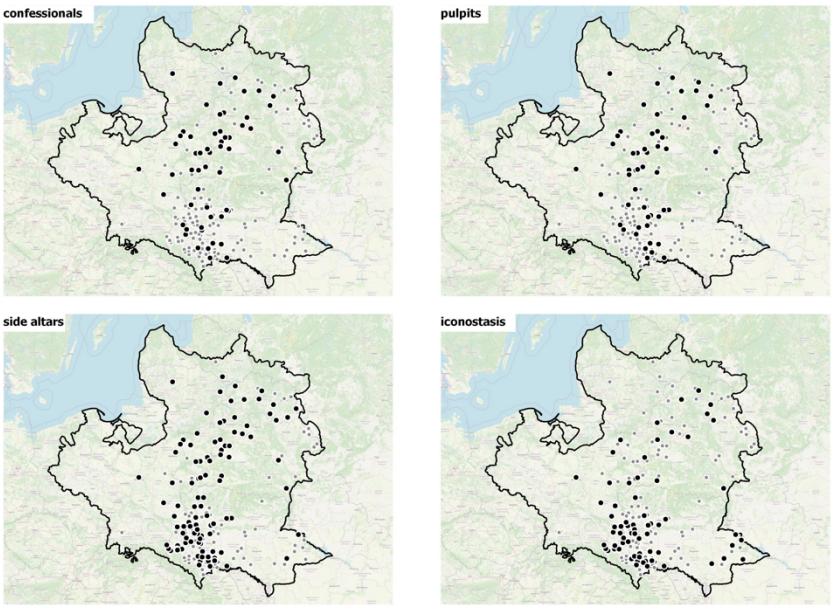

Figure 3. Map showing the spatial dispersion of "Latin" (West) and "Orthodox" (East) elements in Basilian churches. "Latin" elements are side altars, confessionals and pulpits, while "Orthodox" is iconostasis. All other monasteries are shown in grey. The map signals the high level of "Latinization" of the order. Source: own elaboration in QGIS based on various archival queries.

The central goal of the project is to reconstruct the artistic network of the Basilian order, defined as the interconnections among human actors, events, objects, and places. The research questions focus on three key areas: the artistic activity of the order, the uniformity of its artistic expression, and the role of patronage:

- How did the monastic network operate within the Uniate order, bridging the traditions of Eastern and Western Churches?

- Did Basilian superiors and artists promote a universalized artistic vision, or did regional disparities prevail?
- What was the significance of noble founders and patrons in shaping the artistic landscape?

The project draws on diverse historical sources, including written, iconographic, cartographic, and material evidence (in situ art objects). Written sources encompass acts of visitations, inventories, chronicles, building documentation, and correspondence within the Church and with patrons. Historical and contemporary images, along with depictions on maps, complement the available evidence.

To collect, analyse, and visualise the data and address the research questions, a digital humanities toolset is employed, consisting of Nodegoat, QGIS, and Gephi. Nodegoat is used for data model preparation and collection, while QGIS and Gephi are employed for geographical and social visualisations, respectively. The data model, designed in Nodegoat, includes feature types for human actors, places, concrete objects, and events, ensuring data consistency through controlled vocabularies. The use of "actions" in the model links human actors, places, and objects, aligning with event-based modelling principles (Yuan et al., 2015) and CIDOC-CRM "event" (E5) class (Bekiari et al. 2024, p. 60-61). For instance, an action of building a new church takes place in a certain monastery and involves different people of particular roles (monastery superior, patron, architect, contractors, etc.). "Actions" are differentiated not only by their references to particular classes, but also by the type (e.g. building, planning, painting, etc.). The database contains approx. 1600 actions, 700 human actors, 190 monasteries, and 1900 artistic objects. In the analytical stage, Nodegoat, QGIS, and Gephi are employed for filtering, querying, spatial analysis, and graph metrics. For better understanding, the results are put on the map (fig. 1) or graph (fig. 2).

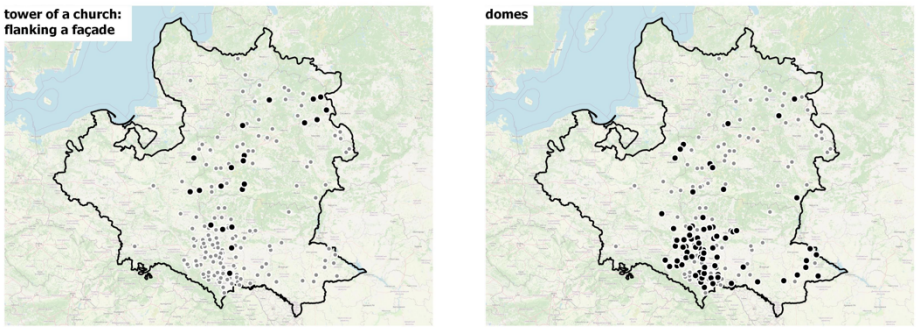

Figure 4. Map exemplifying regional differences in artistic solutions employed by the order. Towers flanking a façade of the church occur in the northern (Lithuanian) province, while domes mostly in southern (Polish). All other monasteries are shown in grey. Source: own elaboration in QGIS based on various archival queries.

The database enables us to answer initial research questions. Basilians were combining Tridentine Catholicism with the spiritual and material heritage of Eastern monasticism. Tracking specific objects in monasteries illustrates the spatial dispersion of "Latin" and "Orthodox" elements and the synthesis of diverse influences. For instance, Basilians introduced "Western" elements, such as confessionals, pulpits, and side altars, while remodelling the most "Eastern" object - the iconostasis (fig. 3). Regional differences within the order, particularly between Polish and Lithuanian provinces, are evident, impacting formal solutions in artworks (fig. 4). Patron preferences often outweighed the rules or preferences of the monastic community, with many Basilian monasteries relying on the financial and organisational support of Polish-Lithuanian magnates (fig. 5). As a result, some great complexes were erected, while other projects were executed only partly or never realised.

The proposed approach holds broader implications for network analysis in history, art history, and related disciplines (Kovacs, 2016; Lozano, 2021). Notably, it makes use of "event-based modelling" with the inclusive concept of "action," facilitating the correlation of different actors with places and artefacts. This approach, integral to the workflow, can be adapted for similar research endeavours. Additionally, the method suggests a means to integrate diverse sources into a single data model, allowing for analysis in various geographical and social contexts. Future works may include such activities as aligning the model to upper-level ontologies (e.g. CIDOC-CRM).

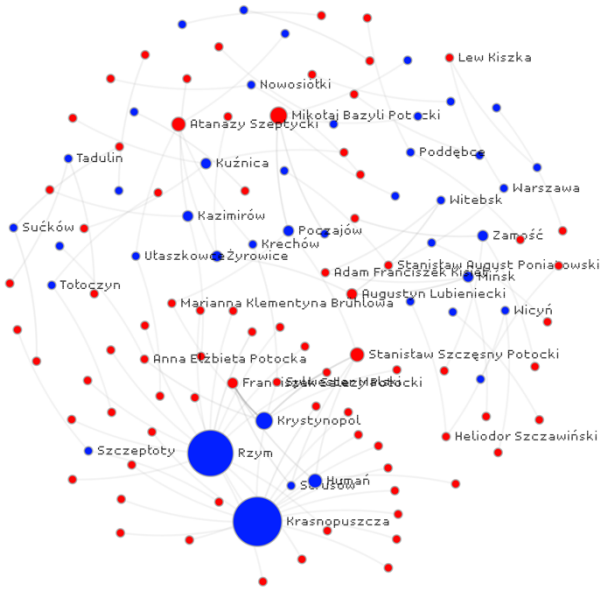

Figure 5. Graph showing monasteries and their patrons. Blue circles and dots represent monasteries, and red depict founders. The larger the circle, the more patrons the monastery had and, vice versa, the more monasteries were founded by a single patron. Two monasteries are significant (Rzym/Rome and Krasnopuszcza) as they had many patrons, whereas Atanazy Szeptycki, Mikołaj Bazyli Potocki and Stanisław Szczęsny Potocki were involved in the highest number of monasteries. Own elaboration in Nodegoat based on various archival queries.

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Cinemas and Films: what can we learn from visualising historical cinema networks based on their programmes?

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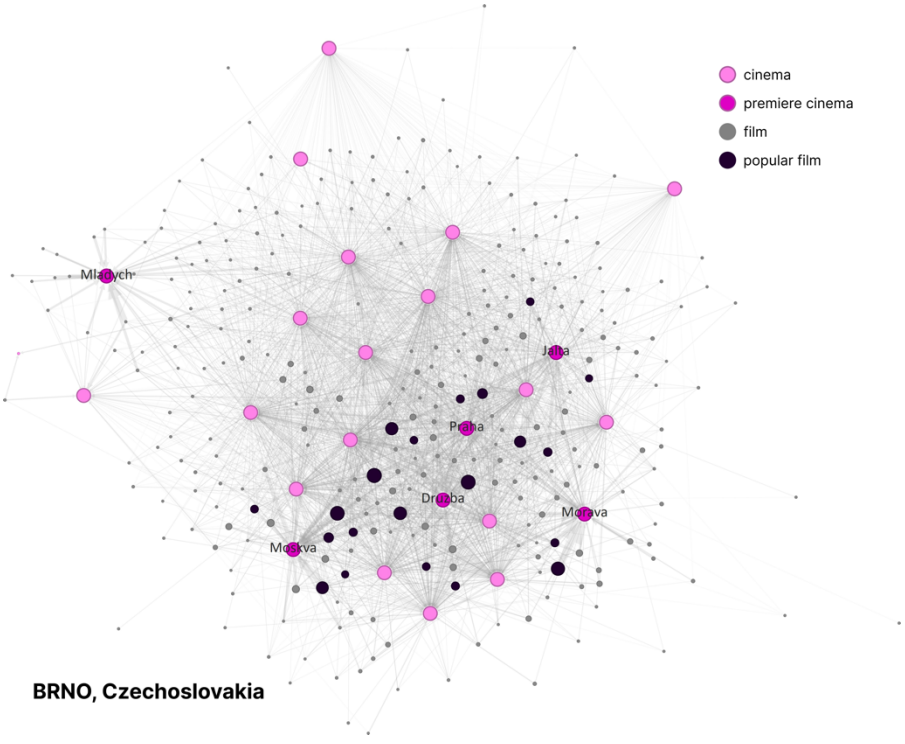
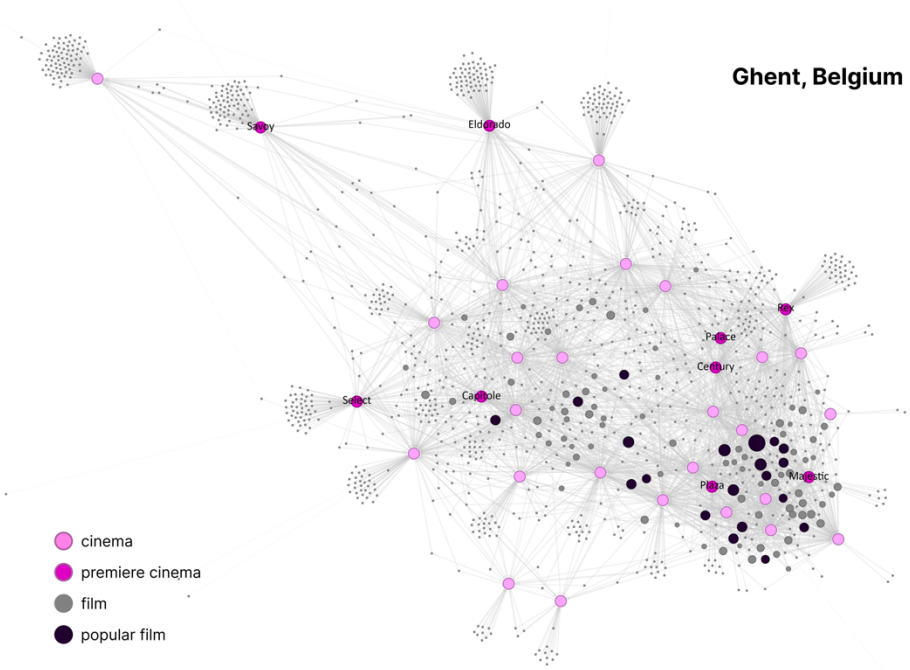
This study aims to contribute to the current methodological debate on research methods using digital visualisation as its starting point while defining a specific research objective. The aim is to explore the advantages that visual network analysis can bring to the research of the history of cinema and local film circulation.

Previous research on the history of the local film culture has mostly visualised the cinema network from its geospatial perspective. The links between cinemas in geographical space as well as in a more abstract network of relationships have been analysed by many authors. Several projects within the history of cinema show the wide possibilities of visualisation that this field of research offers (Verhoeven 2016). However, these bold works are accompanied by many others, which often end up merely placing cinemas on the map. In recent years, a great emphasis has been placed on the analysis of the programming structure of cinemas. With ever-expanding databases emerging in different geographical contexts, the number of cinema historians interested in quantitative analysis and visualisation of cinema history is growing. Also, with this interest, the urge for a comparative approach towards cinema history grows (Biltereyst, Maltby, and Meers 2019; Treveri Gennari, Van de Vijver, and Ercole 2024). The structure of databases varies in each research project. However, the ground base of each such project usually consists of the list of cinemas and their programmes, that is, the films they showed and for how long. The analysis of such data primarily focuses on which films were shown in cinemas, how long they stayed on the schedule, and which ones gained significant audience response. Despite the fact that data visualization in historical research already has its tradition (Kerschbaumer et al. 2020), the research methods that take into consideration the quantitative side of cinema history are relatively scarce and unexplored in the field of cinema history. Although there have



been a number of works over the past 20 years that have attempted to quantitatively analyse as well as visualise various aspects of local cinema history, an established method for how to approach the visual analysis of historical data centred particularly on local film culture is still missing.

This paper explores the possibilities of visualizing and analysing a network of cinemas based on their relations. The analysis would not have been possible without the extensive database built as part of the transnational collaborative project, the European Cinema Audiences (ECA), which focused on researching the local history of cinemas, film culture and audiences in seven European cities in the early 1950s. We take all seven cities: Bari, Brno, Ghent, Götheborg, Leicester, Magdeburg and Rotterdam, and compare their network layouts that clearly illustrate the different conditions in which local film distribution operated and film culture existed on both sides of the Iron Wall at the beginning of the 1950s. The source database consists of almost 980,000 entries on film screenings in the seven cities in the period 1951-1953. We contrast the local film distribution and circulation operated in the Soviet bloc, where the absence of Hollywood and Western European films had an instant impact on the film culture and audiences' preferences, with that of a Western European market, where the viewers were constantly overwhelmed by the Hollywood production. These conditions led to Eastern European audiences choosing from an almost completely different range of films than Western European audiences.



The networks are not defined by the geospatial relations of the cinemas but by the relations that have emerged from their programming structures. As a starting point, we use a bipartite graph constructed from the cinemas and the films they showed. The edges are undirected and their weight is calculated as the number of screening days in a given cinema. The resulting networks give us new information about the ways in which films flow within the city and how what effect the political and social national context had on the local cases. Through the networks, we learn about the similarities between cinemas that geographically or hierarchically seem very distant, and about the new positions of cinemas within the local network that often contradict their position in the established hierarchy.

Among the main results of the proposed visual analysis is the discovery of new patterns of film circulation within the cinema network at the local level, as well as the possibility of comparing several local cases with each other. One eye-catching finding might be the absence of the comet-like tales of films attached to cinemas in Brno. In Ghent, these tails represent films that were only shown in that one cinema and then disappeared from local circulation. In Brno, such films did not exist due to state-controlled production and distribution, which resulted in a limited choice of film offerings. This also resulted in a significantly longer film trajectory compared to Ghent. The benefits that this method of network visualisation and analysis based on similarities in cinemas' programming structures entails are considered to be the most important contribution to the current debate on the methodological issues of researching and, even more importantly, comparing the histories of local film cultures. Its advantage is its applicability to cases with different

historical and political circumstances and, thus, the possibility of comparing these contexts on the basis of the networks created. Our research tests the method on cinema networks operating in the early 1950s in the free market of Western European countries, as well as on cases in Eastern Europe that were subject to state surveillance. Without condemning other types of visualization and analysis of quantitative historical data, we consider the inclusion of this method in local cinema history research to be essential for gaining a more comprehensive picture of the contemporary state of the cinema network and the processes that took place within it.

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Communicating about communication: Using graph comics to explore communication networks in letters of Early Romanticism

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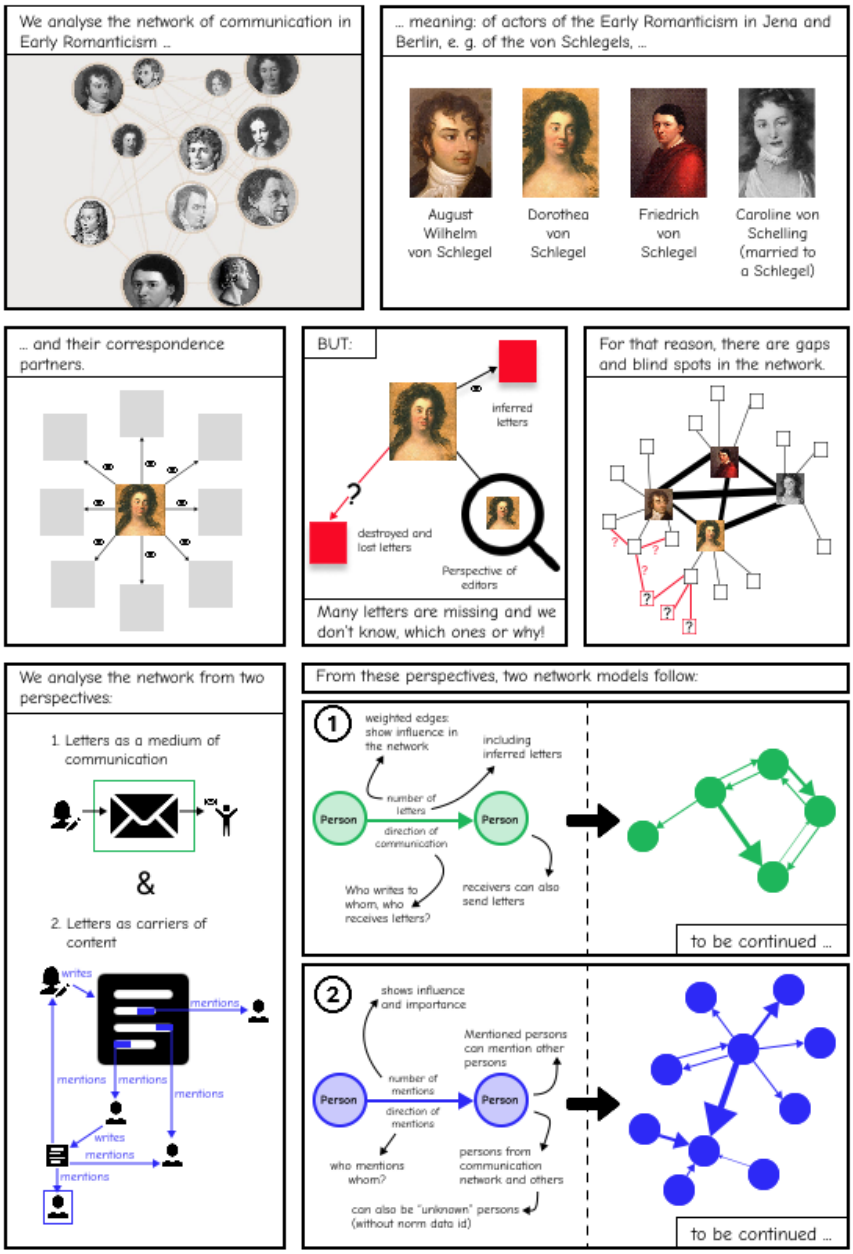
"When visualizing data, the only certifiable fact is that it's impossible to avoid interpretation." This statement by D'Iganzio and Klein (2020, 80) shows the crux of every visualisation. On the one hand it facilitates communication about the insight into data we get through our research: We can share this "simply" by showing it. On the other hand, by doing so we are not communicating crucial information the observer needs to understand this visualisation: Information about the context of the data or biases in the database. In the case of a network visualisation, we might encounter the infamous "hairball", indicating a dense network with so many actors and relationships, its readability has been lost in their overwhelming entanglements. In addition, we might also want to share more information about the temporal changes in the network or to show parallel changes that are important for the context of our research question. These research questions have a crucial role because from the beginning of the analytic process, they shape the data, from which we build our networks, as well as the results and interpretations we draw from them. In fact, in this process, we are showing a specific representation of the data shaped by our research focus which we furthermore hope is interpreted in the way we intend it to be. So how can we enrich our visualisations with more information? How can an *observer* of a visualisation become the *reader* of it?

An attempt to solve this problem is the use of graph comics (Bach et al. 2016). Graph comics serve as a tool for data-driven storytelling and help to improve the communication of what exactly is shown in a network visualisation. They show how the network was built from which data points, from which relationships it is formed and how these can be interpreted, how its structure and appearance can be interpreted and read, and much more (cf. use cases on graph comics website[6] and fig. 1). Hence the users have the opportunity to *read* the comic and follow a narrative instead of just looking at a visualisation. In their test with a focus group, Bach et al. encountered first that "comics are a flexible and expressive medium, enabling communication with a variety of visuals and text". Second, graph comics help "to express changes in networks" because "they are readable by a wider audience and applicable to a variety of usage scenarios" (Bach et al 2016, 3679).

In our talk we want to share our experiences with graph comics, demonstrate how they may serve as a form of internal as well as external documentation, and furthermore help to transport more information about forms of communication in the network of letters of Early Romanticism. Our research is embedded in the DFG-project "Correspondences of Early Romanticism. Edition - Annotation - Network Research" (https://briefe-der-romantik.de). The Early Romanticism in Jena and Berlin is considered the outstanding intellectual revolution of young German authors and scholars at the turn of the epoch around 1800. The group operated publicly and sustainably, dispersively yet network-forming; they reflected and practised "Geselligkeit," for example, through the communication form of letters. The analysis of these epistolary communication processes among the Early Romantics is one of the major desiderata of Romanticism research, which we intend to address. The project aims to build up a database that consists of the letters exchanged among the key protagonists of Early Romanticism (such as Friedrich, Dorothea, August

[6] https://aviz.fr/~bbach/graphcomics/

Wilhelm, and Caroline Schlegel, Novalis, among others) and their correspondents between 1790 and 1802, covering various 'prehistories' up to the dissolution of the Jena Circle (Schanze 2018, 18). By analysing the communication networks, we intend to highlight important actors (or, thinking in graph comics, main characters) in these communication processes, identify potential clusters, search for signs of loss or (re-) establishment of contact as well as set all these factors in a temporal and comparative context. Ultimately, through these results we intend to get a better understanding of knowledge transfer and production in the Romantic circle.



At this stage of the project, however, the database is not yet completed. At the time of writing, around 3,300 of a projected 6,500 letters have been published on the project website in varying states of annotation. This brings its own set of challenges in interpreting and understanding the networks created, and communicating these biases efficiently. At the same time, the project is still developing a network methodology to analyse these processes of communication and network transfer, which is then intended to be applied to the final data set – meaning, a clear and concise way of documenting the successes and dead-ends, the potentials and pitfalls of different methods is needed that can be understood intuitively not only by Digital Humanists but also by literary scholars which are less familiar with formal methods and quantitative thinking – as they make up parts of the project team as well as the intended audience. For these reasons, the project will experiment

with the use of graph comics to facilitate understanding the dynamics and temporal changes in communication based on the networks of the early romantic correspondences.

Additionally, we are also aiming at improving science communication in our project: Considering the large database as well as the many actors involved, just showing the visualisation of the network (e.g. sender-receiver-network) might result in one of the earlier mentioned "hairballs" and not communicate anything of the results apart from the fact that we used a network to analyse the data. As it is impossible to visualise data without interpretation, through the comics more context or framing can be given by reducing the visualisation to abstract symbols or drawings and then contextualising them by using comic strips – all the while never losing the explanatory power inherent in the visual approach. Furthermore, graph novels could also be used to explain the bias or uncertainties in the data so that readers of the comics have this already in mind.

In the presentation, we aim to give an overview of this experimental integration of graph comics in our documentation processes, while in doing so, presenting the first results of our work on the communicative network of the Early Romanticists.

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Emerging Maximilian: temporal co-occurrences network analysis of people mentioned in Regesta Imperii XIII

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Tambuscio Marcella, Luger Daniel and Vogeler Georg. 2024. "Emerging Maximilian: temporal co-occurrences network analysis of people mentioned in Regesta Imperii XIII", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12598653

Introduction

We show here some early results of network analysis applications in the research project ManMax "Managing Maximilian: a prosopographical analysis on the Habsburg emperor Maximilian I (1459-1519)" [Research Project FWF SFB F9200 https://managing-maximilan.net]. Known as "the last Knight", Maximilian is a key figure across two eras (Middle Age and Renaissance) who played a strategic role in European history since the political landscape drastically changed during and after his reign. The project, involving a large interdisciplinary team and different sources of data, aims to focus not only on Maximilian itself, often known as a skilled strategist and master of propaganda, but also on the role of many individuals and groups involved in those changes, inside and outside his court. While many data sources have been still digitizing, we focused here on Regesta Imperii XIII, which includes the documents issued by Maximilian's father and predecessor Frederick III (1415/1440-1493) and we propose a temporal analysis of co-occurrences networks that highlights the emerging role of Maximilian, leading the foundation for the rise of the House of Habsburg to become the most politically powerful dynasty in Europe in the following centuries.

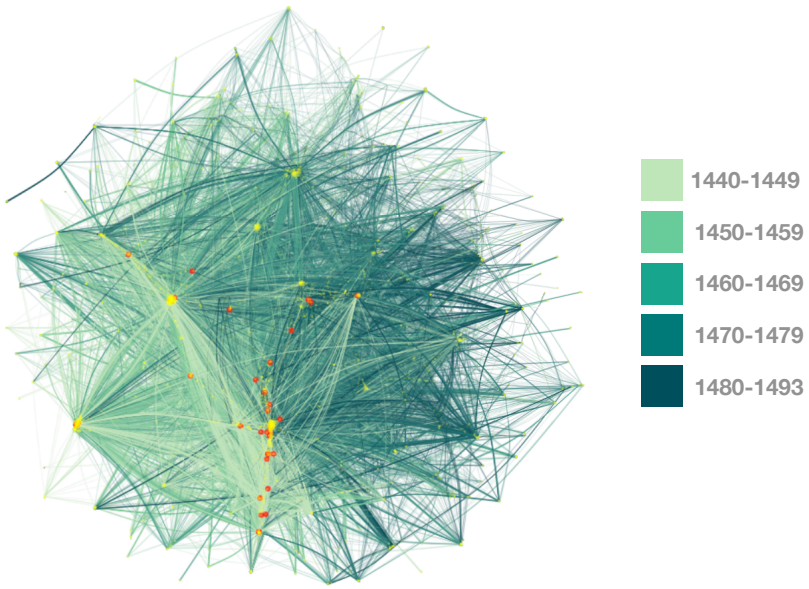

Figure 1. Co-occurrence network of people mentioned in Regesta Imperii XIII. The more central nodes are colored in yellow and red (respectively denoting high values of degree and betweenness centrality). The main issue we want to focus on in this visualization is the role of time in the evolution of interactions, so we colored each edge according to the decade associated in the respective edge attribute "start_date", in order to highlight that such a large network is worth to be studied with a temporal perspective.

Dataset and Network Description

The Regesta Imperii(Rowan, 1973) is a large dataset that includes more than 150,000 abstracts of medieval charters issued by the Roman-German kings and popes distributed over many European locations and a time span of more than 700 years. We focused on the volume XIII, corresponding to the reign of Friedrich III, that has been completely digitized and labeled (Kuczera, 2019, Opitz et al., 2018, John et al., 2017), available at https://gitlab.rlp.net/adwmainz/regesta-imperii/lab/regesta-imperii-data.

In particular we selected the entities related to persons mentioned in the documents, and built a co-occurrence network (giant component) with more than 13K nodes and 230K edges, labeled with temporal and spatial information over a time interval of 53 years (1440-1493). Some people mentioned were actually dead in this time range, but often the death date is saved in the label so we easily drop these people out from our dataset. The network has been built as follows: if a person A and a person B appear in the same abstract we build an edge between nodes A and B, and we label this edge with the information related to that abstract (time and geographical info, if any). With a simple visualization obtained coloring the edges of the network according to their corresponding decade (see Figure 1), we can appreciate the crucial role of time in this network. This is a very huge dataset compared to the large majority of applications of network analysis in history and the large temporal span gives us the great opportunity to analyze in detail how the relationships evolved in time. To do this we then extracted the 53 sub-graphs induced by the date edge attributes, meaning that we consider the yearly network induced by relationships dated with a particular year, so for instance for 1483 we considered the co-occurrences of people mentioned in all the abstracts dated from 01-01-1483 to 12-31-1483. Dealing with those networks is certainly easier because they are smaller (usually less than 1000 nodes) and we will show in the following paragraphs how to use their local properties to have a global view of the whole dataset.

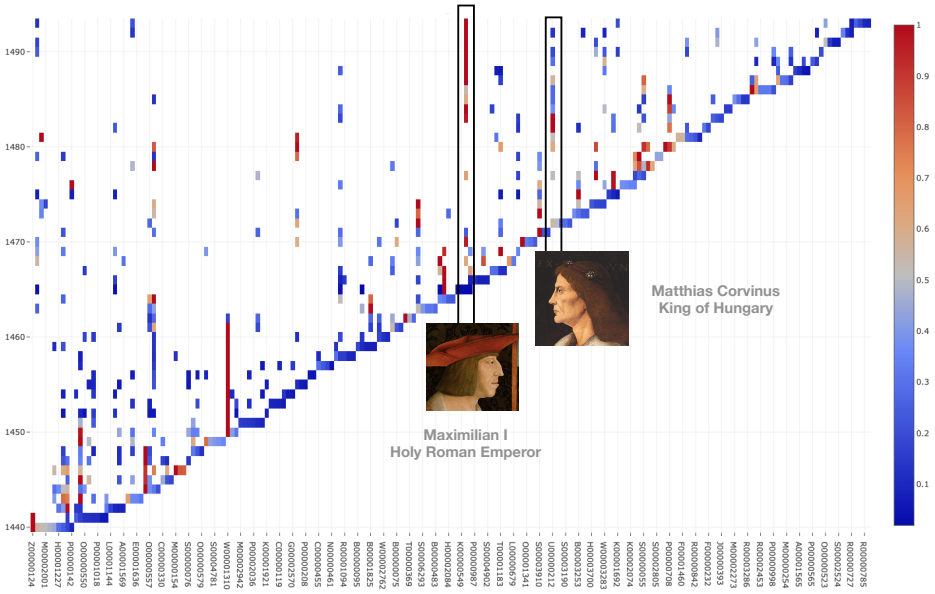

Figure 2. Temporal evolution of betweenness centrality in the network. Each (x,y) point represents the betweenness centrality rank (in the brokers top 10) of a person x in the year y. A red dot (x,y) in particular represents a high rank of person x in the brokers top 10 of year y, a blue dot means a lower rank. Notice that on the x axis are listed only the people who enter at some point in this "top 10", and we chose the number 10 to improve readability of "stories" in this plot. We highlight here for instance Maximilian, who increased his power in the last years of his father's reign, and Matthias Corvinus, the king of Hungary who was involved in war against Maximilian around 1483 and he gained influence in a short timeframe.

Temporal Centralities Results

Computing basic centrality measures (degree, betweenness) in the whole network we obtain a list of the most influential people in the full period covered by RI XIII. Since we are interested in how this influence was built, we split our large network into 53 independent sublayers corresponding to years from 1440 to 1493, as a multilayer temporal network (Kivela et al., 2014; Holme and Saramäki, 2019). For each layer we computed the centralities for all nodes (Prado, 2016) and then we considered those measures normalized

over the maximum value of that year, obtaining ranking values in [0,1] that can be compared. The yearly lists of the first ten most influential individuals changes very quickly in time and are signficantly different from the one of the whole network. Additionally, we can select one person and analyse the evolution of his power across time (see Figure 3). In order to visualize the global dynamics of influence over time we propose a visualization: a heatmap where we show, for each time step, the 10 nodes with highest centrality (Figure 2): a red dot in (x,y) represents a high rank for person x in the "brokers TOP10" (high betweenness) of year y, a blue dot means a lower rank in the same list. This temporal analysis of centralities shows some patterns that were completely hidden if we compute the same measures in the whole net. First of all, we can easily observe that the set of main actors changes quickly in time, and looking at columns and rows of the plot we are finding interesting stories. Maximilian, in the top-center of the plot, rapidly increases his power (a vertical sequence of red points) in the last years of his father's reign (Noflatscher, 1999; Wolf, 2005). Other persons otherwise have a high rank only in very short periods, which might link them to specific events dating in this period: this is the case of Matthias Corvinus, who was involved in a war around 1483 against Frederick III. Figure 3 shows a more detailed evolution of both measures for these two people, while Figure 4 is the visualization of the 1483 layer, a highly polarized network.

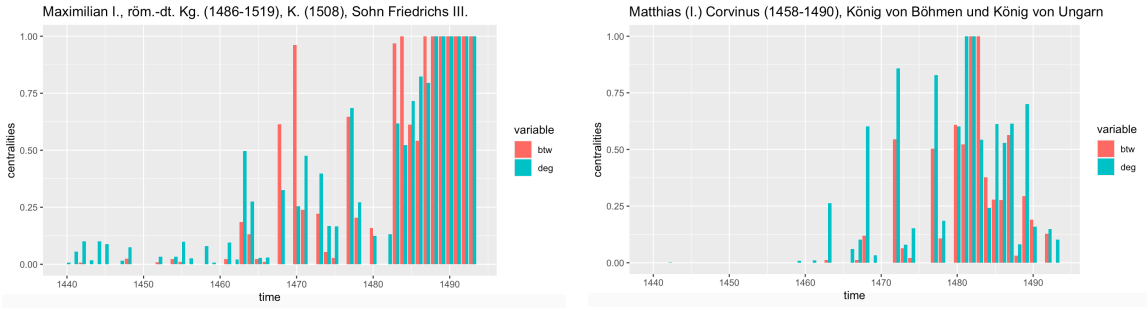

Figure 3. Evolution of normalized degree (lightblue) and betweenness (red) centrality over time for Maximilian (on the left) and Matthias Corvinus (on the right). We can notice here that there is a substantial coherence among the dynamics of both measures, but in some cases they are significantly different (for instance, high degree and low betweenness). These local properties could be explored more in detail to focus on individual roles of people in the prosopographical network.

Figure 4 Induced subgraph corresponding to the year 1483. The network appears to be highly polarized and we notice the central roles of the two main actors: Maximilian and Matthias Corvinus. They were indeed involved in a conflict and not surprisingly next to Matthias Corvinus we find the Ottomans and the Pope, who also had strategic roles on that period.

Temporal Communities Results

Similarly to centralities computation, running a community detection algorithm on the whole network we do not obtain interesting or meaningful results because of the very large size of the graph. Again, we decided to focus on individual layers, running a community detection locally: in Figure 4 the nodes are colored according to the Louvain algorithm. With this approach we obtain a reasonable number (10-15) of communities for each layer and we tried to exploit this local similarity to look for global patterns: we consider how many times two nodes appear in the same community and we build a new graph with this information, keeping only nodes (people) mentioned at least 3 years. Louvain's algorithm detected 7 communities in this new network, as represented in Figure 5: further discussion is needed here, but we already observed an overlapping among some communities and groups of people united by the same social function (1 - imperial elite, 2 - nobility, 3-6 functionaries etc) or by the same geographical areas (4,5,7).

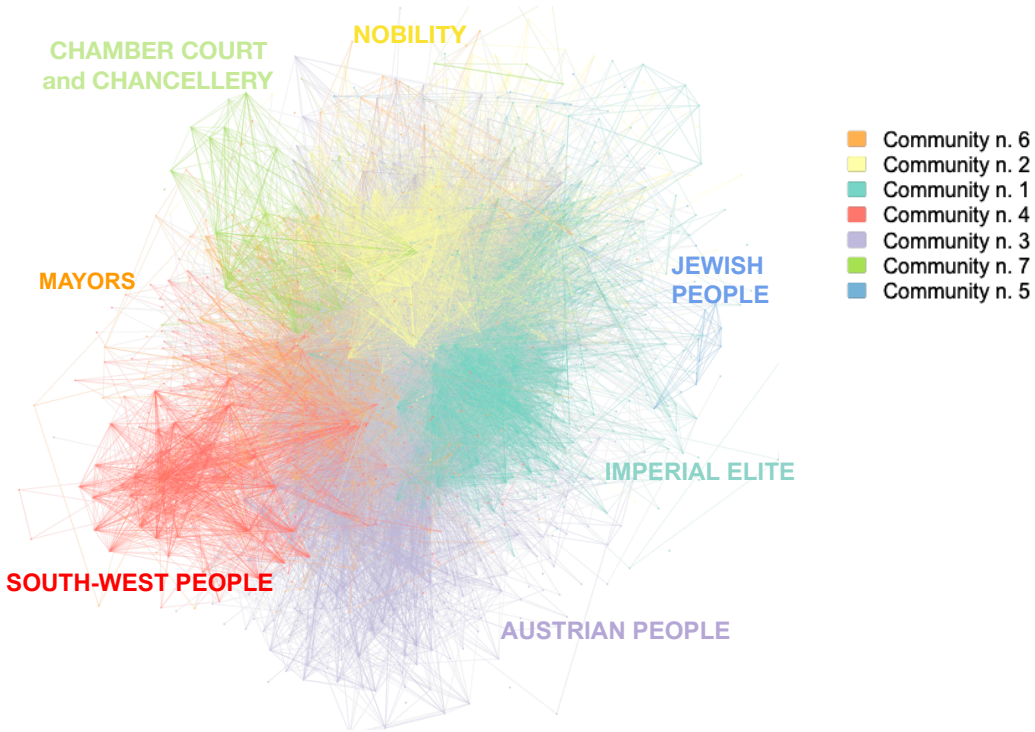

Figure 5 For each yearly projection we ran the Louvain community detection algorithm and then we built a network in which each link (i,j) weighted with w represents people i and j that appear in the same community for w years. Here is the result of the Louvain algorithm on this network: 7 communities that we label with a preliminary qualitative analysis.

Conclusions

The results of a temporal analysis are encouraging and we are still exploring them in order to better understand power relationships during Friederick III's reign (Heinig, 1997), especially in the last years, where the role of Maximilian started to be crucial. For instance, we would like to study in detail the structure of the sublayers to explore eventual correlations among the network topology and some specific periods in the timeline, such as wars.

About the focus topic of this event (visualization), we experimented here several types of network visualizations that highlight the role of time: coloring edges according to their decade, or focusing only on yearly sublayers. Moreover, we think that the heatmap representation of the measures across time is a very informative tool, even if not a direct network visualization, that immediately gives an idea of most influential nodes in different years, specially for large temporal graphs.

On the other hand, we want to stress the main limitation of dealing with co-occurrences networks: considering mentions that appear in the same short text, the real nature of the interactions (if there is any) is totally ignored. This can lead to misinterpretation and overrepresentation problems. Instead, a more consistent and coherent representation could be done considering the semantics of the text that describes

the relationship, or considering a manually assigned ontology of relationships in a structured dataset (payments, communications, commissions etc.). We are currently working in building a prosopographical network based on both approaches in order to combine these two perspectives: extracting multilayer networks representing different types of relationships (Padgett-Ansell, 1993) and temporal network analysis on these layers. When feasible, we would also like to represent the social network with a signed graph, labeling the interactions as positive or negative, and to compute how the balance evolves in time.

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The codes and other material can be found here:
https://github.com/GVogeler/ManMax-RIFIII

Exploring Biographical Networks of Person Objects from Newspaper Clippings in Herder Institute

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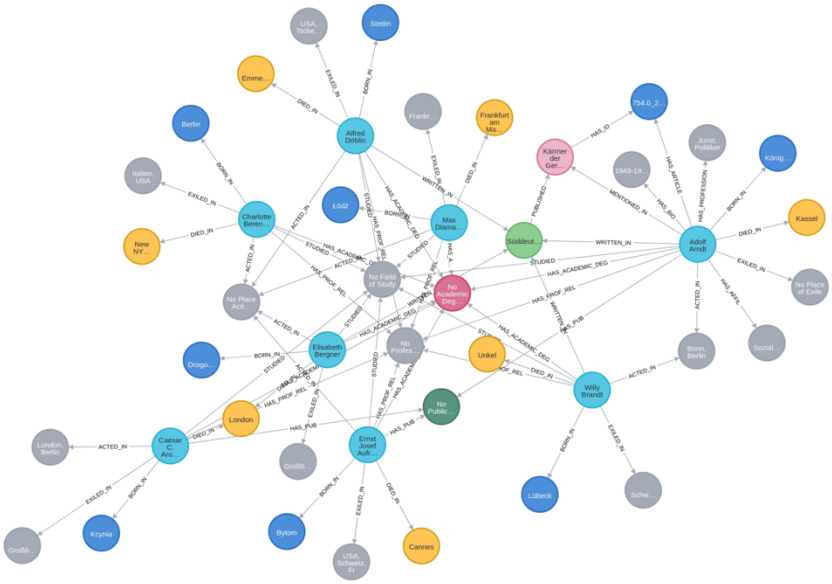

Figure 1. Biographical Network for Person Objects with Birth/Death/Exile/Activity Properties

Biographical Network Analysis (BNA), which is a mixed method combining biographical data analysis and social network analysis, is becoming a more and more prominent field of research in the art of digital humanities (DH) (Armitage 2016; Bernád and Kaiser 2017; Leskinen, Hyvönen, and Tuominen 2017; Brouwer and Nijboer 2017; Fokkens and Braake 2017). Systematically analyzed large scale data, which is converted from unstructured to structured text materials by means of web mining, natural language processing and named entity recognition methods (Tamper, Leskinen, and Hyvönen 2023), may currently lead to clarified networks among the people, organizations and events. A data set with biographical information for persons, therefore, a good candidate for BNA. Such data can be obtained through a variety of methods, usually from libraries or online web addresses that contain individuals' biographies. The data set used in this work consists of person objects mentioned in newspaper clippings digitized at the Herder Institut, Marburg. The newspaper clippings previously collected in analog form at the Herder Institute contain various themes (politics, education, art, etc.) as well as the activities of particular persons. Analyzing these newspaper clippings and their contents with DH methods and network analysis has the potential to provide new information for researchers and interested people on this subject. The bibliographic network approach is also very important for this information, especially for the person objects since the persons have often transnational lives and created complex connections throughout their lives. However, no BNA has yet been performed on the person objects in this data set. And extraction of biographical data of the particular person objects from Deutsche National Bibliothek (DNB-GND) and exploration of mobility for educational or professional purposes and the relationship among educational status/levels, educational institutions, organizations remain untouched in the field. The extraction of related data such as level of education, affiliations, educational institutions or organizations, cities/countries from biographies of the persons is an informative resource for exploring their life and career or educational pathways, mobility

and social networks that they created. Therefore, this paper explores phenomena of biographical networks among these person objects. In order to perform BNA with the data set, there are stages such as obtaining biographic data, modeling and visualizing it.

The current work, thus, focuses on three questions:

a) How to reach biographical data in Deutsche National Bibliothek (DNB-GND) via Lobid platform (Pohl and Steeg 2018)?,

b) How to process the biographical data via related Python Libraries?

c) How to visualize the biographical networks of the persons via graph database, Neo4j?

As a result of the study, information such as birth, death, places of activity, professional relationships and places of exile in the biographical data of the persons are extracted and network visualizations and clusters are obtained with Neo4j (see fig. 1). With these network visualizations, it is explored in which locations and contexts the persons were located and in which contexts they formed potential networks.

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Gender diversity in the historical networks of Soviet film production

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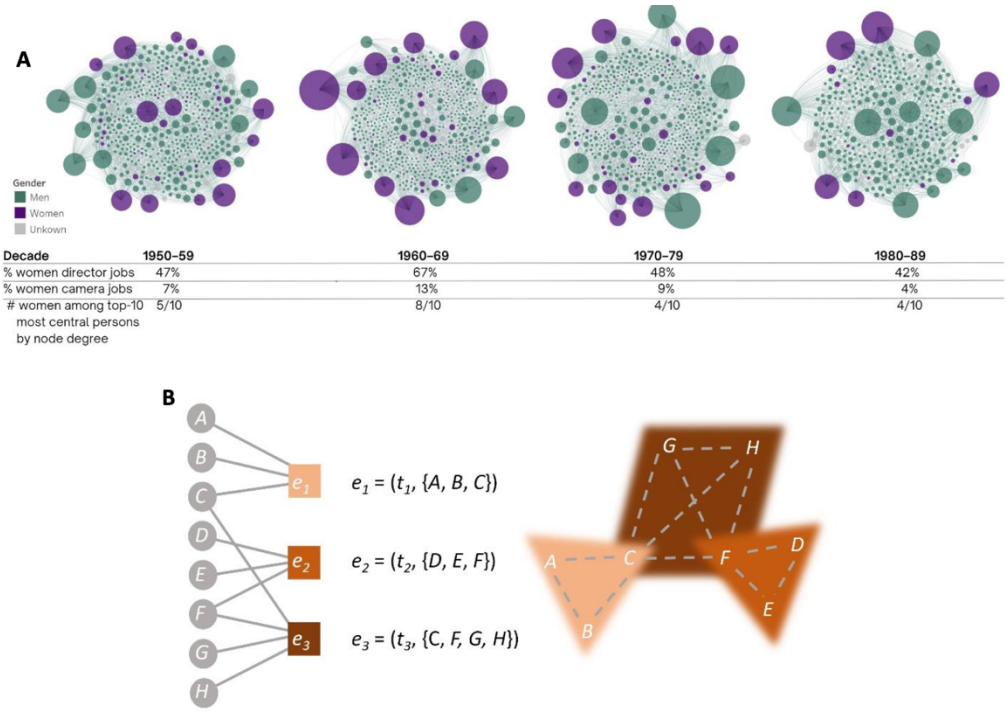
Gender inequality prevails in the global film industry. Men dominate most creative jobs in today's film production, as multiple studies have shown (Coles et al. 2022; Elefant et al. 2021; Jones et al. 2024; Verhoeven et al. 2020). However, research on the history of gendered creative labour outside capitalist Western countries is limited. In this paper, we shift our focus to the newsreel production industry of the Soviet Union to examine how gender has historically influenced team formation.



Decade	1950–59	1960–69	1970–79	1980–89
% women director jobs	47%	67%	48%	42%
% women camera jobs	7%	13%	9%	4%
# women among top-10 most central persons by node degree	5/10	8/10	4/10	4/10

Figure 1. (A) Bipartite director–crew hiring networks of the newsreel production industry in the Soviet Union separated by a decade, coloured by gender (men are green, women are purple, gender unknown are grey), curved edges are drawn clockwise from director to other crew. (B) A stylised example of three newsreel productions as hyperevents e1 to e3 occurring at event times t1 < t2 < t3 with participating crew members given by uppercase letters A to H, represented as a two-mode actor-event network on the left and as a hypergraph on the right (based on Lerner et al. (2021)).

The Soviet film industry offers an interesting setting for studying the gendered nature of creative labour dynamics. The Soviet doctrine proclaimed gender differences socially irrelevant, and the country had a higher female labour force participation rate across different industry sectors than other nations at the time. During the Soviet era, newsreels, which were short clips shown before films in cinemas, were one of the primary ways of communicating news to the public. The creative networks surrounding the production of newsreels provide a unique case for analysing gendered labour dynamics in film production outside the capitalist context.

We have collected detailed metadata on 1,747 newsreels from the Daily News series produced between 1945 and 1992. This metadata includes information about 1,623 individuals who worked as directors, cinematographers, text editors, and other crew members. The metadata was extracted from the newsreel archive digitised by the Net-Film company. The archive contains more than 9,600 clips from 77 different newsreel series produced by various Soviet film studios.

We examined labour relations through bipartite networks that depict the hiring connections between directors and crew members, with respect to the gender dimension of crew members, as seen in Figure 1A. Using the network approach, we can delve into the relational structures that underlie the historical organisation of creative labour. In the Soviet newsreel production industry, we observed a high prominence of women audiovisual media creators in key leadership roles. This contrasts with the significant gender inequality commonly found in contemporary settings (Elefant et al. 2021; Smith et al. 2019; Verhoeven et al. 2020). Between 1945 and 1992, we found that directorial duties were split almost equally between men and women, and that women directors enjoyed long-lasting careers. Women also appeared to be highly embedded within the production network structures, as evidenced by the high degree centrality of women directors, particularly in the 1960s. Despite this, stark gender inequality persisted in occupational roles of lower prestige, such as that of a cinematographer, where work was mainly dominated by men (90/10%). This aligns with the unequal labour split between the genders in today's film production industries (Coles et al. 2022; Elefant et al. 2021; Jones et al. 2024).

The focus of this submission is the investigation of the role of gender in newsreel team selection using relational hyperevent models (RHEMs; Lerner et al. 2021). The model treats the collaboration of a newsreel team as a hyperevent. In this model, hyperedges represent groups of directors and cinematographers of any size (as depicted in Figure 1B). The model specifies the expected number of newsreels produced by a team of newsreel crew within a given time interval. This is based on several network effects and covariates dependent on actor-level attributes. The underlying data structure of RHEMs is hypergraphs, which are a generalisation of graphs to polyadic, or multi-actor, interaction. The use of RHEMs is justified as collaboration on creative products such as newsreels is inherently polyadic, involving teams of people rather than pairs working together.

We show that women directors form creative teams differently than men, and the gendered hiring behaviour differs based on tenure. Our results indicate that women directors are more likely to hire women camera crews, but this is only observable for directors who are new to the industry. Experienced women directors hire more men onto their teams. However, experienced women directors are the most open to new crews overall, although new women cameras are the most likely to be hired by women directors who are also new.

Our approach combines communication and creative industry perspectives with network science and cultural history. Our study sheds light on the gender dynamics of Soviet Newsreel production and showcases the potential of our methodology for broader comparative research. We can gain further valuable insights by examining other geographic regions, historical periods, and industries with similar group dynamics.

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Inclusive institutions? Access to political power in the city of Tainan (Fort Zeelandia) in Dutch Formosa (1655–1662)

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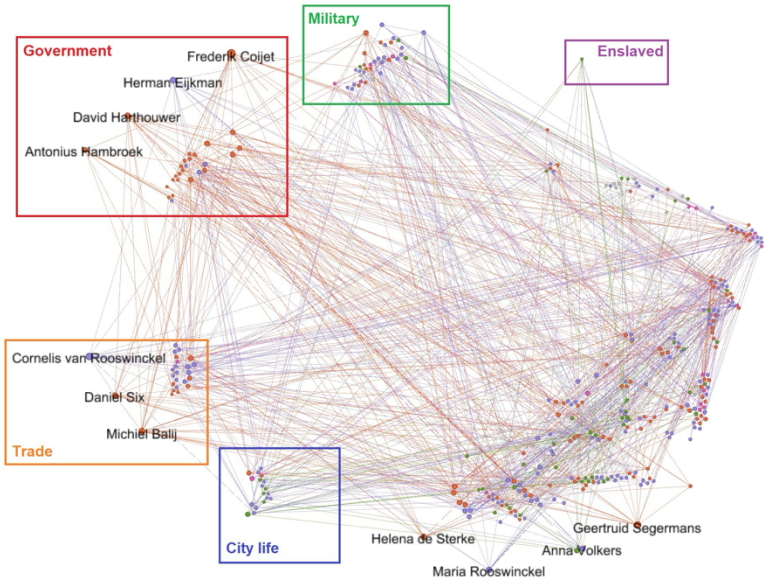
This paper employs social network analysis to examine how Dutch settlers gained access to political actors within the seventeenth-century Dutch settlement Fort Zeelandia. This city was constructed around Fort Zeelandia on the west coast of Dutch Formosa, situated in present-day Taiwan. Social Network Analysis (SNA) provides a framework for exploring the emergence of informal social relationships in this seventeenth-century colonial context. This paper uses the concept of inclusive institutions as proposed by Daron Acemoglu and James A. Robinson, who belong to the New Institutional Economics school of thought. They posit that long-term economic success is determined by the development of political institutions in which ordinary citizens could also exert influence. (Acemoglu and Robinson 2012). Hence, this paper investigates whether various social groups in Dutch Formosa had access to political actors. In a preliminary research published in 1985, Oosterhoff presumed that the Dutch presence in Formosa was successful due to merchants having access to local governance. However, his hypothesis has not been empirically tested to date. Social Network Analysis (SNA) presents a valuable opportunity to address this gap in the existing literature. (Oosterhoff 1985).



The remnants of the Dutch Fort Zeelandia persist in the Anping district of present-day Tainan. In 1624, the Dutch established a fort atop a prominent sand dune along the southwest coast of Formosa. Dutch Formosa stood out as one of the few genuinely profitable territories for the Dutch East Indies Company (VOC), facilitated by a flourishing trade relationship with Chinese cities, the cultivation of sugar and rice in the rural areas, and the imposition of taxes. Fort Zeelandia served as the focal point of Dutch presence in Formosa. Adjacent to this fort, a city developed according to the new Dutch model, adhering to the principles of seventeenth-century Dutch urban planning. The city featured straight, paved streets and various public buildings constructed in Dutch fashion, including a weighhouse, a market hall, trade warehouses, and a town hall. Despite the Dutch appearance of the city, it was a multicultural settlement predominantly inhabited by a Chinese population. Around 1650, the town boasted approximately 5,000

residents, with only 100 to 150 Dutch families among them. (Oosterhoff 1985). This paper scrutinizes the networks of these Dutch families, drawing on available sources spanning the period from 1655 to 1662. In the latter year, the city fell under the control of the influential Zheng family, seeking to consolidate their influence in the South China Sea following the expulsion of the Ming dynasty in China by the new Qing dynasty founded by the Manchus (Emmer and Gommans 2012).

Methodologically, the choice is made to employ serial sources for mapping informal networks. To achieve this, we rely on baptismal records, as they serve as a reliable indicator of significant social relationships within and beyond the family in Christian communities. In the eighteenth and nineteenth centuries, families predominantly turned inward to select godparents from within their own kin, but in the seventeenth century, a reliance on broader social networks was more common. Therefore, an analysis of baptismal witnesses provides valuable insights into crucial social relationships (Van Dijck 2015; Alfani and Gourdon 2012). Such sources are available for the period spanning from 1655 to 1661 (Heyns and Cheng 2005). Unfortunately, these documents only provide insights into the Christian community, making it considerably more challenging to delineate connections with the Chinese population. Nevertheless, the baptismal registers are not confined to Dutch individuals, as many settlers married Asian women, resulting in mixed families with heterogeneous social networks. These sources are cross-referenced with the names recorded in the daily registers maintained by the governors of Formosa (Blussé and Everts 2000). In this manner, five distinct social groups can be delineated within the urban settlement: administrators, merchants, military personnel, urban craftsmen, and enslaved individuals.

Through social network analysis, it is possible to determine the extent of interconnections among the various social groups. For instance, the analysis explores whether there existed a political class that remained distinct from merchants and urban craftsmen, or if close ties existed between these groups. Visualizing this Christian network of informal relationships among the inhabitants of Fort Zeelandia can provide interesting new insights. The advantage of social network analysis lies in its ability to illuminate connections between social groups and not restrict the research to describing the various groups. This makes it possible to find out whether certain groups isolated themselves from the broader society or were open to interactions with other segments of the city. Additionally, centrality measures allow an examination of the residents who played pivotal roles in the networks. A first network graph already suggests that influential merchants on the island formed a cohesive community with strong interconnections. This stands in contrast to the local administration, where members had close ties with military personnel and merchants but lacked interconnectedness among themselves. Noteworthy is the significant role of women in these informal networks. Despite not being obligatory as baptismal witnesses, certain women played central roles in the urban network. This aspect, brought to light through the use of social network analysis, is often overlooked in traditional historical research, where the role of women in the early modern period tends to be underemphasized.

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Integrating library and prosopographical data in the early modern publication network of the University of Louvain (1501–1797)

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Introduction

After the Catholic University of Louvain split in the 1970s, the rare books from the Old (or premodern) University of Louvain (1425-1797) were inherited by the newly founded KU Leuven and UCLouvain. Decades later, the two sister universities share joined efforts to reunite this intellectual heritage to one and the same digital gateway. Their remarkable reassembling effort of the *Collectio Academica Antiqua* (Caa, henceforth) on the online platform *Lovaniensia* is a milestone in this renewed cooperation. As the Caa is an artificial – and not a historical collection that includes works authored primarily by members of the university, it is arguably quite representative of the intellectual community of Louvain at the time. Thus, the collection metadata potentially store enough information to draw the web of relationships of the publishing world behind the Old University of Louvain. The present paper strives to offer an interdisciplinary perspective to the study of academic communities as real-world networks, using the Old University of Louvain as case study. We apply historical social network analysis (HSNA hereafter) to the records of the Caa collection, to visualize the web of relationships of the publishing world of the Old University of Louvain, as well as to describe under a new perspective the diachronic evolution of the role of well-known, relevant figures. We use a rolling-window approach to compute time-consistent network metrics, and study the evolution of the network and the role of its components. Then, we elaborate a new interpretation of nodes' degree centrality in our scholars' network, and relate it to the social dimension of printed items. We examine the evolution of the social presence of some relevant Louvain scholars and relate it to insights on prosopographical chronicles as well as on the history of the Old University.

Historical context

The academic output during the early modern period took on various forms, such as epistolary correspondence among intellectuals, but also, crucially, as printed publications. In the wake of the revolutionary introduction of the printing press, which started in Louvain in 1473, it was customary for scholarly research to be published in printed books, pamphlets, and, much later, journals, thereby benefitting from a far larger audience. Part of this production survived the test of time – both figuratively and physically – and represents the cultural heritage of the Old University of Louvain, under the *Collectio Academica Antiqua*.

Books were never a one-person job. Not only in terms of authorship but also production, funding, and inspiration. They were the result of joint efforts. The untapped, high-quality resource of the Caa enables us to reconstruct the network of the publishing world of the Old University of Louvain. Reconstructing the identities of the Caa contributors and their acts of collaboration allow us to provide an evidence-based network of what the publishing world behind the Old University of Louvain might have looked like.

Methodology

Building upon the rich metadata of the collection, we use a data-driven perspective which substantiate in the application of HSNA, i.e., an application of graph theory to historical data. We reconstruct the Old University of Louvain as a graph, and study it using network metrics.

Our goal is twofold. On the one hand, we aim at investigating the global structure and evolution of the premodern publishing network of Louvain. On the other, we attempt to describe under a new perspective the diachronic evolution of the role of well-known, relevant figures within the academic network of the Old University of Louvain.

Representing the academic community of Louvain as a network, however, poses some challenges, the first of which is its 3-century long timeline. Taking a network's temporality into account is crucial, insofar as it could affect both topology and flow (Blonder et al., 2012). Neglecting the aspect of time may lead to erroneous interpretation of the metrics. However, Historical Network research currently lacks a standard framework to address dynamics in real-world networks.

To address the temporal dimension of our case study, we resort to a rolling-window approach. We set the rolling window to 25 years, and its increment to 1 year, and we let it slide over the network time, generating a subgraph at each passage. Each of the resulting subgraph represents the central year of the 25-year span.

Data

As described from the *Collectiewijzer Erfgoedbibliotheken*, the Caa comprises the works from and around the old University of Leuven (1425-1797). The collection is part of the rare books curated by the KU Leuven Libraries Special Collections. We received the metadata of the Caa holdings from the KU Leuven Libraries in the form of a MARC21 XLM export. We extracted the relevant records for the purposes of our analysis (i.e. contributors' biographic records, as well as books' titles and publication dates). Then, we processed the metadata using the Python library *pymarc*, and we identifyied the historical figures by standardizing the multiple variants of their personal names, with the help of the clustering feature of the software *OpenRefine*, coupled with a careful manual inspection and several cross-checks. From this cleaned data subset, we are able to extract the nodes and edges lists to create the network.

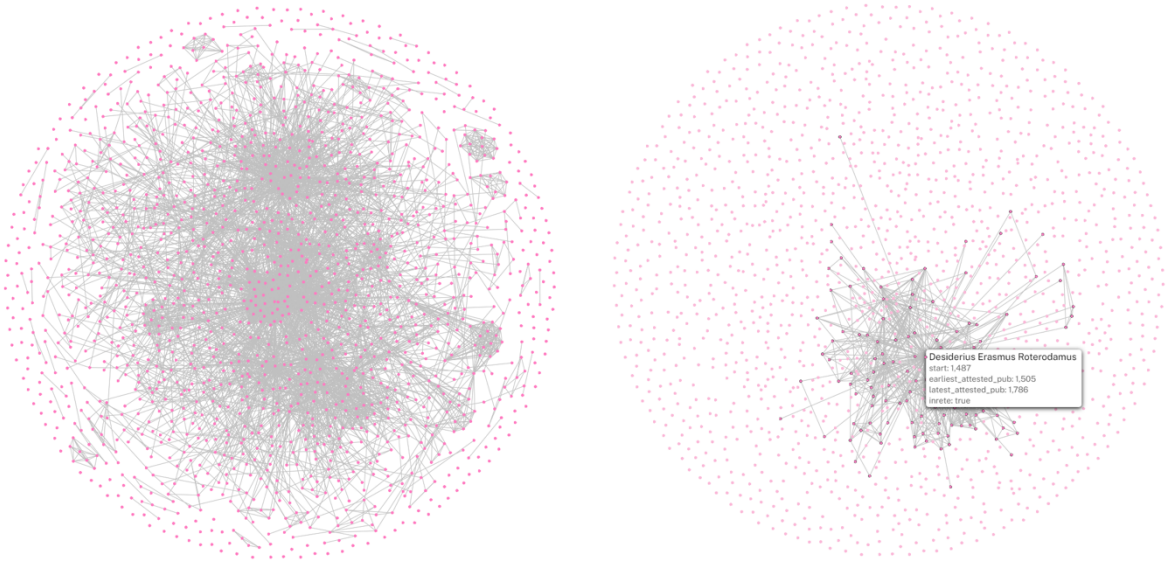
Results

From the Caa metadata, we derive two network: the full network and the scholars' subgraph. The former depicts the publishing world revolving around the Old University of Louvain. The nodes are the contributors to the Caa printed items (authors, printers, publishers, dedicatees, editors, booksellers, censors, and more), whereas the edges are their shared book collaborations. The latter on the other hand is essentially a subset of the main network, with an ulterior restriction, that is, the inclusion of nodes with a form of involvement in *authoring* Caa works. We consider the role of author as a proxy to spot scholars of the Old University. This allows us to zoom in on the scholars of the Old University of Louvain, thereby providing insights that are more theoretically sound when dealing with the evolution of the roles of prominent academic figures.

In terms of the node selection, we exclude whatever resembled an institution from the contributors. It is safe to say, then, that in the current visualization, nodes actually represent people.

We process the network visualizations on the software Gephi (Bastian, Heymann, and Jacomy 2009) and then upload it to the web application Retina[7], thereby providing browsable, interactive graphs. The figure below displays a screenshot of the Retina visualization of our scholars' network.

[7] More on the Retina web application: https://ouestware.gitlab.io/retina/1.0.0-beta.1/



We compute some standard global metrics (density, diameter and average path length) for each of the rolling-window subgraphs, thereby obtaining a time series of the metrics. By assessing the metrics distribution over time, we may infer that the full network experiences a tendency of expansion and loss of connection, as evidenced by the decreasing pattern of the density towards the end of the timeline, as well as by the increasing trend of the diameter and of the average path length.

Our rolling-window approach allows us to obtain a panel dataset of node-level metrics. We attempt to disentangle our results by nodes' prevalent involvement type in the Caa holdings. More in detail, we aggregate at the role level some of the main centrality metrics (degree, betweenness, closeness, and eigenvector centrality) averaged out over our timeline. We find that nodes with the role of *censors* tend to score the highest, closeness centrality, and eigenvector centrality. Taken together, these results confirm the leverage censors possessed in the regulation of the early modern book industry. The roles of printers and publishers, on the other hand, appear particularly prominent in terms of aggregated betweenness centrality. In a network representing the intellectual community revolving around printed publications, it is to be expected that printers and publishers would emerge as critical hubs that connect different segments of the network.

Shifting the focus to the scholars' network, we argue that the various metrics of node centrality as proxies for understanding the social presence or sociability of scholars during the era in question. These metrics potentially offer a rather historically accurate insight due to the meticulous selection criteria employed for the Caa holdings, alongside the collection's comprehensive representation of the academic *milieu* of Louvain at that time. Although these metrics do not aim to be a measure of authority, they somewhat mirror the concept of human capital, which leads us to undertake a comparison with an existing human capital index provided by Catoire et al. (2021). We find a positive monotonic rank correlation with the human capital index, stronger in the case of betweenness centrality, and weaker for the other centralities. We then investigate who are the scholars for whom these rankings go in opposite directions.

Lastly, among the various network-based measures of centrality, we propose that degree – which essentially captures how many connections a vertex has with other nodes in the network, relative to the maximum possible number of connections it could have in the graph – may be a direct indicator of the social aspect of books in an academic scope. This metric measures the intensity and the scope of collaborations associated with the Caa rare books from which we draw the network. A scholar who frequently authors numerous works with a few other scholars will have a low degree centrality. Conversely, a scholar who publishes a few books but collaborates with a large number of co-authors will score a high degree centrality. While not constituting a measure of authority, the degree centrality within the network may proxy the social presence or scholar sociability during that era.

We show a series of plots tracking the evolution of degree centrality for some scholars of influence in the history of the University of Louvain. We summarize the main results below.

1) Louvain scholars' *acme* generally occurs while they were alive, with their 'sociability' falling after death. Yet, we find a relatively more lasting permanence of humanists in the network beyond their lifetime.

2) Our analysis corroborates the demise of Scholasticism and the advent of the 'New Science', by focusing on the degree evolution of Aristotle (384-322 BC) alongside that of outstanding Louvain scholars whose area of expertise would fall in the hard sciences by modern standards.

3) We document a peak in popularity for Cornelius II Jansenius of Ypres around the period of the Jansenist controversy, as well as of key figures of Humanism during the 15th and 16th century.

Concluding remarks

Our data elaboration of the Caa metadata, in the fashion of Digital Humanities, and coupled with some statistical inference, culminates in the ability at one's fingertips to browse through the publication network of the Old University of Louvain.Our paper represents a pioneering attempt in integrating quantitative and qualitative approaches, within the context of Historical Social Network Analysis. While our aim is to shed light on case study of the Old University of Louvain, we believe that this approach could be generalized to the study of other academic communities.This work underlines the potential of digital humanities in grasping the complexities of historical data and revealing fresh insights into traditional narratives.

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Interactive Visualization of Linked Open Data Networks Representing Historical Writings

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Recent projects leverage linked open data (LOD) principles to create digital editions of historical writings, focusing on correspondence and diaries. While RDF technologies enhance machine-readable editions, the resulting graph remains hidden from web application users, limiting their comprehension of data connectivity. Visualizing RDF data empowers scholars to analyze distributions, detect irregularities, and formulate new research questions. This paper introduces three generic interactive web-based tools for visualizing RDF graphs, specifically those of historical correspondence networks and travel diaries. The tools offer 3D force-directed graphs for correspondence networks, 3D DAG-force trees to track correspondence topic changes over time, and maps for displaying journey routes in travel diaries.

To prevent node and edge overlap, the first two visualizations are in three dimensions and are force-directed. For the readability of a visualized network, since the 1990s it has been advocated that the number of edge crossings must be minimized (Grandjean, 2019). To generate graphs free of edge-crossing without reducing graph size, force-directed layout algorithms are developed (see Hu 2005, Nooy 2003, and Kobourov, 2012), which can be implemented in web applications using ThreeJS/WebGL;[8] the resulting 3D graphs can then be rendered on the web. The visualization tools offer interactive features such as moving graph components, zooming, and changing camera views. Configuration parameters (e.g., node and line colors) and RDF data in JSON/JSON-LD format are input for visualization. Nodes in the graphs are linked to underlying RDF resources, enabling users to navigate from visualizations to the textual source with a click. These visualization tools support an exploratory and methodological approach to studying graphs, empowering research ers to delve into the data accompanied by explanations of sources and relations.

3D Force-Directed Correspondence Graph Visualization

The visualization tool can render any RDF graph as a 3D force-directed graph on the web, allowing interaction with the simulation (Alassi et al. 2020). This simulation tightens connections between connected vertices and pushes unconnected ones apart, achieving a symmetric and aesthetically pleasing layout. The iterative engine seeks a mechanical equilibrium for the system of springs, resulting in well-recognizable clusters without overlapping edges. In the initial stage, the graph appears tangled but evolves into a stable layout. In correspondence network visualization, to avoid overcrowding, nodes representing RDF resources of correspondents and letters, along with edges for three main RDF predicates (hasAuthor, hasRecipient, isReplyTo), are included in the graph (Figure 1).

[8] https://threejs.org/

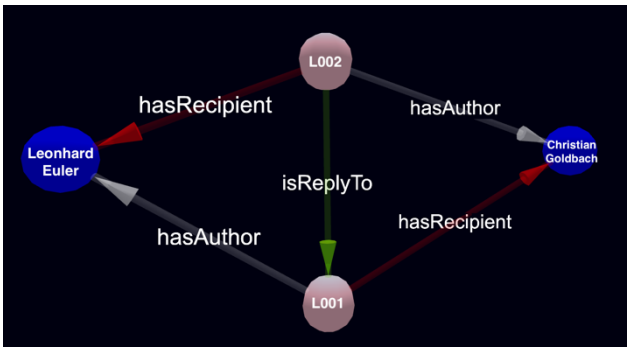

Figure 1. An example of the 3D visualization of RDF triples.

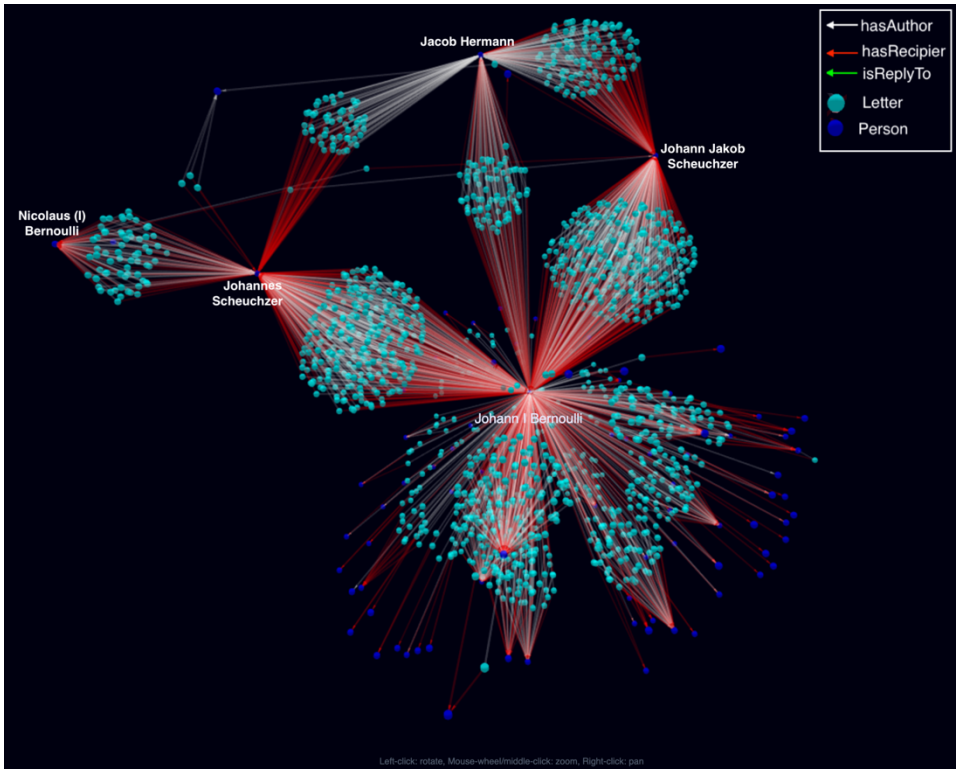

Figure 2. Visualization of the correspondence of mathematicians of the Bernoulli dynasty.

Figure 2 depicts the correspondence network of the Bernoulli dynasty members[9] that are available online as RDF-based digital editions with full transcriptions and facsimiles (Alassi, Rosenthaler 2024).[10] Among Bernoulli mathematicians, Johann Bernoulli was the one who corresponded intensively with prominent persons of his time; he not only kept the letters he received, but he also kept a draft of the letters he authored. Thus, our database contains an extensive number of letters sent or received by Johann Bernoulli, and the node representing him in the graph has a higher degree which puts him in the center point of the force-directed graph. The visualizations reveal significant correspondence by Johann I Bernoulli with renowned mathematicians, especially with Swiss mathematicians Johann Jakob Scheuchzer[11] and Johannes Scheuchzer,[12] forming noticeable clusters. The visualization also shows Jacob Hermann's correspondence

[9] https://vis.beol.dasch.swiss/myLetterNetwork_3D/graphs/bebbCorrespondence/

[10] https://dhlab-journey-star.dhlab.unibas.ch/

[11] http://ark.dasch.swiss/ark:/72163/1/0801/rE1GJDa6SQicRl11FhwNgAo

[12] http://ark.dasch.swiss/ark:/72163/1/0801/4o5cyqGYS1qHTfFCTMDDzwM

with Johann I Bernoulli, which began in 1702, three years before the death of Jacob Bernoulli,[13] Hermann's master. Considering the conflict between the Bernoulli brothers, one wonders about the nature of the correspondence between Jacob's disciple and his rival. This question can be answered by studying the underlying resources connected to the graph nodes.

The correspondence networks are also visualized in Web-VR format to enable direct interaction with the network components as if they were real objects in the same 3D spatial dimensions as the viewer, increasing the tangibility of the visualized network.[14] The VR version of the visualization tool uses A-Frame[15] for rendering the 3D force-directed graphs. Therefore, it can only be used by the full-fledged VR devices that support A-Frame.

3D DAG-Force Tree Visualization of Hierarchical Information

Hierarchical tree structures can be visualized as a 3D DAG (Directed Acyclic Graph) Force Tree, which prevents the overlap of nodes and edges based on the repulsive and attractive forces assigned to the nodes. Since this kind of visualization is directed and does not contain loops, it is best suited for visualizing hierarchical tree structures such as RDF lists (see Figure 3).

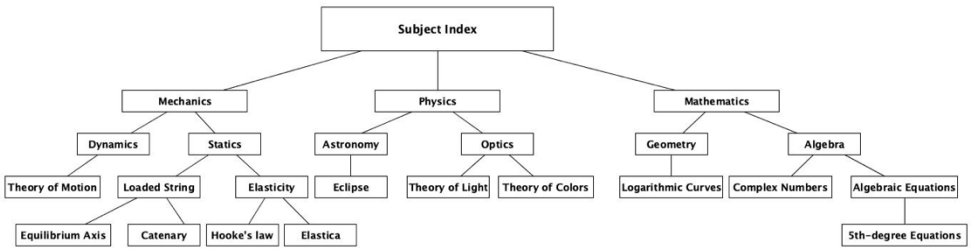

Figure 3. A hierarchical RDF list representing the correspondence topics.

Having modeled the correspondence topics as such a list, we could then visualize the correspondence network categorized by the topics of the letters. Moreover, a slider widget in the tool, representing the date of the letter with year precision, allows users to study the change in the topic of correspondence over time. This slider triggers the highlighting of the nodes representing the letters authored at the chosen year by changing the node colors to red. The graph nodes are connected to the underlying RDF resource representing the letter transcription; thus, users are directed to the source document from the visualization through a simple right-click on a node.

The visualization of the Euler-Goldbach correspondence in this way, for example, shows that at the beginning of their correspondence, Leonhard Euler[16] and Christian Goldbach[17] mostly discussed mathematical topics, starting with number theory and continuing with analysis and geometry (Figure 4a, b).[18] Their correspondence had years of pause between 1732 and 1735 and later again between 1754 and 1755; a close study of the letter contents can reveal the reasons for these periods of pause in correspondence.[19] Moreover, between 1746 and 1750, they mostly corresponded about astronomy and technology. This change in the topic of correspondence might be related to Euler's breakthrough in these subjects in this period, especially astronomy. The visualization also exhibits that the topic of their

[13] https://ark.dasch.swiss/ark:/72163/1/0801/6E07Zq0RRTeRnBreFKB=TQF.20211025T081140028236Z

[14] Other correspondence visualizations and Web-VR visualizations can be found here: https://vis.beol.dasch.swiss/

[15] https://aframe.io/

[16] https://ark.dasch.swiss/ark:/72163/1/0801/NbmhfOBlQoGbX3HwXuC3Tg_.20191028T092209709Z

[17] https://ark.dasch.swiss/ark:/72163/1/0801/EVAEahjpR_e6lXOWX=RVzQS.20191028T092209716Z

[18] https://vis.beol.dasch.swiss/myLetterNetwork_3D/graphs/subjectVisualization/

[19] Digital Edition of some of Leonhard Euler's correspondence, including his entire correspondence series with Christian Goldbach with English translations, can be found at https://bernoulli-euler.dhlab.unibas.ch/biography/Leonhard%20Euler

correspondence, over time, shifted toward personal matters. Towards the end, between 1763 and 1764, the number of letters exchanged decreased. Studying the highlighted letters written in this period shows that Goldbach's health was declining; thus, he reduced his communication, stating that "with every year that goes by, I am reading and writing less."[20]

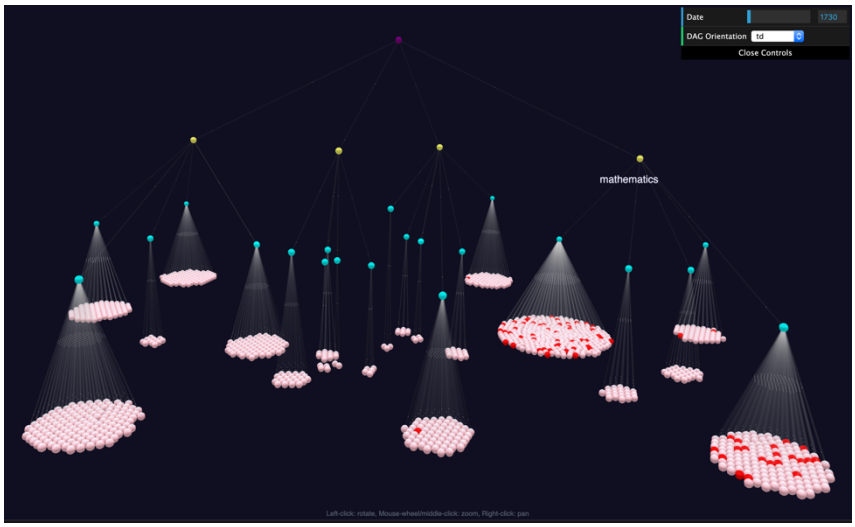

Figure 4a. The topic of the Euler-Goldbach correspondence in 1730 was mainly mathematics.

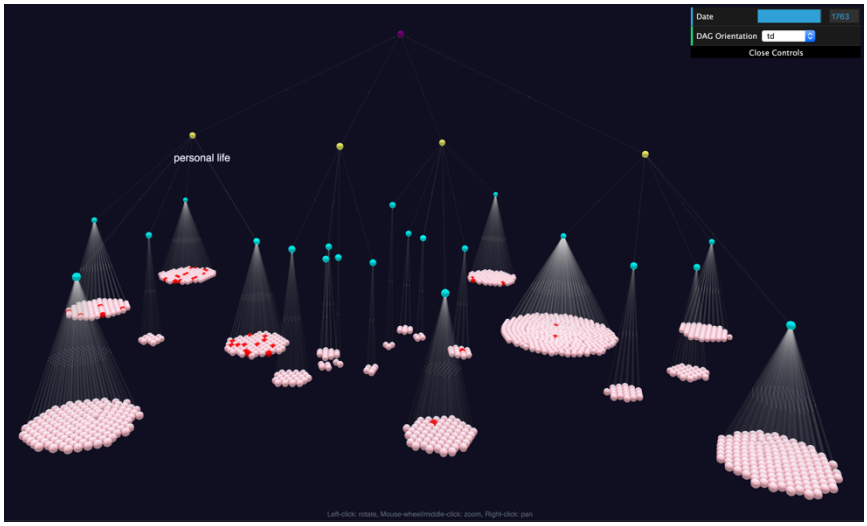

Figure 4b. The topic of the Euler-Goldbach correspondence in 1763 was mainly personal life.

Visualization of Journey Routes on Maps

Travel diaries, both modern and historical, detail routes, transportation, accommodation, activities, and individuals, each accompanied by metadata like dates and information sources. RDF-star[21] technology facilitates the efficient representation of travel records as linked open data, with metadata attached to graph edges (Alassi 2022, Amman et al. 2023). The journey information, such as routes and stages, can then be retrieved from the graph database using SAPRQL-star. In 2023, an interactive RDF-star-based digital edition of Jacob Bernoulli's travel diary, Reisbüchlein, was created as part of a project funded by the

[20] http://ark.dasch.swiss/ark:/72163/1/0801/v5mma7PzTcOD8ZndsBBDVAq

[21] https://w3c.github.io/rdf-star/cg-spec/editors_draft.html

University of Basel.[22] To aid scholars in visualizing journeys without constant map references, a dynamic web-based visualization tool was developed that retrieves data about the stages of the journey from the triplestore and displays it on an interactive map. To prevent creating yet another silo containing location information, coordinates, and GeoName-IDs of locations, they are obtained dynamically from LOD-based repositories like Wikidata through federated searches and used for map visualizations. Having the coordinates of the locations, the journeys are visualized on interactive web components based on Angular 16 and the Leaflet plug-in[23] of the OpenStreetMap. Figure 5 illustrates Jacob Bernoulli's journey from Basel to Geneva in 1676, given as the first entry in his travel diary Reisbüchlein and all stages of this journey.[24] Figure 6 illustrates his journey mostly on foot from Paris to Basel in 17 stages in 1680.[25]

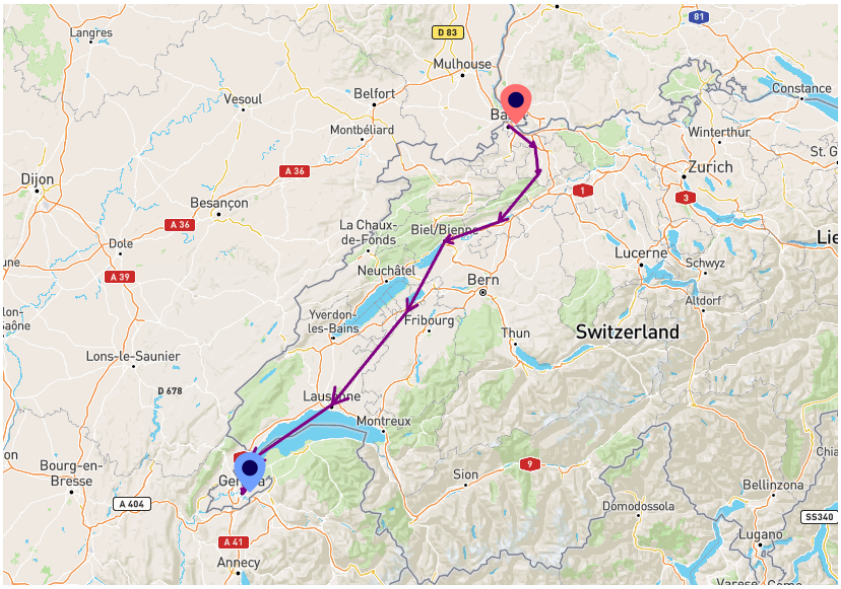

Figure 5. Jacob Bernoulli's journey from Basel to Geneva in 1676.

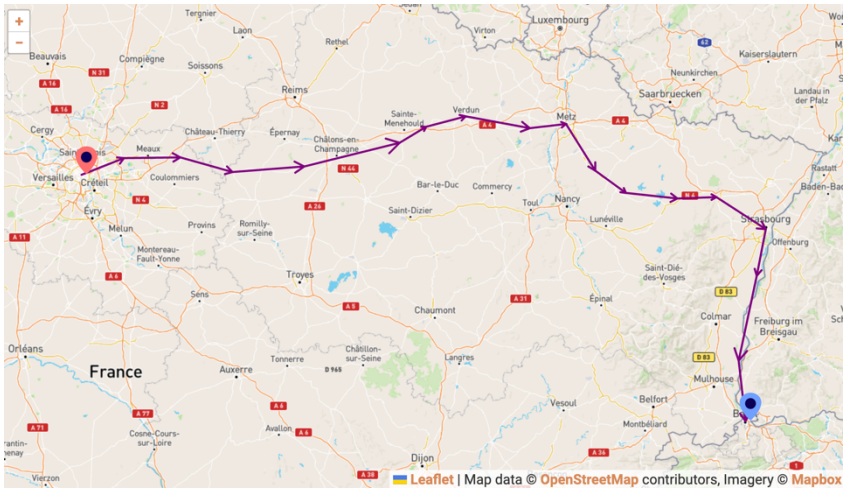

Figure 6. Jacob Bernoulli's journey from Paris to Basel in 1680.

[22] The RDF-star-based digital edition of Jacob Bernoulli's Reisbüchlein with map visualizations is available at https://bernoulli-euler.dhlab.unibas.ch/biography/Jacob%20I%20Bernoulli

[23] https://www.npmjs.com/package/leaflet

[24] The digital edition of Jacob Bernoulli's entry in his travel diary Reisbüchlein about his journey from Basel to Geneva with transcriptions, journey information, and dynamic visualization can be found at https://bernoulli-euler.dhlab.unibas.ch/manuscriptEntry/http:%2F%2Frdfh.ch%2F0801%2FGcXDoaZgRu6E2scC77h6gw

[25] The digital edition of Jacob Bernoulli's entry in his travel diary Reisbüchlein about his journey from Paris to Basel with transcriptions, journey information, and dynamic visualization can be found at https://bernoulli-euler.dhlab.unibas.ch/manuscriptEntry/http:%2F%2Frdfh.ch%2F0801%2F_KaGmqZLTyW9U9__vCUzLA

Conclusion

This paper describes tools to create three types of visualization for RDF-based networks, facilitating the study of the relations between network components and connectedness of atoms of knowledge present in LOD-based scholarly editions. The first described visualization enables the representation of data networks, such as correspondence, as interactive web-based 3D-force-directed graphs that help with the observation of the data distribution and connectivity, preventing data loss due to overlaps of graph components. The second visualization type enables visualizing hierarchical and categorical data structures, for example, correspondence clustered by topics as interactive web-based 3D DAG force trees, which preserve the hierarchical structure of data clusters by preventing loops and overlap of nodes and edges. With an example, I have shown how this visualization can be enhanced to represent more data by adding widgets, for example, to allow the study of the change in the topic of correspondence over time. Through interaction with this kind of visualization, scholars gain knowledge about the data that would not be so readily accessible and would require a comprehensive close study of texts. With multiple examples, this paper has established the benefits of these two graph visualization tools, illustrating that through studying and interacting with the graph, scholars can obtain a picture of the data connections and formulate questions that can then be answered through the close study of the underlying sources. Thus, conjoining the visualizations with the text sources as implemented for the graphs presented in this paper is important to facilitate scholarly research on the data.

The paper also suggests a third visualization tool for representing map data in interactive form on web applications. This paper presents a use case for this tool for an interactive web-based representation of Jacob Bernoulli's travel routes retrieved from the RDF-star-based digital edition of his travel diary. The map visualization tool benefits from the possibility of retrieving coordinate data for locations from the external linked open data repositories through federated searches and dynamically generating the visualizations upon access. The three visualization tools will be extended, and a generic Angular-based tool will be developed to be easily integrated into the web applications so that other projects can produce similar visualizations for their RDF graphs. This tool will also be able to generate visualizations based on the results of customized CONSTRUCT queries submitted to the SPARQL endpoint of the target triplestore.

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L'analyse de réseaux pour l'étude des coopérations intergouvernementales : le cas du Bureau International d'Éducation (1929-1952)

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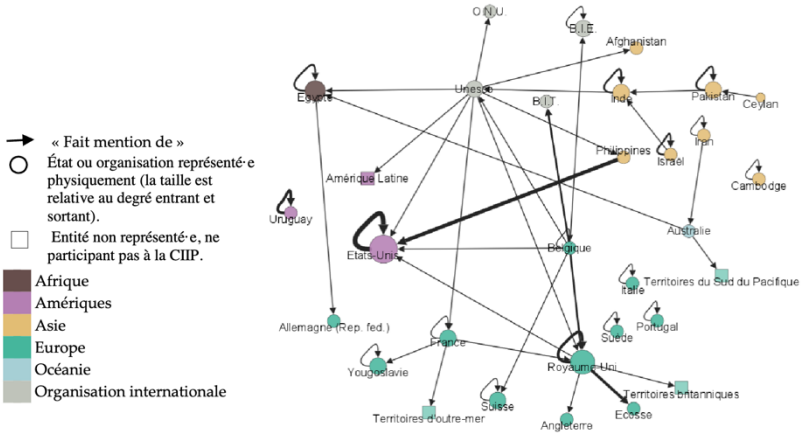
Cette communication vise à présenter la thèse Recommander l'Utopie ? Construction d'une coopération intergouvernementale par le Bureau International d'Éducation au milieu du 20e siècle[26] (Brylinski, 2022), en mettant l'accent sur l'emploi des techniques d'analyse de réseaux et les résultats obtenus.



Note : dans ce graphique, l'épaisseur des liens est relative au nombre de mentions émises (degrés sortant) d'un sommet A envers un sommet B ; la taille des nœuds est relative au nombre de mentions reçues (degrés entrant).
Source : Brylinski & Hofstetter, 2021, p. 234.

Figure 1. Représentation graphique du réseau unimodal des citations « valorisant le modèle éducatif de... », entre États et organisations, lors du débat portant sur la scolarité obligatoire (CIIP, 1951).

Créé en 1925 à Genève, le Bureau international d'Éducation (BIE) devient, dès 1929, une organisation intergouvernementale ancrée dans le sillage de l'effervescence des institutions internationales pendant l'Entre-deux-guerres. Au cœur de ce Bureau s'expérimente et se formalise une coopération intergouvernementale axée sur les questions éducatives, avec pour objectif d'asseoir la paix dans le monde (Hofstetter & Erhise, 2021). Les acteurs et actrices impliqué.e.s dans ce projet défendent l'idée selon laquelle c'est en pratiquant des formes de collaborations internationales, préservées d'enjeux politiques, qu'en découleront des attitudes pacifistes, la compréhension entre les peuples, et donc logiquement, la paix. Recommander l'utopie, peut-être est-ce une manière de résumer ces efforts incessants portés par nombre d'acteurs et d'actrices gouvernementaux impliqué.e.s au BIE : ces derniers sont engagé.e.s à concevoir un monde qui n'existe pas encore. Dès lors se construit une vision universelle portée par le Bureau se retenant d'être unique et encore moins imposée. Mais il y a là une certaine tension : cette utopie, qui se créait collectivement, se forme dans un espace-temps circonscrit par un groupe restreint de protagonistes chargés

[26] La thèse (Brylinski, 2022) s'inscrit dans le cadre d'une recherche financée par le Fonds national suisse pour la recherche scientifique (FNS) qui s'intitule « Le Bureau International d'Éducation (BIE) : un laboratoire de l'internationalisme éducatif (1919-1952) » (Hofstetter (dir.) & Droux (co-dir.), 2016-2020 ; subside n° 100011_169747).

de représenter des gouvernements. Recommander, certes, mais par qui et comment ? Qui sont les acteurs et les actrices de ce projet éducatif porté à l'échelle dite « intergouvernementale » ? Comment parviennent-ils à définir et à promouvoir leur(s) utopie(s) éducative(s) en se préservant de tout enjeu politique extérieur et des rapports de pouvoirs préexistants dans les relations interétatiques ?

Cette recherche s'inscrit dans le courant de l'histoire transnationale (Iriye, 2013) et privilégie une approche à la fois quantitative (faisant emprunt aux techniques d'analyse de réseaux et de prosopographie) et qualitative (analyses de discours et de correspondances personnelles). L'analyse de réseaux se révèle pertinente pour cartographier les géographies à l'œuvre, et pour distinguer les stratégies employées par les États et leurs représentant·e.s afin de diffuser leurs idées, mais aussi d'écarter certaines propositions. De fait, l'attention portée sur les interactions entre le BIE et les représentant.e.s d'État, et entre ces derniers, permet d'étudier comment se construit l'intergouvernementalisme éducatif, et d'identifier comment les parties prenantes de la coopération intergouvernementale se saisissent et définissent la cause qui les rassemble, soit l'éducation pacifique.

Ainsi, pour contribuer au débat concernant l'usage de l'analyse de réseaux en histoire, cette communication se concentre sur l'emploi de cette technique sur deux publications phares du BIE. D'une part sur les Bulletins d'information (1930-1933) qui valorisent les initiatives éducatives des États, et, d'autre part, sur les Procès-verbaux des Conférences Internationales de l'Instruction publique (1934-1958) qui retracent les débats en amont de la production de recommandations internationales en éducation. En restituant les résultats obtenus, il s'agit de démontrer comment l'analyse de réseaux permet d'étudier des mises en scène d'États (Laqua, 2011) et de leurs représentant.e.s, leurs interactions et les stratégies de coopération à l'œuvre pour valoriser ou faire taire certains savoirs (par exemple, voir la figure 1 insérée en pièce jointe). La visualisation de ces réseaux permet à la fois d'illustrer ces comportements, mais aussi de repérer certains phénomènes invisibles à partir d'une simple lecture de ces sources : une approche qui oriente, dans une seconde étape, l'analyse qualitative des archives manuscrites (Grandjean, 2018). Cette démarche permet d'affiner notre compréhension de la circulation et la co-construction de savoirs dans le cadre d'une organisation intergouvernementale, et peut également relever des enjeux de violence épistémique (Dotson, 2011).

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Le marché foncier à Lausanne au 19e siècle. Mutations et réseaux des protagonistes

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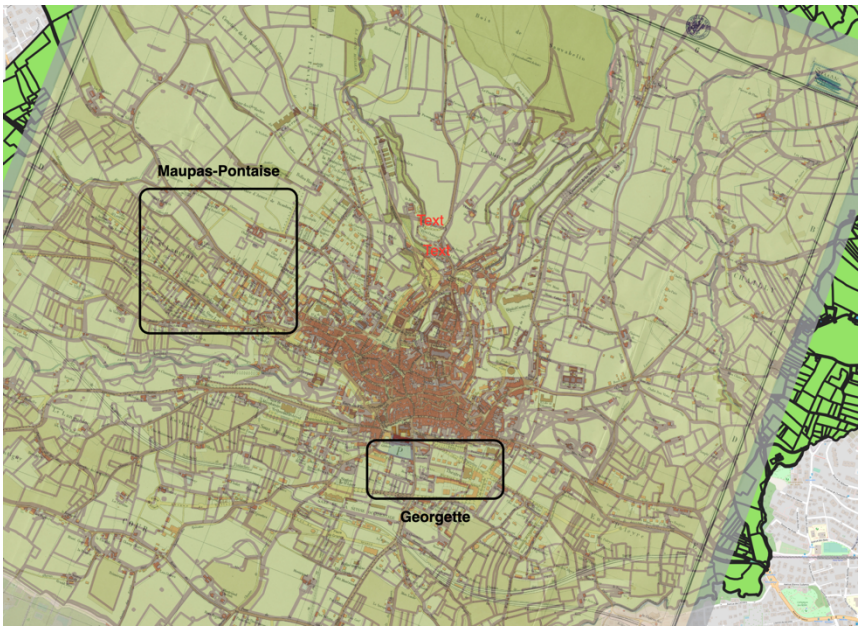
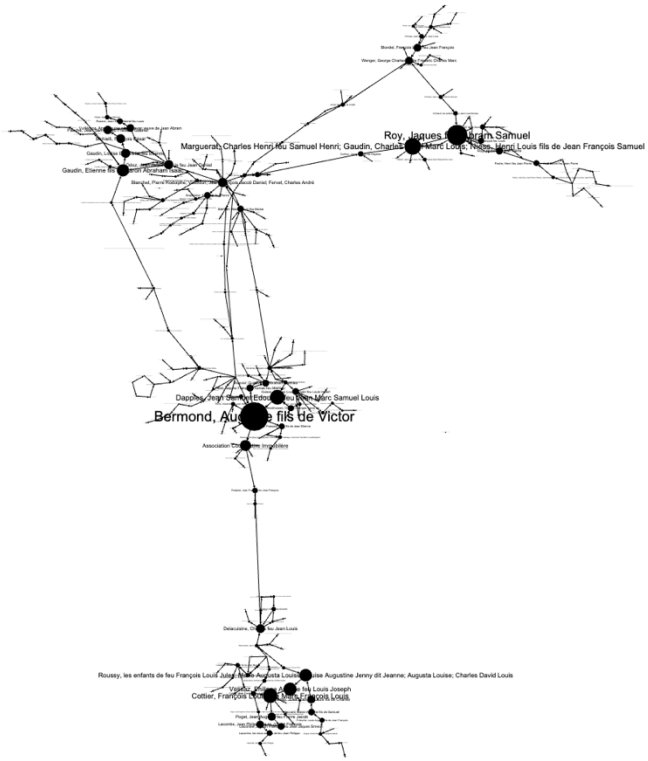
Cette contribution a pour objectif d'analyser l'évolution des acteurs et actrices sur le marché foncier à Lausanne au 19e siècle. Sur la base de plans cadastraux (1827-1831 et 1886-1888), les propriétaires des terres et bâtiments de deux quartiers lausannois sont comparés entre les deux périodes. Afin d'identifier les endroits concernés par un fort développement du bâti, une carte de 1900 a été géoréférencé et superposée sur le plan cadastral de 1827-1831 intégré dans un système d'informations géographique (SIG). Ainsi, il est possible de déterminer les nouvelles constructions réalisées sur le territoire lausannois. Deux quartiers en particulier ont été choisis pour leur développement (Georgette et Maupas-Pontaise), présentant des caractéristiques différentes (figure 1). Les propriétaires au début et à la fin de la période sont ensuite identifiés sur la base des plans cadastraux. Enfin, les différentes transactions durant cette cinquantaine d'années sont observées afin de déterminer la place des acteur·rice·s sur le marché foncier en utilisant le cadastre qui renseigne sur les transmissions et ventes de parcelles.



Or, comme le rappelle David Harvey, l'accumulation du capital s'effectue dans un espace donné et cette opération créé des structures géographiques spécifiques (Harvey 2001, 237). Il est ainsi essentiel de comprendre dans quelle mesure les opérations réalisées peuvent s'apparenter à de la spéculation immobilière. Le 19e siècle voit en effet la ville de Lausanne s'étendre et croître passant de 13'000 habitants en 1813, à 33'340 en 1888 (Coutaz et al. 2009). Cette hausse de la population demande donc la construction de nouveaux bâtiments et conduit à une probable crise du logement puisque la ville de Lausanne demande à la fin du 19e siècle une enquête sur les conditions du logement (Schnetzler 1896), comme dans d'autres villes suisses (Walter 1994, 220–22). Pour certains protagonistes, il s'agit de placer ses capitaux de manière adéquate afin de réaliser un gain (Thiveaud 1999, 229), en même temps que la location se répand dans les

villes helvétiques (Walter 1994, 254–56). De nouveaux quartiers apparaissent dans les villes du 19e siècle, aussi à Lausanne. Différents acteurs sont présents sur le marché foncier et de la construction : des particuliers, des banques ou encore des sociétés.

Il s'agit donc de déterminer les changements dans la nature des acteur·rice·s et la place des différents protagonistes. Pour cela, l'analyse de réseaux est mobilisée et différentes mesures sont appliquées au reseau des acteur·rice·s, par exemple la centralité d'intermédiarité (figure 2). On sait que des coopératives et des sociétés immobilières prennent de l'importance durant le 19e siècle pour le développement de quartiers notamment en construisant des maisons ouvrières (Lüthi 2010). Cependant, d'autres protagonistes sont également présents sur le marché, sans qu'ils aient été identifiés. Qui permet la transformation du paysage lausannois et le développement de son bâti ? Quels sont les acteur·rice·s essentiels ? Quelle est la place des grandes familles de l'élite ? Existe-t-il des personnes ou sociétés exerçant un rôle spécifique sur le marché dans le but d'accumuler du capital ?



Ainsi, en utilisant l'analyse de réseaux, les transmissions de propriété et les achats sont détaillés dans le but d'observer la structure du marché immobilier à Lausanne. Il s'agit en particulier d'identifier des protagonistes clés sur le marché, soit ceux à l'origine du marché ou les intermédiaires importants. Existe-t-il une stratégie d'accumulation et de revente pour certain·e·s acteur·rice·s ? Quelle est leur identité ? Ces interrogations et l'utilisation de l'analyse de réseaux permettent ainsi de mieux comprendre les dynamiques du développement urbain de Lausanne au 19e siècle.

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Les réseaux urbains lyonnais pendant la guerre civile (1589-1594)

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Mes travaux s'inscrivent dans l'histoire sociale et politique de la Ligue catholique à Lyon et dans l'histoire du gouvernement du Lyonnais. Après l'assassinat du cardinal et du duc de Guise à Blois, en décembre 1588, le roi de France, Henri III, est rejeté par une partie des grandes villes et de la noblesse du royaume. Lyon, sa région et le gouverneur du Lyonnais, le duc de Nemours, entrent dans la Ligue catholique au début de l'année 1589. Cette période est celle d'une grande déstructuration des liens sociaux : la rupture des dirigeants lyonnais avec le roi nécessite un grand travail de réorganisation de la société urbaine lyonnaise, autour d'idées fortes pour convaincre les individus de se maintenir ou de s'engager dans le mouvement ligueur. Le lien social m'est alors apparu comme le fondement de la capacité d'un individu à entrer et à faire partie d'un groupe ligueur, à s'identifier lui-même comme ligueur et à rompre les liens de fidélité dus au roi.

Mon postulat de départ repose sur l'importance des ramifications des réseaux urbains de Lyon dans la région pour asseoir le pouvoir des notables lyonnais qui ont basculé dans la Ligue. Ils ont besoin d'appuis urbains et nobiliaires pour être soutenus sur le plan financier, militaire et idéologique. Je me suis donc demandé dans quelle mesure ils intègrent dans leurs réseaux les chefs militaires et les dirigeants des villes et des villages du gouvernement du Lyonnais et ceux des provinces voisines : il s'agissait de discerner quel groupe, précisément à Lyon, menait la politique de la ville, les moyens employés pour influencer la population des villes et des villages, ainsi que les gentilshommes et les groupes nobiliaires sur lesquels les dirigeants lyonnais s'appuyaient dans la région. Or, il s'avère que les groupes ligueurs repérés à Lyon sont multiples et se disputent le pouvoir consulaire. Dans ce contexte, comment la Ligue catholique lyonnaise a-t-elle pu se maintenir pendant cinq ans ?

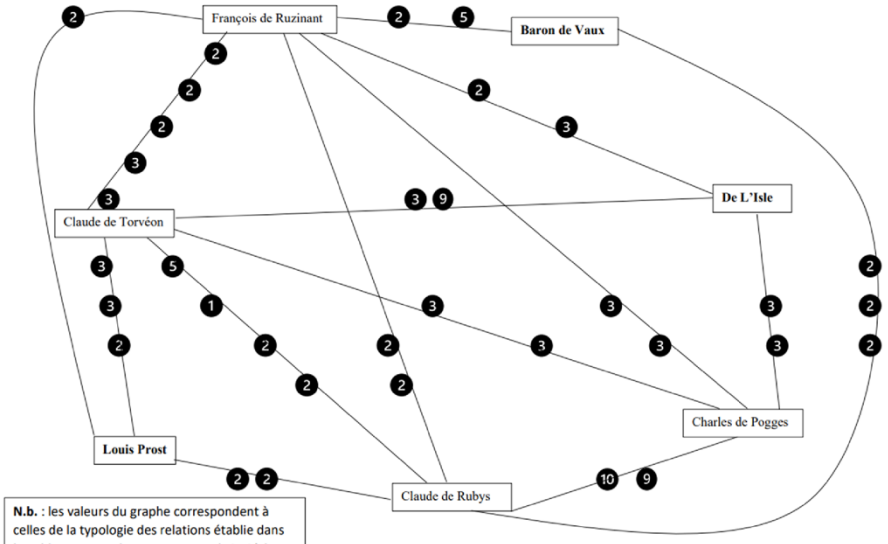
L'analyse de la structuration de ces groupes, des liens établis entre leurs sommets et des moteurs d'engagement des individus permet de comprendre la durée du mouvement ligueur lyonnais. Aussi, mon but a été de repérer le « capital social » (Bourdieu 2006, 29) des ligueurs au pouvoir en mettant en évidence leur appartenance à des réseaux structurés, et de comprendre la cohérence, le fonctionnement, l'organisation et l'évolution de la Ligue lyonnaise. J'ai utilisé l'analyse de réseaux comme un outil pour comprendre pourquoi et comment ces groupes se sont formés, ce qui les maintient en place, le rôle et la place de chaque individu dans le groupe, ainsi que l'aire d'influence de celui-ci. J'ai donc appliqué l'analyse structurale à plusieurs groupes politiques urbains, en étudiant leurs structures intérieures et leurs interrelations, et en articulant cette analyse au champ politique.

Pour préparer l'analyse des réseaux, j'ai utilisé la méthode prosopographique en établissant une liste de plus de trois cents individus et de leurs actions accomplies pendant la Ligue à partir des sources émanant de Lyon (délibérations, archives militaires, correspondance municipale). Cette première prosopographie a été divisée en deux : d'un côté les bourgeois de Lyon et de l'autre, les chefs militaires agissant dans le gouvernement du Lyonnais. Dans ces petites biographies j'ai ajouté, lorsque c'était possible, le métier de l'individu concerné, ses liens familiaux et les relations qu'il entretient avec d'autres individus avec lesquels il accomplit des actions pendant la Ligue. Je n'ai pas pu établir les connexions de l'ensemble de ces individus, mais seulement celles des notables – une cinquantaine – pour lesquels les sources étaient en nombre suffisant. Pour compléter cette prosopographie, j'ai également réalisé des tableaux des membres ligueurs des institutions judiciaires et financières, ainsi que les membres du consulat lyonnais pendant les années ligueuses. Cela m'a permis de voir les liens professionnels entre les individus. J'ai pu alors rassembler les élites lyonnaises au sein de

différents réseaux, selon la fréquence et le type de liens qu'ils ont entre eux. J'ai pu aussi établir des liens hiérarchiques pour mettre en évidence la « pyramide réticulaire » (Rentet 2011, 261).

Pour construire les graphes des élites ligueuses, j'ai réalisé des graphes qui montrent chacun la fréquence, les types de lien, la hiérarchie au sein du groupe, l'intensité et la valeur de la relation en distinguant des liens forts et des liens faibles, ainsi que les pôles de dominance et les pôles périphériques. Ce type de graphes n'est possible que si le groupe délimité et la fréquence de la connexion des différents sommets sont faibles numériquement, ce qui est le cas pour les élites lyonnaises. Un tableau rassemblant les critères utilisés pour caractériser les relations entre les sommets est nécessaire pour la lecture de ces graphes. Ces critères ont été établis selon les « critères d'époque » (Lemercier 2005, 108), c'est-à-dire en partant des sources de l'époque moderne. Cette typologie est à la fois institutionnelle, affective, morale et familiale, car cet ensemble de liens correspond à ce que j'ai perçu dans les sources.

J'ai choisi de joindre le graphe du premier de ces groupes ligueurs repérés, accompagné du tableau indiquant les critères et le chiffre qui fait référence à chacun de ces critères sur le graphe. La répétition du chiffre sur les arêtes ou les arcs correspond à la fréquence du lien entre deux sommets. Les sommets en gras correspondent à ceux qui ont une connexion directe et fréquente avec le gouverneur du Lyonnais, le duc de Nemours.



N.b. : les valeurs du graphe correspondent à celles de la typologie des relations établie dans le Tableau 1. La valeur 1 correspond ainsi à la première ligne du tableau, la valeur 2 à la deuxième ligne, etc.

Tableau 1. La typologie des relations des notables ligueurs de Lyon

Types de relations entre les ligueurs	Développements sur le type de relation observée
1.Relations professionnelles	Appartenir au même corps de métier
2.Participation aux institutions politiques de la Ligue	Participer au consulat, au Conseil d'État, au conseil ordinaire qui aide le consulat à partir de février 1589 et au conseil extraordinaire réuni à partir d'avril 1590
3.Missions en-dehors de Lyon	Voyages, montres, lettres ou informations à communiquer, …
4.Charge donnée à Lyon pendant la Ligue	Recherche de suspects, renvoi des « politiques » hors de Lyon, recherche d'armes, …
5.Relations amicales	Protection personnelle lors d'un danger d'emprisonnement ou de mort, avertissement personnel direct ou indirect, …
6.Exils politiques	Exils hors de Lyon à la même période, en même temps, pour les mêmes raisons et dans un même lieu
7.Liens d'ordre militaire	Participer à la garde des pennonages, dans un même pennonage
8.Actes ou actions politiques d'importance	Se rendre en petit groupe au consulat pour une réclamation, écrit politique, participation à des barricades dans un même pennonage, …
9.Liens familiaux	Mariage, parentés
10.Lien épistolaire	Lettre ayant pour but la réalisation d'une action politique grâce à l'entremise du destinataire

Cette analyse des réseaux m'a permis d'établir l'existence de cinq cliques à l'intérieur de Lyon. A partir de ces cliques, l'analyse de leurs liens a mis en évidence les clés des relations entre les individus ligueurs, leur type d'engagement politique et donc les raisons de l'existence de ces groupes. La première clique montre qu'il existe un groupe très radical et partisan du duc de Nemours, le gouverneur du Lyonnais, qui s'est formé avant le basculement de Lyon dans la Ligue et qui réunit presque tous les principaux bourgeois de Lyon. Ce premier groupe est très structuré, a une idéologie bien précise et cherche à influencer Lyon et sa région pendant toute la durée de la Ligue. Au contraire, un des groupes mis en évidence reste en retrait du pouvoir politique et n'est pas du tout animé par le même type d'engagement politique : le discours tenu par ses membres est beaucoup moins radical et leur organisation est très différente. De plus, malgré l'engagement de ses membres dans la Ligue catholique, ce groupe parvient à recevoir des promotions d'Henri IV après la reddition de la ville, grâce à ses liens avec l'archevêque de Lyon.

J'ai prolongé la réalisation des graphes sur les réseaux urbains et leur analyse à l'ensemble de la région lyonnaise afin de mettre en évidence les liens établis entre les notables ligueurs lyonnais avec la noblesse provinciale. Reprenant la prosopographie initiale, une soixantaine de chefs militaires ont pu faire l'objet d'une réalisation graphique. En revanche, la typologie des liens établis entre eux est plus complexe que la première parce qu'elle est adaptée au vocabulaire nobiliaire et aux représentations nobiliaires et parce qu'elle distingue des liens forts et des liens faibles, qui soulignent le degré d'intensité des relations entre les individus. Sept groupes cohésifs en lien avec les notables lyonnais ont pu être représentés sous forme de graphes. Le

capital social de certains groupes urbains est donc immense et nécessaire pour mobiliser les hommes et les ressources afin de mener la guerre contre les armées royales.

Une de mes difficultés a été d'articuler l'analyse des réseaux urbains avec l'analyse des réseaux nobiliaires. En effet, dans les lettres consulaires, l'ensemble des échevins de Lyon s'adressent à un gentilhomme : ce n'est donc pas une relation de groupe à un autre groupe d'individus, mais une relation d'un groupe d'individus à un seul individu, ce qui ne permet pas de percevoir les liens personnels du gentilhomme avec certains notables de Lyon. C'est pour cette raison que j'ai croisé l'analyse structurale avec l'analyse égocentrée, car l'analyse égocentrée me permettait de percevoir les liens personnels du gentilhomme concerné avec certains membres de la notabilité lyonnaise. Pour cela, je me suis appuyé en partie sur des sources généalogiques. Une autre difficulté a été de surmonter le problème des relations presque invisibles dans les sources, pour lesquelles justement je ne pouvais voir ni la fréquence ni l'importance de la relation : j'ai donc réalisé des schémas circulaires, qui sont beaucoup moins précis que les graphes mais qui permettent de voir la hiérarchie entre les individus. C'est le cas par exemple pour les groupes nemouristes qui gravitent autour du duc de Nemours, gouverneur du Lyonnais. Il est difficile d'établir un graphe, car la fréquence de leurs liens sociaux et leurs types de liens sont quasiment invisibles. Il n'existe presque pas de lettres qui les mentionnent. En revanche, j'ai pu établir un schéma circulaire de leurs relations hiérarchiques.

Une fois que j'ai établi cette méthode, j'ai pu travailler sur le type d'engagement des individus dans la Ligue, la structuration des groupes et leur évolution. Pour le cas des ligueurs lyonnais, j'ai suivi dans un premier temps les méthodes des travaux précédents en appliquant notamment les critères de Robert Descimon (Descimon 1983, 50) pour repérer un individu ligueur (il a établi les critères majeurs et les critères mineurs). J'ai ensuite travaillé sur l'appartenance des individus à un groupe social spécifique, à un milieu socio-professionnel ou à une famille spécifique : la plupart des membres de la Ligue appartiennent à la notabilité ; le rôle de la famille et de l'appartenance socioprofessionnelle des individus sont des clés de lecture importantes de l'entrée des individus dans certains groupes ligueurs. Mais à Lyon, il faut prendre en compte également les liens de fidélité au duc de Nemours, gouverneur du Lyonnais, qui sont très importants et qui peuvent transcender les milieux socio-professionnels. Enfin, j'ai voulu étudier l'évolution du mouvement ligueur et j'ai pu constater que les milieux socioprofessionnels marchands qui n'appartiennent pas aux grands réseaux des négociants, finissent par prendre leur revanche sur les notables qui animaient la Ligue, et obtiennent à leur tour le pouvoir au sein du mouvement ligueur.

L'utilisation des outils sociologiques liés aux réseaux m'a donc permis de distinguer les différents groupes urbains au pouvoir à Lyon et de comprendre leur moteur idéologique ainsi que les clés de leurs relations. J'ai pu également analyser les liens entre les différents réseaux ligueurs en mettant en évidence le rôle des « brokers » dans le renversement ou le maintien des groupes au pouvoir. Ensuite, l'analyse des réseaux m'a été utile pour appréhender l'étendue des relations des élites urbaines avec certains nobles provinciaux, des relations utiles à la mobilisation d'hommes et à la direction d'opérations militaires. Enfin, ces analyses ont été menées dans un cadre chronologique précis permettant de percevoir l'évolution de ces groupes sociaux due aux événements extérieurs et aux changements d'allégeance des individus.

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Levantine Transitions. A Social Network Approach to Elite Formation in Urban Egypt, 1890–1914

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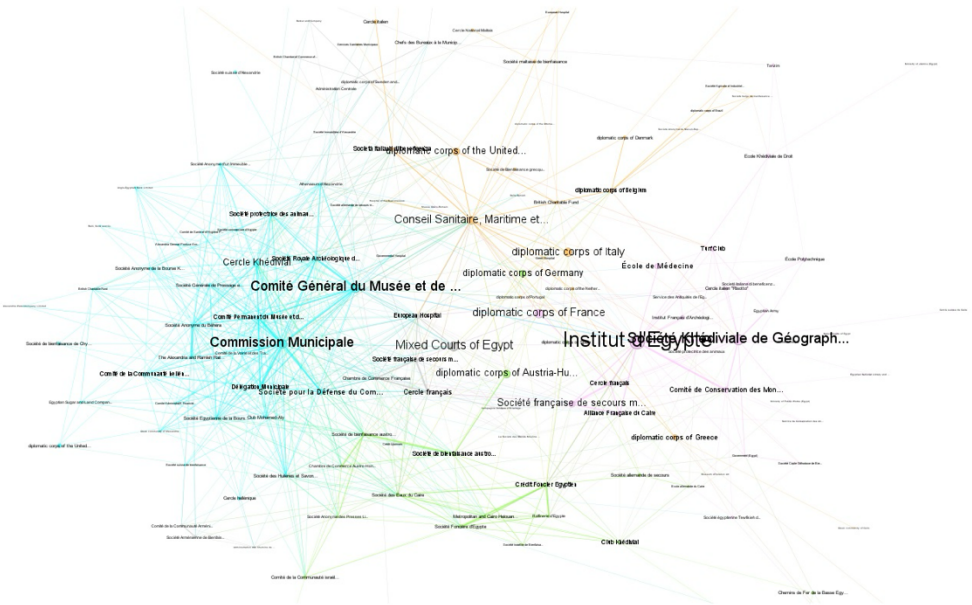
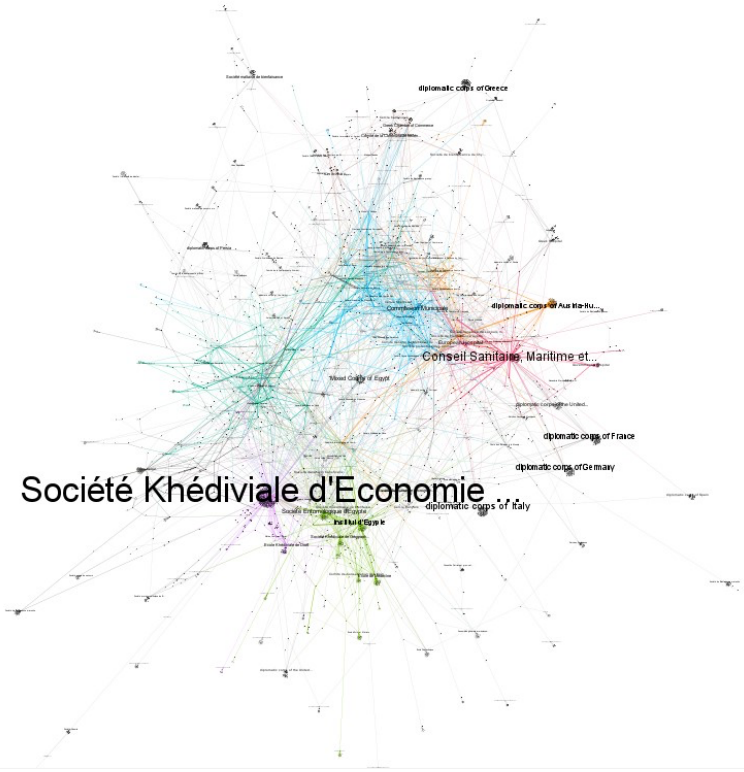
Both in popular discourse as well as in historiography, urban elites in turn of the twentieth century Egypt are perceived as archetypically cosmopolitan. Yet, most of these accounts rely on either anachronistic literary accounts or case studies covering an ethnic or religious subgroup (Abdulhaq 2016, Hanley 2008, Kitroeff 2019, Mak 2018, Miccoli 2015, Starr 2009). In this paper I will overcome these biases by mapping the interconnected character of this stratum while comparing different variations of social cohesion and tracing specific clusters of communal organisation from a longitudinal perspective. Relying on both the Almanach de Gotha as well as a set of local Egyptian yearbooks, my approach is based on a relational database covering the professional and socio-cultural affiliations of more than 3500 single actors and their respective 8000 relations in the 1890-1914 timespan. First, I will outline the challenges and pitfalls encountered while assembling this dataset. Special attention will go to the linguistic specifics of the Egyptian context, the availability of relevant source material and the limitations of exhaustiveness. Secondly, this paper highlights the potential of prosopography to answer the recent call of Rossier (2019) to use quantitative methods to make true the ambitions of a qualitative thick description of elites based on relational sociology. Through this prosopographic approach the people who actually made up the ranks of Egypt's elite communities enter the narrative and dynamize the analysis of the organisations that so far have been described in a static institutional perspective (Ilbert 1996, Raymond 2000, Reimer 1999). Additionally, my paper also introduces a non-Western case into the currently resurging field of elite studies. (Ankoud 2020, Buchen and Rolf 2015, Bukodi and Goldthorpe 2021). Thirdly, I will develop my longitudinal approach along the lines of Kathy Giuffre's (1999) research on artistic careers by applying her so-called sandpile conception of personal trajectories on groups of organisations in which parts of the Egyptian elite were assembled. Three snapshots of aggregate data, respectively concerning the 1890-



1898, 1899-1907 and 1908-1914 frames, will be used in this regard to temporally dynamize my analysis. Fourthly, within each snapshot itself I will address the level of cohesion based on Thierry Rossier's (2022) typology of Swiss elites in the interwar period.



This paper is not only innovative as it addresses the often-overlooked non-Western Egyptian elite, but even more so through its attention for external influences on elite formation as well as by bringing in a spatial dimension. In the first place, I will assess the impact of the presence of the foreign diplomatic corps in Egypt on organisational clustering in the elite communities. Often presented as the ultimate gateway to social promotion, I will challenge the assumption that consular offices had this function per se. Instead, this paper will position diplomatic office-holding members of the local Egyptian elite in a more sophisticated social structure. Secondly, I will assess the relation between the foreign diplomatic corps and the presence of both career diplomats and locally recruited agents on the one hand and the patchwork of judicial, socio-cultural, economic, and learned organisations on the other. I argue that against the backdrop of an increasing professionalization of the diplomatic corps, the Levantine and foreign local elites that had formerly been in foreign service, organised their local and international contacts in a plethora of other organisations. Making use of the K-core decomposition method (Seidman 1983; Kong, Shi, Wu and Zhang, 2022), this evolution, the tightness of these new networks, and the relative role of particular sectors and their organisations will be scrutinized. In sum, I will thus provide an innovative and quantitatively-underpinned understanding of the formation of elites in late-nineteenth century Egypt that surpasses the much-fragmented historiography and overcomes many of the bureaucratic and practical hurdles related to doing archival research in contemporary Egypt (Carminati 2018).

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Modéliser les réseaux de pouvoir de la fin du Moyen Âge

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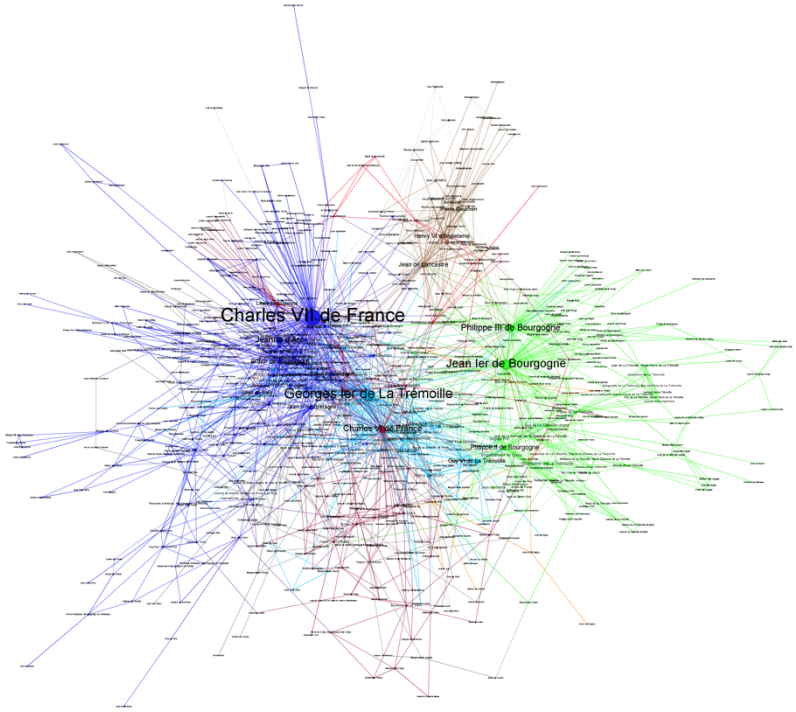
Carbonne Raphaël. 2024. "Modéliser les réseaux de pouvoir de la fin du Moyen Âge", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12599115

La fin du Moyen Âge est, pour le royaume de France, une période troublée. A la guerre contre le royaume d'Angleterre s'ajoute une guerre civile entre Armagnacs et Bourguignons, conflit comportant lui-même plusieurs couches parfois difficiles à cerner. Différents groupes se forment et se décomposent au gré des évènements, aboutissant à une lecture difficile du rôle de chacun dans ce conflit tant les individus peuvent naviguer d'un groupe à l'autre. Afin de comprendre le fonctionnement de ces réseaux de pouvoir, il nous faut suivre le parcours d'un personnage, à la fois singulier par son parcours et suffisamment représentatif de son corps social, qui servira de point focal depuis lequel nous pourrons délier les fils de la toile.

Pour cette présentation, je vous propose d'étudier le cas de Georges de La Trémoille, seigneur de Sully et de Craon, grand chambellan de France. Ce personnage, méconnu et fascinant, a vu sa vie rythmer par les grands évènements de son temps : croisade de Nicopolis, bataille d'Othée, révolte des Cabochiens, bataille d'Azincourt, épopée Johannique, Praguerie... En occupant une place plus ou moins importante selon les périodes, il a participé à la pacification du royaume, au travers d'un usage plus ou moins habile de ses réseaux de soutiens qu'il ne cesse de faire évoluer. Pourtant, il est un personnage mal connu des chercheurs, même spécialisé. Les études biographiques complètes le concernant sont quasiment inexistantes, tout au plus pouvons-nous citer les travaux de M. Contamine et quelques articles épars, amenant beaucoup à simplement voir en lui un conseiller parmi d'autres dans l'entourage des puissants de son temps. Pourtant, c'est bien lui qui amena, pour un temps seulement, une certaine stabilité au sein du conseil de Charles VII, préparant le terrain pour le voyage vers Reims, mais surtout œuvrant à la réunification des grands nobles du royaume autour de la Couronne du roi de Bourges. Sans lui, les ducs de Bretagne et de Bourgogne auraient continué leurs machinations avec l'Angleterre, empêchant toute résolution du conflit. Cette capacité à ainsi réunir les différents partis du royaume, il la doit avant tout à un réseau savamment construit au fil des années, que ce soit par la mobilisation de liens familiaux ou par la construction d'alliances plus ou moins solides.



Par la réalisation d'une biographie prétexte sur cet individu, sur le modèle des travaux menés par Mme Valérie Toureille sur la figure de Robert de Sarrebruck, il a été possible de proposer une stratégie originale de modélisation des réseaux, qu'il sera possible d'enrichir au travers d'un travail collaboratif entre historiens médiévistes. Elle s'appuie sur l'analyse des liens entre les différents individus au travers d'un système de catégorisation (lien familiaux, seigneuriaux...) afin de créer une base de donnée exploitable sur le logiciel GePhi afin d'y appliquer différents algorithmes, notamment le Yifan Hu, pour proposer une lecture nouvelle des réseaux de pouvoir médiévaux, permettant l'établissement des différents groupes et sous-groupes politiques, leurs évolutions et l'identification des individus opérant comme des passerelles entre les différents groupes. Dans cette structure, chaque sommet représente un individu, lié aux autres par les arêtes qui matérialisent les différents types de liens. Ainsi, chaque personnage est replacé dans son environnement complet, explicitant les liens qu'ils entretiennent à l'échelle macro comme micro. Il est possible notamment de mettre en lumière un groupe d'individus afin de comprendre les liens qu'ils entretiennent les uns avec les autres. Cela en fait un outil particulièrement efficace pour comprendre les tenants et aboutissants d'évènements historiques parfois rendus difficiles à étudier par le manque de sources, tels que les complots.

Ces modélisations ont déjà pu participer à expliquer le rôle exact qu'occupait Georges de La Trémoille sur la scène politique de son temps, le sortant du carcan historiographique qui en faisait un ennemi de Jeanne d'Arc pour le replacer dans son environnement socio-politique et ainsi expliquer son rôle comme intermédiaire entre les cours princières de France, de Bourgogne, de Bretagne et d'Angleterre. Le modèle ne demande donc qu'à être enrichi afin d'aboutir à une cartographie complète de la société médiévale. Plusieurs pistes sont actuellement à l'étude, visant à affiner le modèle dans sa structure afin de mieux y intégrer d'autres profils (femmes, religieux, communautés urbaines, communautés non françaises...). L'idée serait ainsi, sur le long terme, de construire une plateforme en ligne afin de rendre accessibles les données et modélisations, tout en permettant aux chercheurs d'enrichir la base à partir de la méthodologie d'analyse proposée appliquée à leurs travaux, ouvrant la voie à une meilleure compréhension des sociétés médiévales.

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Network hermeneutics: exploring the meaning of a source using network analysis, case of inquisitorial protocols from 14th century Stettin

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Hermeneutics, the art of nuanced interpretation of text, is the cornerstone method within historical studies. Its meaning has taken on new dimensions with the development of digital technologies, leading to the emergence of 'digital hermeneutics' and related concepts e.g digital source criticism (e.g Mallery et al. 1986; Fickers 2020; Romele et al. 2020). This paper explores digital source criticism not just as a means to interpret digital representations of sources but as an approach to uncovering the context and creation processes behind historical documents.

In the context of our case study we ask how the network structure of relational data derived from the textual source reflects on its nature and creation process. Can we use this knowledge to learn about the historical phenomena operating in the background and how they influence any quantitative analysis of the source? Employing statistical methods, particularly network analysis, we analyse complete data projections from the source.

With this, we add a new type of quantitative layer that can reveal patterns, connections, and structures within the texts that might not be apparent through conventional reading and analysis and hint at the context of the creation of the source.

The case study at the heart of this paper is the inquisition protocols from the 14th century, specifically the records of the Celestine inquisitor Petrus Zwicker from 1392 to 1394 in Stettin. These documents, central to understanding the Waldensian dissidence and the broader inquisitorial practices of the time, are reexamined through a digital lens. This analysis is based on a network form structured dataset created from the original sources, based on D. Kurze's regesta edition (1975). This data creation process followed the social network analysis (SNA) coding which involved close reading of the sources and documenting people, events, places and relations between them. The dataset was then converted into edge lists containing relations between specific entities.

We investigate the origin story of the source. Is it a document resulting from "live" inquisitional interrogations that evolved during the investigation, where new information influenced subsequent interrogations, or a pre-planned process devoid of such dynamism? For this, we study the inclusion of deponents in the trial process, did information leading to the interrogation of deponents originate from previous depositions? This question is not merely procedural but goes to the heart of understanding the nature of the source itself. The differentiation between a dynamic and a static interrogation process can lead to significantly different interpretations of the source and variations in the network model that can be derived from it.

To explore those variations we describe the evolutions of the evolving evidence network longitudinally, measuring its spatial and network characteristics as it evolves in time bearing the footprint of the intent behind the inquisitorial process.

The study's findings demonstrate how the creation process impacts the nature of the source giving its contents a different structure when converted to a complete digital form. It shows how "network hermeneutics" can contribute not only to our historical knowledge of the source but also frame the interpretation of any digital models derived from it. We aim to contribute to the critique of historical sources

and demonstrate that protocols are not just straightforward accounts of interrogations and show how they have been shaped by the institutional and procedural frameworks of the Inquisition. We discuss natural biases in the network structure within the text coming from its creation process and which opportunities and limits it creates for further quantitative analysis.

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Networks and textual production during the Middle Ages (12th-15th centuries)

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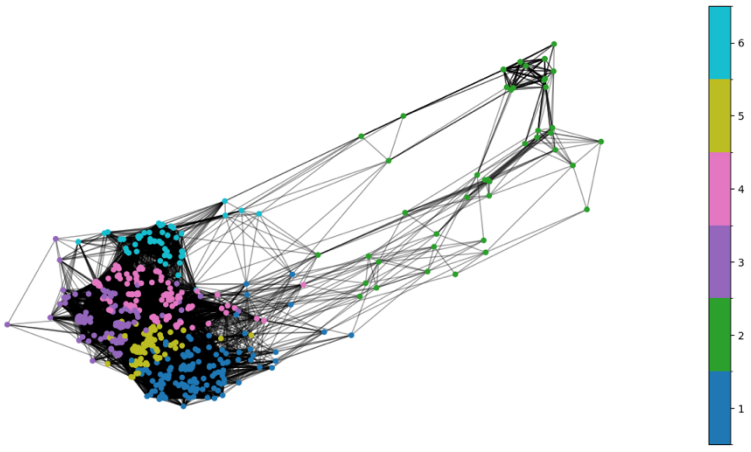
In this article we would like to demonstrate how social network analysis can lead us to establish historical hypotheses regarding the production of books in the Middle Ages.

To this end, we have identified 125 digitalized manuscripts containing scientific texts preserved in the Bibliothèque nationale de France. We will justify the acquisition and curation of this data. Insofar as the experiment should be continued on a larger scale. To compile a usable dataset from these digitalized manuscripts, we carried out image segmentation in order to identify lines of text and other codicological elements using *dhSegment* (Ares Oliveira, 2019). The data, resulting from the processing of these lines of text allowed us to be able to reconstruct the layout of the text on the pages.

Our approach proposes to unlink the manuscripts in order to examine not the books but the texts' copies contained in these *codices*, which we call "witnesses". This comparison is based on metrics resulting from quantitative codicology. To our knowledge, there has never been such a study compiling and exploiting such detailed and precise data, making it possible to account for the layout of so many manuscripts.

Based on the data collected, we have built a graph network of these factures (*i.e.* text making). This graph constitutes a n ew source of information that has been analyzed to study the production of scientific texts in the Middle Ages. This is an original approach and network analysis in humanities academic field have traditionally focused on the study of social groups, and not object production as we have done here.



In this graph of text factures, each node is a witness and each of these witnesses are described by a set of measures allowing us to understand its layout. The edges of the graph are valuated according to the number of codicological measures for which the two witnesses share proximities. The valuation of the edges therefore corresponds to the degree of similarity between the witnesses. The construction of this network and the use of social network analysis tools enable us to obtain a classification that is better suited for the accounting of contacts, which are likely to reflect the formatting habits of witnesses, than those we could have obtained using more "traditional" clustering methods.

To establish our classification, we compare two clustering approaches: the hierarchical algorithm of the Louvain method (Blondel and *al.*, 2008), and the stochastic blockmodels (Holland, 1983). The use of these algorithms enabled us to isolate seven clusters. This corpus-driven classification, which emanates from the structure of the data, makes it possible to reflect on what we think we know about the layout of scientific texts by observing isolated individuals.

In order to interpret these clusters, more traditional quantitative analysis techniques are used. In particular, we used a type of multivariate statistical analysis: multiple correspondence analysis (MCA) (Escofier and Pagès, 2016). MCA enabled to understand which codicological measures were most important in discriminating classifications. On the basis of these explorations, we were able to isolate what characterizes text facture classes resulting forme the use of clustering algorithms mentioned above.

Like the members of the QUANTICOD group (QUANTICOD, 1985), we consider the medieval book as a "machine with a complex operation" (Bozzolo, 1990). For us, the theme of the text is one of these many constraints. It may be less determining than the wealth of the patron, but it is a relevant and important cultural constraint, which plays a part in the production of the book object, right down to its physical appearance. Therefore, we wanted to observe the impact of this constraint and understand the results. To this end, we projected onto the network data, that had not been used to calculate it, *i.e.* the data relating to the themes of the witnesses. This data comes from the informations available in the catalog of the Bibliothèque nationale de France and in the online database of scientific manuscripts *Jodanus*, which we have requalified. We hypothesized an impact on the theme of the text on its layout. This hypothesis was confirmed, since we were able to see that the classes we had obtained brought together a number of thematics in a coherent way for medieval society. Therefore, we have observed and demonstrated the existence of a non-negligible impact of a text's thematic, within the sciences, in the way the page is laid out.

To consolidate our results, we compared them with another method that can produce a corpus-driven classification: self-organizing maps (Kohonen, 1995). The result was a very similar classification, confirming our interpretation.

The approach developed in this paper is innovative in that it mobilizes techniques which, to our humble knowledge, had not previously been used in quantitative codicology. From our perspective, this demonstrates the value of using network analysis in historical field, beyond the study of social groups. The network can also be a means of carrying out analyses and classifications based on resemblance rather than dissimilarity. Provided we distance ourselves from any interpretation that would subject our data to social mechanisms, the network can be a means of taking a fresh look at historical data.

Our study confirms the interest of research projects using artificial intelligence to acquire data on vast *corpora*. Indeed, artificial intelligence it possible to acquire codicological data on manuscripts that are not necessarily listed in the catalogs of conservation institutions, and to do so on large volumes of manuscripts.

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Networks of Confessional Affiliation: Religious Choice and the Schism of Utrecht

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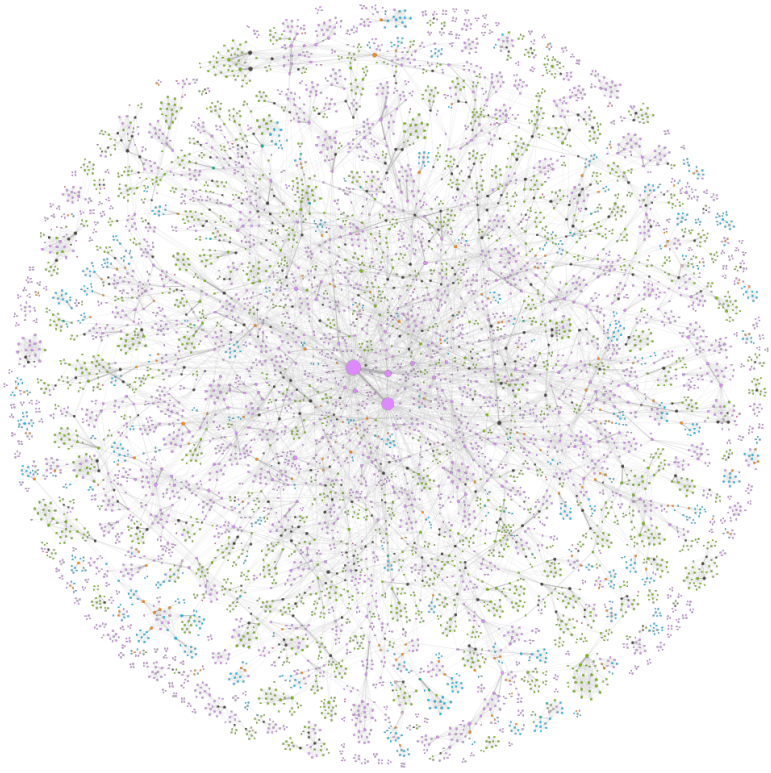
This article demonstrates our methodology for studying the process of intra-Catholic confessional affiliation during the schism that occurred in the Catholic Church in the eighteenth-century Dutch Republic. The schism resulted in the remarkable fact that the Republic, a Protestant state, became home to two competing Catholic Churches, the Roman Catholic Church and the *Roomsch-Katholieke Kerk der Oud-Bisschoppelijke Cleresie* (OBC Church).



In order to understand the choices made by laypeople for one of the two Catholic Churches, we created a dataset based on the baptisms and marriages taking place in two mission stations that were part of the OBC Church in the cities of Utrecht and Leiden. The data was ingested into a specifically designed graph database – connecting people, events (baptism and marriages), and places (churches and secular courts) – that enabled us to study the people who participated in events in the Catholic Churches as well as their roles at these events. Then, we reconstructed the corresponding two-mode networks, connecting people to events, as well as their projections, consisting only of links between people. We used the the framework developed in a series of papers (Vasques Filho, and O'Neale 2018, 2020a, 2020b) to analyze the two-mode networks and their projections, considering metrics such as degree distributions, clustering, overlaps, and ego-centric analysis to infer religious choice and confessional affiliation. Taken together, this approach allowed us to perform both detailed and structural analysis of the data.

One insight revealed by our analysis is the existence of a group of lay Catholics who participated in events taking place in rival Catholic Churches. Moreover, network analysis has shown that the process of intra-confessional religious affiliation did not take place in the context of larger groups or collectives, but nor was it a strictly individual affair, as it mainly occurred at the level of couples or individual family nuclei.

Our mixed-methods approach, combining qualitative and quantitative analyses, has various advantages as it (1) enhances our understanding of the schism; (2) enables a more detailed analysis of religious choice than the quantitative methodology adopted in the older literature on the schism; and (3) spurs and gives focus to further archival research.

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‘Our Maist Speciall Freindis': Using historical network analysis to study clan structures in early modern Scotland

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This paper will explore the application of network analysis for examining clan structures and similar social systems during the early modern period. Drawing on examples from the Scottish *Gàidhealtachd*, a society historically viewed as backwards and simplistic due to their perceived failure to embrace opportunities for urbanisation and commercialisation, this paper demonstrates the use of HNA (historical network analysis) to study a seemingly unsophisticated social system and to trace soft power and influence outside formalised power structures.

Background

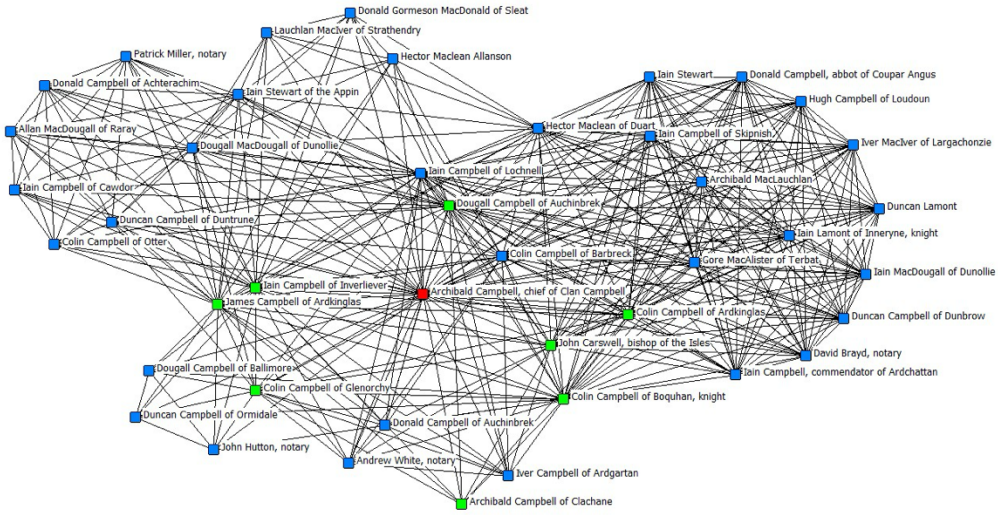
Throughout the medieval and early modern periods, Scotland was broadly divided into two distinct socio-linguistic spheres: the Scots-speaking Lowlands in the south and the east, and the Gaelic-speaking Highlands and Islands in the north and the west. While Lowlanders were generally perceived as civilised, law-abiding subjects to the Scottish Crown, the Gaelic clans inhabiting the western Highlands were instead regarded as a barbaric, savage people who refused to observe the law and lived only by the command of their warmongering chiefs. Studies by Alison Cathcart (2006), Aonghas MacCoinnich (2015), Martin MacGregor (2012) and others have done much to reform historians' perception of clan society, but one aspect that has yet to be addressed in detail is how clan chiefs governed their kindreds during this period and to what extent they could draw on processes of (in)formal consultation and representation inside the clan. Using HNR, this study will unpack social organisation and clan management in the western Highlands in the mid-sixteenth century to argue that the clans maintained a range of formal and informal socio-political structures of communication and representation which were crucial to foster their sense of shared identity and enable effective collective decision-making. The complexity of early modern clan communities has long been underestimated by historians but must be addressed to gain a better understanding of the Scottish *Gàidhealtachd!*

Research subject and approach

Traditionally, Scottish clans relied on a deeply personal system of rulership in which a chief provided for his kinsmen by dispensing resources, administering justice, and offering protection in return for loyalty and services rendered. Jane Dawson (2002) and Stephen Boardman (2006) have previously suggested that some Gaelic chiefs may have been aided in their duty to govern by a council or advisory board of their kinsmen, but the evidence available to historians using traditional research methods alone was never sufficient to prove the existence of any conciliar structures. Taking Dawson's suggestion of a ‘clan council' within Clan Campbell in the sixteenth century as a starting point, this paper showcases how historians can combine historical network analysis with a close critical reading of land grants, precepts of sasine, witness lists, and bonds of manrent to prove the existence of two formal advisory bodies which had not previously been identified: an informal council, and a formal parliament or assembly of Campbell clansmen. Taken together, the council and assembly enabled effective communication and collective decision-making within the kindred, and allowed successive clan chiefs to draw on the expertise of their kinsmen and allies. Using a series of time snapshots of the networks underpinning Clan Campbell between 1558 and 1573, this paper further showcases how HNA may be used to trace the career and influence of individual councilmembers

and how we might distinguish between formal and informal conciliar structures within a clan, thereby offering novel insights into the organisation of Scottish clans during this period.

In this network, nodes are individual clansmen and places while edges are their direct ties based on letters, presence in the same location, or transactions/appointments. As such, if two individuals co-witness a charter or grant lands and offices to each other, they have a direct connection. Direct blood or foster relationships between members of a family are not coded as edges unless there was another transaction, direct communication, or other interaction to underpin the tie. Ties are undirected and not weighted. Clan communities usually had a small set of traditional names which were used with disproportionate frequency (e.g. John/Iain, Colin, Archibald, Donald etc) but, like many other early modern societies, did not follow any standardised spelling conventions while also switching between the Scottish and Gaelic version of the same name – as a consequence, John MacDonald might also be called Iain MacDonnell or indeed Iain, son of Donald/Dòmhnall, which makes identification difficult. To avoid artificial inflation of centrality scores, the dataset underpinning the networks treats two individuals with similar names as two separate nodes unless it can be demonstrated beyond reasonable doubt that they were the same person. The main sources for this dataset are the various charters and letters of Archibald Campbell, fifth earl of Argyll, and his kinsmen. The Argyll papers are an unusually rich source although they, like most family muniments or archives, are incomplete. So far, more than 1400 individuals and 150 places have been identified for the period between 1558 and 1573. Although places have also been coded as nodes, they are primarily used to identify whether individual persons had a particular connection to a geographic area and are otherwise excluded from the HNR part of the study since they cannot facilitate the flow of information and merely provide more context on the individual clansmen of Clan Campbell.



Research Questions

1) How can network analysis enable historians to study informal mechanisms of government in clan communities during the early modern period?

2) To what extent can network visualisations help identify individuals in formal and informal roles within a clan? How can HNA be used to distinguish between formal and informal advisors within a community?

3) Focussing on the example of Clan Campbell between 1558 and 1573, what evidence is there for the existence of one, or more, advisory boards that supported the clan chief in his duty to govern the wider kindred?

Wider implications

While this paper is concerned primarily with the identification of formal and informal conciliar structures within Scottish clans, there are wider implications for historical network analysis. Firstly, this study highlights that no society is too remote or too simplistic to be studied through network analysis. If HNA can reveal new insights into a society as ostensibly 'uncivilised' and unsophisticated as the Scottish *Gàidhealtachd*, there is no reason to believe that the same may not be true for other, similarly understudied communities. Secondly, the project highlights that network analysis does not always require a large volume of evidence to be applied successfully. Although many studies using HNA draw on extensive bodies of correspondence (e.g. the 'Republic of Letters' or the less well-known 'Tudor Networks'), a dearth of letters and similar documents does not automatically prevent historians from using network analysis. Most Gaels in the early modern period were unable to sign their names, let alone write a letter, but the surviving evidence from bonds, witness lists, and land grants can still be used to create and study a series of networks that offer fresh insights into their society. Finally, there can be no doubt that historical network analysis is well-suited to study social relationships, soft power, and influence outside formalised power structures. In some cases, as outlined above, HNA may indeed be able to detect otherwise imperceptible mechanisms of government and collaboration such as the existence of two separate conciliar structures which had previously gone unnoticed.

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The Diplomatic Networks of Ancient Athens: The Evidence from the Decrees

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Auf Der Maur Silvan. 2024. "The Diplomatic Networks of Ancient Athens: The Evidence from the Decrees", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12606021

This study combines attempts to expand on the traditional scholarship around Athenian diplomacy by systematically evaluating the extensive corpus of decrees which were passed by the Athenian assembly to reconstruct the diplomatic network of the ancient city state and observe how it shifted over time.

The decrees of the Athenian assemblies have been painstakingly collected, transcribed and translated by scholars and are published as the *Inscriptiones Graecae,* a project by the University of Berlin-Brandenburg (Hallof et al. 2001).

These decrees have the ability to yield considerable insight into the political networks within Greece, a topic for which they have not yet been systematically used. While there has been a growing interest and awareness of the importance of networks of interaction in the ancient world, as shown by ground-breaking new approaches such as that of Irad Malkin, these perspectives are still developing in the field of ancient history and have rarely been applied to specific, empirically based case studies (Malkin, 2013). As such, this paper will seek to fill this gap in the current state of the field on Athenian decrees and answer the question: What can decrees tell us about ancient Athenian diplomatic networks in Greece? Understanding how the political institutions of Athens determined their diplomatic focus, and how they put it into practice is of crucial relevance in order to assess whether the Athenian state had a coordinated foreign policy and what role decrees played in this process.

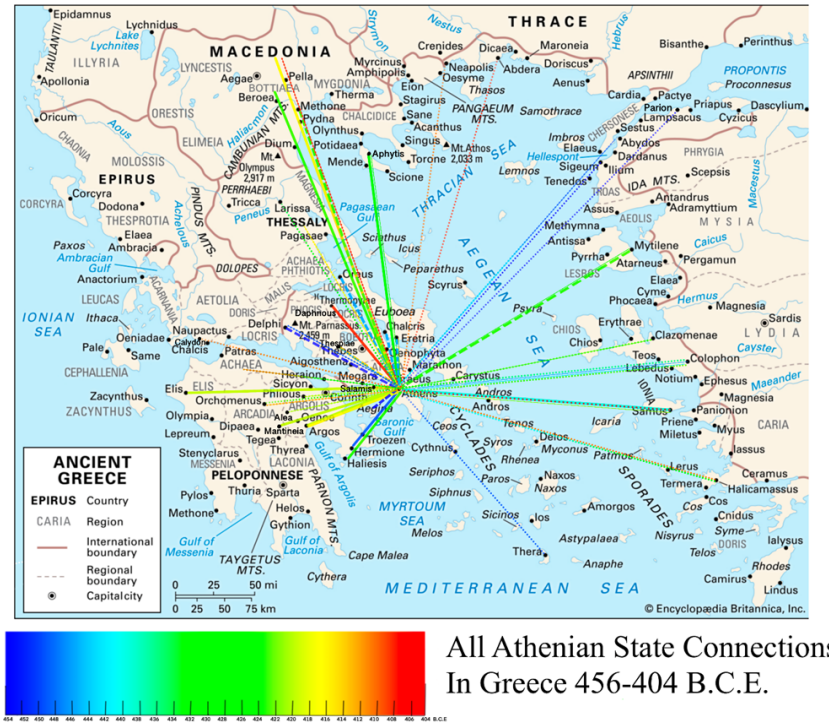
A select number of decrees which were passed by the Athenian *demos,* refer specifically to other locations in Greece, indicating that they may be of relevance to the study of diplomatic networks. By visualizing these geographically specific decrees, a networked view of diplomatic decrees and the various city states or regions they referred to is created, providing a geographical picture of the transnational connections of the Athenian state.

This dataset of over a hundred decrees consists of various forms of diplomatic pacts, as well as honorific decrees, bestowing honors on politically influential individuals from foreign cities, as well as honoring certain individuals with the role of proxenos, which served as a sort of ambassador who was trusted to represent the interests of Athens in their home city. These various kinds of decree are categorized, dated and mapped to provide a visual representation of the extent of the Athenian diplomatic network and its evolution.

For the purposes of this study, Athenian diplomatic history is divided into two distinct periods, for each of which a separate network is constructed. The first period begins with the first documented finds of decrees of relevance to diplomacy, in 456 BCE, and continues until the decisive end of the Peloponnesian war in 404 BCE, which made for a clear break in Athenian political history, as an oligarchic government was temporarily imposed on the city. (Krentz, 1982) The second period will pick up from this temporary loss of sovereignty and track the recovery of the Athenians until their second major defeat in 338 BCE at the hands of the Macedonians.

These periods each ended with transformative changes both for Athens and for Greek diplomacy at large and are therefore useful periods to track the shifts and developments of the institution of diplomacy in Athens. These clear upheavals provide a means of comparing the traditional historical narratives promulgated by ancient authors to the picture which emerges from the analysis of the decrees. This study shows, that these shifts are also reflected in the decrees, which display a shifting distribution of diplomatic pacts, in line with the historical narratives.

The decrees, however, go beyond the narratives told by later historians and show other developments which may not have drawn the attention of those scholars. This may be due to the lack of historical consequence some of these decrees ended up having, but at times it is also due to the narrow focus on specific conflicts or developments which do not encompass the full complexity of Athenian foreign policy. The decrees reveal, for example, the ties which Athens cultivated with cities and citizens throughout the Mediterranean and they also show the overarching developments in how diplomacy was conducted. The dominance of Leagues, while widely acknowledged in scholarship, is clearly emphasized when looking at the evidence of the decrees. The consequences the further entrenchment of these federal entities had also become clear, such as the disappearance of non-aggression pacts in favor of outright alliances. Most importantly however, the decrees demonstrate how an ancient society was able to decide on foreign policy collectively through democratic institutions, and that this process resulted in a coherent and intelligent strategy which responded and adapted dynamically to a continually shifting diplomatic landscape.



All Athenian State Connections
In Greece 456-404 B.C.E.

An in-depth source analysis of the decrees also provides insight into the biases inherent in analyzing large historical datasets, such as the survivorship bias which led to the preservation of certain decrees over others. The field of ancient history is familiar with these limitations, due to their severity in the sparse material and textual record of these periods, but the lessons learned from such an analysis are crucial for all attempts at constructing networks of historical actors and through the more extreme case of this ancient example, other practitioners of historical network analysis could be sensitised to the limitations of their data as well.

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The networked geography of a newspaper

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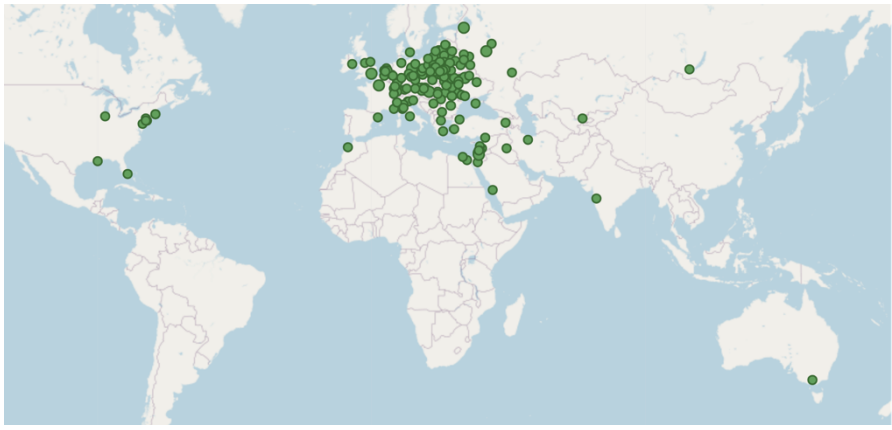
Segal Zef. 2024. "The networked geography of a newspaper", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12606057

Isaiah Berlin's assertion that the Jewish people have experienced "too much history and too little geography" reflects a conventional perception of geography as fixed and territorial. This paper challenges this notion by adopting a fluid, relational, and networked perspective, revealing the Jewish preoccupation with space, place, and spatiality within their history and culture. Grounded in the fluidity of space, the paper takes a networked approach to explore the spatiality of a 19th-century Hebrew periodical.

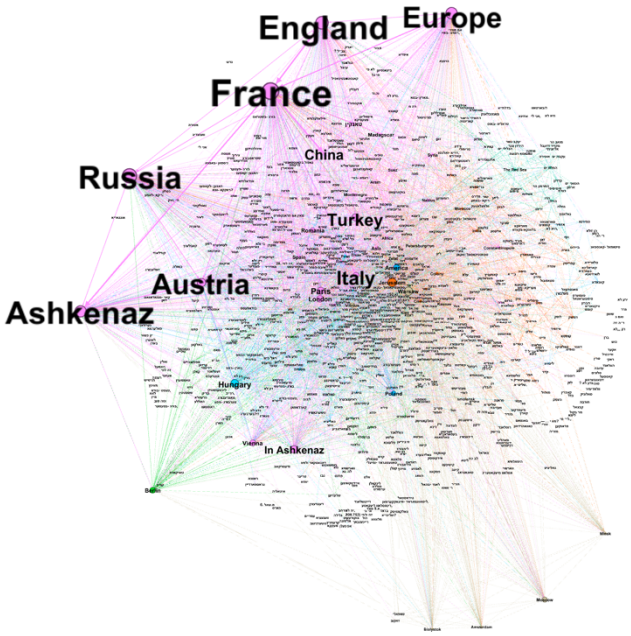
A historical periodical, much like any historical event or phenomenon, exists within space and time. Its institutions function from tangible buildings; it circulates through transportation routes; and through its reader network, it establishes connections between places and people. However, the relationship between "geographical space" and "periodical" is not unidirectional. Just as much as the periodical exists within a geographical space, one must explore the ways in which geographical spaces are within periodicals and, significantly, are crafted by them. Many periodicals generate an internal geographical space, shaped by the text and inner conventions of the periodical, including distinctions between different pages, articles, and sections or between places in headlines and those in the body of the text. Geographical places, such as cities, mountains, rivers, states, and continents, reside on paper rather than on the globe; their sizes or altitudes are defined by the frequency of their references, and the distances between places are determined by proximity on the line, page, or article. These geographical spaces emerging from the text are mediated geographical spaces with shapes and topographies different from the "normal" world map. They are influenced by cultural, political, ideological, and economic perceptions of writers and readers, but they also serve to reinforce and legitimize such perceptions.

Recent advances in digitization, automatic annotation, morphological and lexical analysis, as well as geographic and network mapping, have made exploring such uncharted and chaotic spaces more feasible than bef ore (Piatti 2009). This paper uses textual proximity within periodicals to recreate an alternative geography, visualized by a network (Figure 1), rather than a two-dimensional locational map (Figure 2). In these networks, two locations are adjacent if they appear at a distance of 300 characters. This network represents a fuzzy geography, which does not always align itself with the “real world”.



The paper explores the nineteenth-century Hebrew periodical HaTzfira as a case study for different geographical spaces that originate from and within the periodical. “The history of the Jewish Press,” claims Derek Penslar, “is a microcosm of the Jewish public sphere” (Pensler 2000,7). For Jewish communities, lacking central political and economic leadership, and spread throughout the world, the press gave voice to

a public sphere; a sphere that spanned geographic and linguistic boundaries. As a result, editors of Jewish periodicals explicitly referred to their "global" or "international" journalistic mission. Even Theodor Herzl entitled his Zionist newspaper Die Welt (the world), rather than a nationally oriented title. However, they rarely clarified what it meant to be "global" (Segal 2022). What did their "world" consist of, where were its boundaries, and what were its centers? HaTzfira, which operated between 1862 and 1931 was established in order to educate its readers with worldly knowledge. Its articles discussed global news, travel stories, and scientific discoveries, all of which involved spatial references. By analysing the evolution of networked geographies over a decade between 1874 and 1883, it is demonstrated that spaces were constantly being deterritorialized and reterritorialized. In particular, the analysis highlights the rising interest in the Land of Israel as well as the changing geographical alliances and interests of the Hebrew "Republic of Letters" of the pre-Zionist era.



The paper discusses various methods for exploring the relations between textual spaces within the journal and their spatial references, along with digital methodologies employed for unveiling these spaces. Recogito was used for annotation, Gephi for network analysis and visualization, and QGIS for mapping.

In conclusion, this research contributes to the discourse on historical network analysis by providing insights into the dynamic interplay between geography and periodicals, offering a nuanced understanding of space formation within historical texts.

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The transfer of German pedagogical knowledge to Turkey through Turkish educators in the Early Republican Era: A historical social network study in the field of transnational education

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This study focuses on thirteen educators who were sent to Germany to study teaching and pedagogy in the late Ottoman and early Republican periods. The works of these individuals between 1923 and 1946 were analyzed to determine their educational ideas. In parallel, the thoughts of their German teachers were analyzed and historical social network analysis was applied between both groups. As a result of this analysis, the knowledge transferred by Turkish educators from their German teachers was obtained and how this knowledge was used or transformed was discussed.

The practice of sending students abroad emerged as an important parameter in Ottoman modernization (Erdogan, 2016). Since 1830, the Ottoman Empire sent students to Europe to receive education in different fields. In addition to the prominent specializations of the countries, Ottoman foreign policy was also a factor in this sending. As a result of the political and military rapprochement between Turkey and Germany in the late Ottoman period, the preference for Germany came to the fore (Yıldırım, 2005). This preference continued to be influential during World War I and after the establishment of the Republic. In particular, the preference for sending students to Germany to study teaching and pedagogy attracted attention (Aslan, 2014).

The aim of the research is to concretize the pedagogical knowledge transferred through the students sent to Germany by the state in the context of the developing educational relations between Turkey and Germany. In order to do this, it is to trace the process of knowledge transfer by monitoring the knowledge network between the students and their German professors. This will be done through the pedagogical phenomena and concepts identified in the publications and discourses of Turkish students after their return to their country.

The thirteen Turkish educators analyzed in this study received education in Germany in different periods. Therefore, they attended different teacher training institutions that developed within the history of German education. However, the common point of all of them is that they took part in the Turkish education bureaucracy between 1923 and 1946. They were commissioned by the state to prepare textbooks. They translated many works from German and put them into circulation in Turkish. On the other hand, they continued to communicate with their German teachers and with Germany itself. They closely followed the developments in the German education world. In general, they were all acquainted with the ideas of the new pedagogical movement in Europe. In addition, each of them adopted, followed and specialized in their own fields. For this reason, these thirteen educators were considered suitable for network analysis.

The written documents obtained in the research were first meticulously and systematically analyzed using the document analysis method (Wach, 2013). Thus, the necessary data were obtained from archival documents. Historical social network analysis method was used to analyze these data. In this analysis, the network between Turkish students and their German teachers, in other words, the structure formed by the relationships between individuals (Marsden, 2005) was obtained. In this historical network analysis, the network structure technique, which reveals all the structural features of the entire network, and the bond strength technique, which allows focusing on individual actors, were used (Öztaş & Acar, 2004).

In the part of the research conducted in Turkey, the necessary data were obtained from the state archives of the Presidency of the Republic of Turkey and the İsmail Hakkı Tonguç document archive. In the archival studies conducted in Germany, the archives of the cities where the students were sent, state archives, university archives and the Berlin Library-Archive of the History of Education were examined. In these examinations, the years the students were in Germany, the institutions they were sent to, their report cards, and the teachers they took lessons from were obtained. In addition, publications of both students and German teachers were included in the research as a source to determine their educational thoughts. In the determination of pedagogical thoughts, the limitation for German teachers was determined as the prominent works of the students in the years they took courses. The limitation for Turkish students was based on the year 1946 as the time interval determined in the research since their return to Turkey.

A network was formed between Turkish students and their German professors, which enabled the flow of information from German professors to Turkish students. Through this network, the pedagogical agendas of German professors, which were prominent in their educational ideas, were adopted by the Turks. Turkish students followed this knowledge after returning home. The networks were stronger in the types of information that were practical, easy and beneficial to apply. In this network, Turkish actors were connected to their German teachers in their ideas on collective education, rural education, arts education, vocational education, the combination of theory and practice for teacher training, and education for the state. This general framework will be customized for each actor and their teachers.

When the books of Turkish students were analyzed, it was seen that they knew the prominent pedagogical ideas of their time. In addition, they showed special interest in the world of German pedagogy. This can be seen in the bibliography they used for their works. The entire social network showed that they all advocated for German pedagogy in general. For each of them, it was seen that they followed their own understanding. On the other hand, although the books they translated were faithful to the text, they were technical works. In the works describing the theory of pedagogical thought, they did not stick to a single source. They supported the book they translated with other sources and produced a work that supported their own ideas. They stated this as preparing the book, not translating it. Based on this, it can be argued that they were trying to produce the knowledge needed by the Turkish education system or that they wanted to justify what the state expected from them.

While the research serves the aims of the discipline of comparative education (Kandel, 1955), it also has a transnational historical perspective that links the local with the global (Patel, 2009). The transnational ground of the research is provided by examining Turkish students as concrete carriers of knowledge. In this context, transnational history applied social network analysis.

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Tracing the Network Continuity: From the Socialist to the Communist Women's Movement (1907–1934)

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Bujakovic Minja. 2024. "Tracing the Network Continuity: From the Socialist to the Communist Women's Movement (1907-1934)", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12664672

In my work, I explore the intertwined history of the Socialist Women's Movement (SWM) (1907-1917) and the Communist Women's Movement (CWM) (1920-1934). By examining these two movements, I aim to investigate the role of network continuity as a facet of the continuity of left-wing women's activism. To do so, I focus on the SWM network as a pre-existing CWM network. The idea of a movement emerging from a pre-existing network is not new – it is solidified in the theory of collective organising and discussed in the literature as one of the most successful strategies for establishing a new movement and/or organisation. As Nick Crosley noted, the pre-existing ties imply the existence of coordination, channels of communication, esprit de corps, and a division of labour with the lines of authority; these factors, thus, serve as predictors of collective action, significantly accelerating the movement's development.[27] Even though this argument has also been highlighted in the research on the history of women's movements and activism, in the case of the SWM and CWM, its implications and significance have not been thoroughly examined.[28]

Recognising the intrinsic link and continuity between the SWM and its successor is not a mere observation but an insight made by the movement participants. Clara Zetkin, serving as a secretary for both movements, provided a basis for the argument of continuity, stating: "At a higher level of historical, theoretical knowledge and practical activity, the Communist Women's Movement [...] is today using what the Social-Democratic women's movement started but betrayed."[29] This statement, along with other discussions of communist activists, underscores the importance of examining the SWM network to comprehend the CWM's development fully. Therefore, I start my research by examining the network of the SWM through the lens of Historical Network Research (HNR), seeing it as a transnational network of collaboration and communication among left-wing women activists and an organisational base for the future CWM. To reconstruct it, I focus on four international SWM conferences held between 1907 and 1917: Stuttgart (1907), Copenhagen (1910), Bern (1915), and Stockholm (1917). These conferences constituted spaces where internationalism was practised, although, in the case of the SWM, internationalism predominantly remained within the confines of Western Europe. Moreover, women activists recognised that international women's conferences played an essential role in mobilising and recruiting for their movement by establishing new ties among activists while reinforcing, evolving, or occasionally dissolving existing ones. Still, The network forged through the conferences was essential for spreading and exchanging ideas, information, and strategies, significantly contributing to the movement's growth.

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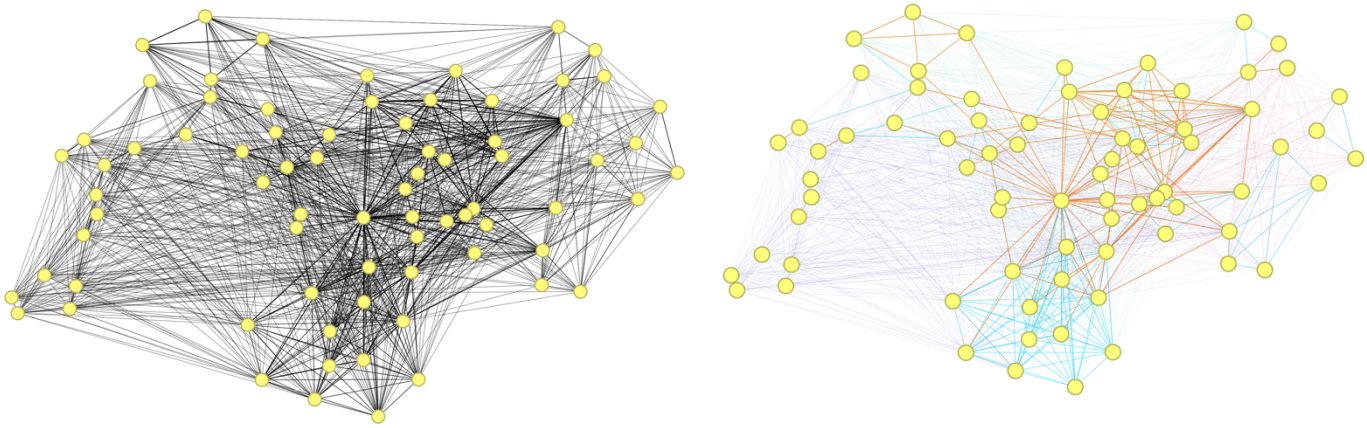
[27] Nick Crossley, "Social Networks and Extraparliamentary Politics," *Sociology Compass* 1, no. 1 (September 2007): 230. https://doi.org/10.1111/j.1751-9020.2007.00003.x.

[28] Aldon D. Morris and Carol McClurg Mueller, eds., *Frontiers in Social Movement Theory* (New Haven, Conn: Yale University Press, 1992), 162. On the scholarship on women's movements and international networks of collaboration see also: Bonnie Anderson: Joyous Greetings: The First International Women's Movement, 1830–1860."; Krista Cowman, "The Women's Movement and Internationalism in the 20th Century," Moving the Social, October 14, 2016, 55-74. https://doi.org/10.13154/MTS.55.2016.55-74. Patricia Ward D'Itri: Cross Currents in the International Women's Movements, 1848– 1948, Bowling Green Ohio 1998; In the case of the SWM and CWM, author Mike Taber acknowledged the CWM's ambition to draw from the SWM legacies while rectifying its shortcomings.

[29] Communist Women, Bourgeoise Women, Social- Democratic Women, 1931, Fond 528, Description 1, Reel 6, File 1863, International Institute for Social History, Amsterdam, Netherlands, 42.

Seventy-five women activists who participated in these conferences constitute nodes in the network, connected with multiple kinds of ties, resulting in 1215 ties differing in thickness by weight. (Figure 1)

The difference between the ties is visually marked through the tie colour and the weight of the ties, represented by the thickness of the ties, ranging from 1 (events), 2 (same party membership), and 3 (personal relations). (Figure 2) The first kind of tie – event participation – is used to develop the movement network's general structure based on chosen representatives' participation in international conferences. Considering that these events gathered rather a small number of participants that would not pass 50, it is possible to assume that the actors present met each other or participated in the form of an exchange of ideas, either directly or through mediators. Further analysis of primary sources allowed for discovering different types of ties that connected the activists beyond these conferences, such as personal relations. Even though defining a tie as a personal relation could be disputable, primarily due to the impermanent character of the relations, in the case of the movement, the tie was defined as such when primary sources proved the existence of correspondence, meetings outside of the conferences, collaboration through other activities. The last kind of tie includes same-party membership, connecting activists through their activities in national parties, and creating cliques in the network. The cliques constitute an important part of this network, serving as hubs of communication and collaboration of activists from the same national parties, significantly affecting their participation in the movement.



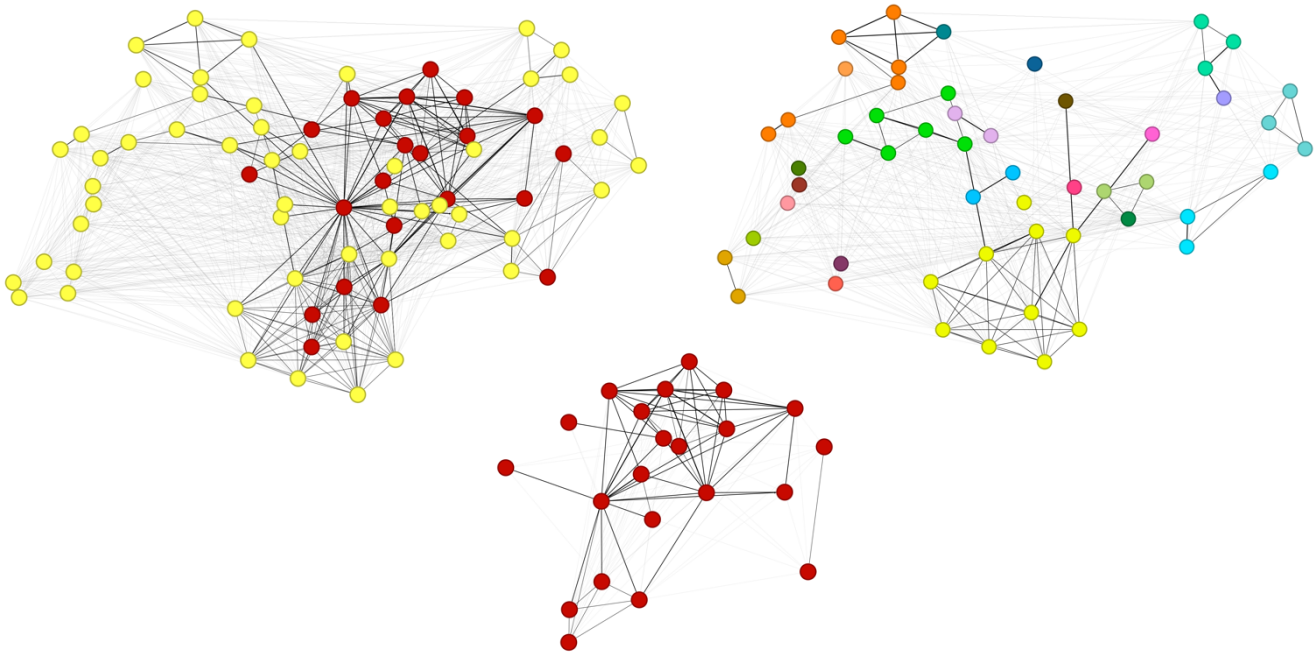
The identification of the nodes represents the main challenge in the research. Given the SWM's semi-clandestine nature after the First World War outbreak, documents detailing its history do not consistently feature lists of conference participants. Consequently, the data is gathered from various sources, including conference reports, newspaper articles, letters, memoirs, and diaries. This suggests that the network of the movement likely encompassed more nodes than has been identified so far. Moreover, the strategic lack of documents that could connect activists with the network affected the character of the network, making it semi-covert. Due to this change, it is unclear whether new actors joined, especially the 1917 conference, which had a stronger left-wing orientation, and whether any of them subsequently joined the CWM. The political developments of 1917, especially the October Revolution, directly affected the movement, putting it in a state of abeyance. Abeyance, as explained by author Verta Taylor, "depicts a holding process by which movements sustain themselves in non-receptive political environments and provide continuity from one stage of mobilisation to another.[30] The movement in abeyance, Taylor writes further, becomes a cadre of activists who create a niche for themselves.[31] The political developments of 1917, including the October Revolution, led to the dissipation of the movement in correlation with other factors. With the success of the revolution and the establishment of the international organisation – Communist International, a portion of the SWM's activists found their "niche" within the CWM, established in 1920. Out of 75 activists, 22 joined the new movement. (Figure 3)

[30] Verta Taylor, "Social Movement Continuity: The Women's Movement in Abeyance," *American Sociological Review* 54, no. 5 (1989): 761–75, https://doi.org/10.2307/2117752.

[31] Ibid. 762.

Meanwhile, seven have passed away, one withdrew from politics, and the remaining 45 maintained their active roles primarily within socialist and social democratic parties, often engaging in formal political institutions and/or other women's organisations. Most women who opted not to align with the CWM belonged to tightly knitted cliques, maintaining strong connections with one another compared to the border network. (Figure 4)

The varied colours of the nodes signify diverse party affiliations, indicating that cliques primarily formed around the connections established within each national party. Focusing on these cliques, it is possible to hypothesise why activists decided not to join the CWM in relation to three factors: 1) tactical and ideological differences, 2) multiplexity and salience of ties, and 3) political restrictions and opportunities. Ideologically and strategically, while communist women viewed revolution and the establishment of a new social, economic, and political order as a route to women's emancipation, those aligned with socialist and social-democratic parties saw the solution in social reforms performed within the frameworks of the existing orders. Moreover, the connectedness within the cliques serves as a reminder that all the activists were embedded in multiple networks. Their decision not to join the CWM could be understood through the multiplexity and salience of ties, as joining a revolutionary organisation constituted a form of high-cost activism that would necessarily cut some of these ties and be aware of this cost. This dilemma was already discussed in 1915, with the SWM's involvement with the anti-war efforts, which some women rejected, fearing the accusation of treason by both the belligerent countries and their parties that supported the war. This was particularly the case after 1917: due to their semi-illegal character and the rise of the counterrevolutionary movements, joining communist parties constituted a high-cost activist choice restricting the political opportunities other parties offered. With the interplay of political opportunities and restrictions, the salience of ties, and often ideological affinities, many socialist women decided to stay in their previous organisations. Consequently, even 23 SWM members later assumed significant political roles, underscoring the nuanced decisions around movement participation.



The CWM's pre-existing network included 22 activists connected with 175 ties, making the network highly connected and tightly knitted. (Figure 5)

The pre-existing network predominantly compromised individuals linked by strong ties based on personal relations. This finding supports the theory that activists deciding to participate in high-risk activism were connected by strong personal ties and shared activist experience.[32] Moreover, it confirms that prior ties,

[32] Donatella Della Porta, Clandestine Political Violence, Cambridge Studies in Contentious Politics (Cambridge: Cambridge University Press, 2013), 159, 160.

next to a strong identification with the newly emerging movement, are crucial factors in encouraging high-cost activism, such as communist women's activism.[33] Therefore, strong ties garnered through the activism within the SWM, shared views on women's emancipation, and ideological proximity constituted structural factors that allowed the successful activation of the pre-existing network. This conclusion also underlines that the embeddedness in the network determines the effect of the pre-existing ties and enhances the potential for successful activism mobilisation through the existing network.

Furthermore, key figures within the CWM maintained and built upon their central roles from the previous movement, underscoring the legacy of effective leadership, mutual trust and commitment to a common cause. In the following years, communist women leveraged the ties established through the SWM: members of the pre-existing network participated as delegates at the CWM conferences, contributed to CWM publications, and developed ideas and strategies for the CWM. This underscores the indisputable role of the pre-existing network, which facilitated strong connections among activists and acted as a reservoir of tested ideas and collective experience. The evolution of the network from SWM to CWM showcases the significance of the preexisting network in maintaining the momentum of left-wing women's activism, suggesting the importance of further investigation into how these networks contributed to the movement's continuity, especially in the case of left-wing women's activism.

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Visual Exchanges as a Network: The Case of Avant-Garde Periodicals

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In the history of representation, the illustrated press has functioned as a significant driving force, curating and disseminating ideas of visuality to artists and a wider audience. An illustration published in one magazine could be shared or copied by another, while periodical editors absorbed ideas from different publications and reused them in novel settings. The result is a network of exchanges, a polycentric map that shows how the visual spreads across space, time, and the public sphere. However, how can we even capture the interaction and circulation of the visual at scale? How is it possible to analyse and comprehend image globalization? To answer these questions, the Visual Contagions project[34] has developed a global corpus comprising more than 4000 illustrated magazines from 1890 to 1990. Using computer vision algorithms[35], we extracted more than 10 million images from their pages, compared them together and arranged them into clusters of "image types": vectors of visually similar images. In parallel, for each retrieved publication, and thus for each image extracted, we collected and normalised a set of descriptors documenting the date and place of publication, as well as the type of audience (community type) to which each periodical was addressed (e.g. Avant-guarde Art, Automobile, Male Fashion).

By combining the two data sources, we were able to query each image type and analyse the spatiotemporal attributes of its component, i.e. where each identified image was published, by which periodical, for which audience and on which date. The result is an initial panorama of globalisation through images, which reveal unexpected axes of circulation between countries. However, if such work has shed light on the geographical and thematic distribution of exchanges, it has not yet explained the process of visual dissemination and image distribution.

Following the example of previous investigations[36], this contribution applies network science methods and metrics to the study of the exchanges. Visual dissemination will be examined by focusing not on the entire Visual Contagions corpus, but on a specific case study: image exchanges within avant-garde magazines between 1910 and 1945 and their impact beyond the original community of readers.

The paper presents the process of selection and construction of a metadata network[37] and outlines the conceptual decisions behind it. The use of a centrality algorithm combined with a temporal analysis will make it possible to analyse the dynamic relationships between periodicals in the community and their role in image distribution at a national or international level. The analysis of these results will reveal which periodical was more active within the avant-garde community in incorporating visual inputs, as well as the role and tendency of national visual exchange in the art world.

This initial analysis focuses on the network of avant-garde magazines itself, and it reveals the dynamics of its structure and characteristics over time. However, in order to comprehend exchange, it is also important

[34] B. Joyeux-Prunel *et al.*, "Un œil mondial? La mondialisation par l'image au prisme du numérique: le cas du projet Visual Contagions," *Sociétés & Représentations*, vol. 75, no. 1, pp. 203-226, 2023

[35] R. Champenois and B. Joyeux-Prunel, "Visual Contagions : extraction et traitement d'images pour l'étude globale de la circulation d'images illustrées," *Humanistica 2023*, 2023

[36] E. Erikson and P. Bearman, "Malfeasance and the Foundations for Global Trade: The Structure of English Trade in the East Indies, 1601–1833," *American Journal of Sociology*, vol. 112, No. 1, pp. 195-230, 2006

[37] M. Grandjean, "Using Network Analysis to Question the Concepts of Centrality and Periphery in Complex Historical Structures," vol. Cultural Organizations: Between the Local and the Global, no. 1880s-1960s, 2020

to understand how the images produced within this network are received outside of it. For such an analysis, a network comprising all the magazines (and the publication/exchange data) documented in the Visual Contagions data will be created. Thus, the images produced by avant-garde magazines will be examined with respect to their impact on other non-avant-garde magazines and communities of readers. Specifically, we will examine how the images produced by avant-garde magazines are received outside the art community, which communities act as a bridge between avant-garde periodicals and non-art magazines (betweenness), and which avant-garde periodicals are more successful in distributing images outside (shortest path) their domain and community of readers.

This second investigation will reveal the extent of influence exerted by avant-garde magazines and identify the channels and communities through which they achieved cultural significance.

Visualising Bibliographical Data on Polish Literature after 1989

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Maryl Maciej. 2024. "Visualising Bibliographical Data on Polish Literature after 1989", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12606176

Goal

This paper discusses the challenges of meaningful exploration and visualisation of the large networks based on bibliographical data. The particular focus is put on tracing relationships between the actors of literary life and providing data-stories of career trajectories and success/failure patterns of particular writers.

Data

The analysis is conducted on the data derived from Polish Literary Bibliography (PBL) and ingested into neo4j environment. PBL is a comprehensive database of Polish literary and cultural life, indexing all instances of literary life and literary reception: books, reviews, journal articles, mentions in newspapers, dramas, adaptations of literary works, and literary prizes. This provides rich data about the relationships between literary entities (e.g. A is a review of B; C is an adaptation of D). The dataset extracted from the PBL for this study provides a network of over 2 million unweighted connections between over 1 million nodes in a timespan of 1989-2002 (see: Table 1. for breakdown and Fig. 1 for data model visusalisation).

NODES	1072066	EDGES	2080536
Book	201309	Published	871285
Journal	2814	Located in	213420
Journal article	673907	Is about	231843
Location	3634	Awarded	6215
Person	153215	Wrote	757773
Prize	3616		
Publisher	33571		

Table 1. Breakdown of nodes end edges in the dataset

Method

In the presentation I am focusing on the challenges with meaningful visualisation of the large dataset by providing a comparison between a mono-modal projection of inter-author relationships based on the literary reception (edges created through books and articles written about the author) with career trajectories derived from multimodal dataset in neo4j. The differences will be discussed on the basic of career trajectories of writers who debuted after 1989: on the one hand I will employ network statistics and visualisation of tendencies overtime on the monomodal projection of the dataset in Gephi) on the other, I will use more advanced and qualitative queries to reveal overall patterns and outliers in data (with Neo4j GDS).

The analyses currently carried out in the framework of CLS INFRA TNA fellowship are aimed at plotting individual career patterns of authors and how subsequent events (e.g. publishing a book with a large publisher, being reviewed in a particular journal, receiving a prize) influence their careers.

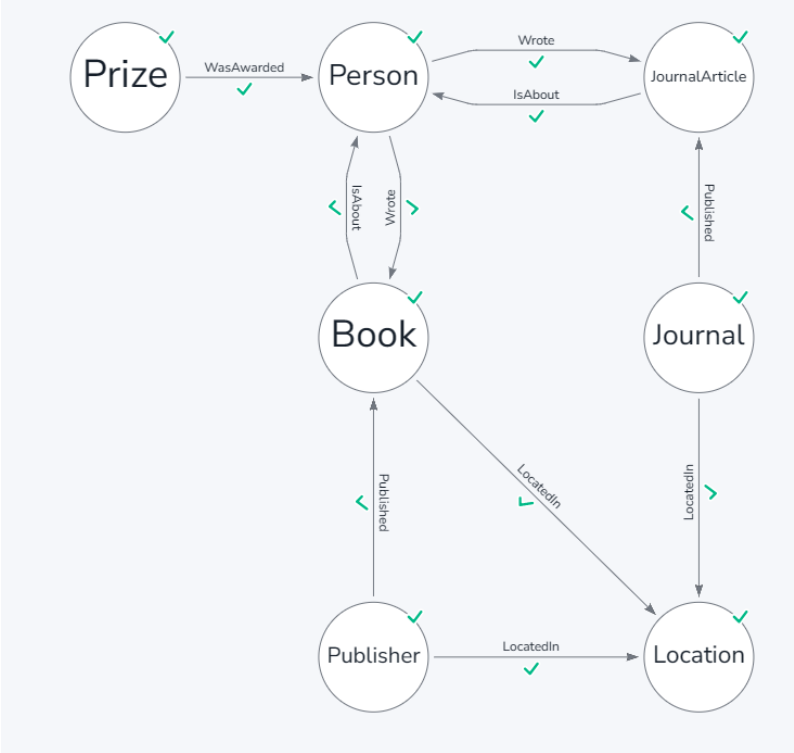

Figure 1. Data model.

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Short papers

Agir et documenter: la double action du vicaire apostolique de Tripolitaine pendant la Seconde Guerre mondiale

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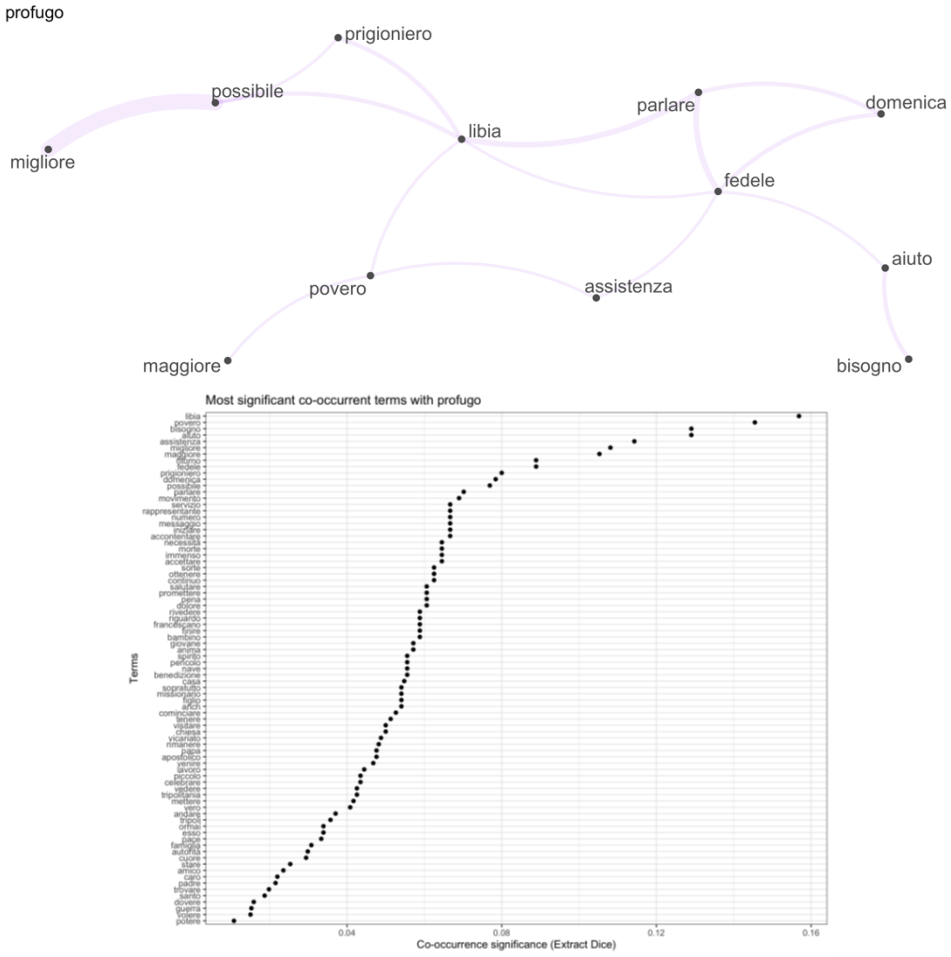
L'histoire de la Lybie coloniale italienne reste peu étudiée, et les récents troubles qu'a connus ce pays nous rappellent l'importance de cette histoire. Pour pallier ce manque, je m'intéresse à Mons. Facchinetti (1883-†1950), vicaire apostolique de Tripolitaine (1936-1950). Le but de mon étude est la mise en valeur du caractère protéiforme de son action en faveur de la communauté italienne de Libye durant la Seconde Guerre mondiale. Plus spécifiquement, je veux mettre en évidence l'importance humanitaire de son action, mais aussi la valeur historique de ses écrits. Je fais cela via l'analyse de réseaux de co-occurrences de mots dans l'un de ses écrits, *La Provvidenza in viaggio* (1945). Ici est décrit un des principaux faits d'armes de Facchinetti: son rôle majeur dans la protection et la défense des soi-disant réfugiés italiens qui, depuis l'Italie où ils étaient partis pendant la guerre, ont essayé de retourner illégalement en Libye après la fin des combats.

Après avoir comparé les résultats obtenus avec différentes mesures de similarité – le coefficient de Sørensen-Dice (Dice, 1945; Sørensen, 1948), le log de vraisemblance (Dunning, 1994) et le score d'information mutuelle (Shannon, 1948), je choisis d'utiliser le coefficient de Sørensen-Dice et je produis le réseau de co-occurrences d'un terme clef, *profugo* (réfugié). Pour déterminer le nombre de co-occurrents choisis, j'observe



la réduction de l'importance des termes (fig.1) et ne retiens que les quatorze premiers, situés dans la partie plus rapide de la courbe.

J'obtiens le graphe présenté dans la fig.2. Ces mots se regroupent en deux champs lexicaux distincts. L'un concerne les conséquences désastreuses de la guerre, l'incertitude liée au statut de réfugié ainsi que la pauvreté et l'emprisonnement (*prigioniero, povero, possibile, migliore* et *Libia*). J'inclus dans cette catégorie également le mot *maggiore* (de l'anglais *major*), qui fait référence à la plus haute autorité de la *British Military Administration* en Tripolitaine, responsable des consignes empêchant le retour des réfugiés en Libye. Le second champ lexical concerne l'aide humanitaire (*assistenza, aiuto, bisogno*}. Dans ce champ je fais rentrer également les mots: *parlare, domenica, fedele*, car ils témoignent du rôle d'intermédiaire joué par Facchinetti entre la communauté italienne de Libye et leurs proches réfugiés en Italie. Ces deux champs lexicaux peignent la nature double de l'œuvre de Facchinetti: ce dernier fait œuvre d'historien en documentant la souffrance de la communauté italienne bloquée en Lybie, mais, loin d'en rester au simple constat, celui-ci déploie des efforts démesurés pour venir en aide à cette même communauté.

Pour pousser plus loin mon analyse, je me demanderai quel a été l'impact du réseau social de Facchinetti sur son action caritative en faveur des réfugiés italiens de Libye. Pour ce faire, je devrai OCRiser l'intégralité des textes conservés de Facchinetti, identifier les noms propres de personnes et regarder leur place dans les réseaux de co-occurrence du mot *profugo* ou d'autres mots du champ lexical du socio-humanitaire.

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Archaeological networks in pre-Roman Italy: approaching new visual methodologies

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In the context of ancient southern Italy, the study of burial goods has been coloured by long-held assumptions drawn from the Classical archaeological tradition. From trade and exchange to mobility and migration, the Greek and Italic communities of the region have been subject to an outdated agenda that not only limits our understanding of their identities, but also obscures the connections between them. In the same vein, social interaction amongst these groups has largely been viewed through a Hellenised lens, and while network research has proliferated in recent years (Blake 2014, Donnellan 2019, Donnellan 2020), south Italian archaeological data has seldom been subject to contemporary methods of digital analysis.

The following paper reframes our understanding of Italian connectivity through a novel and systematic network analysis of burial goods, spanning from the Iron Age to the Classical period. Drawing together affiliation networks (Mills 2017, 383) and spatial data, it seeks to identify ties between a diverse range of human and material agents, and is underpinned by two key questions: (1) how were personal and communal identities constructed in south Italian burial kits; and (2) what do these findings reveal about the nature of social networks and cultural interaction in the region? These questions are explored via statistical analyses conducted in R (Peeples 2011), and are complemented by a new method of network visualisation which clearly illustrates connections at various regional and interpersonal scales. While the preliminary results suggest that indigenous groups played a leading role in the historical processes that shaped pre-Roman Italy, this project ultimately aims to reconcile the social, geographic and agent-based factors that drove cultural engagement in the broader ancient world. This paper, then, has the potential to enliven the network research landscape, offering a heuristic and methodological contribution that intersects diverse disciplines, timespans, and landscapes.

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Beyond nodegoat: a critical look at historical network research workflows

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Van Bree Pim and Kessels Geert. 2024. "Beyond nodegoat: a critical look at historical network research workflows", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12606364

Data exchanges between data collection and storage software on the one hand and data analysis and visualisation software on the other hand remain a largely static process.[38] Scholars store and work on their data in one tool, and generate an export of this data to analyse and visualise it in another tool.[39] While specialised tools make for a straightforward field-specific user experience, the strict divide between the working environment and the analysis software hampers many opportunities offered by exploratory data analysis and visualisation.

The open-source software nodegoat offers scholars a research environment that can be used for data modelling purposes, multi-user data collection tasks, as well as various data analysis and visualisation functionalities.[40] While this environment presents scholars with features for exploratory data analysis and visualisation, these functionalities are not exhaustive. For this reason, exports can be made of all data as CSV files[41], and every nodegoat research environment is equipped with an API.[42]

In this paper, we describe the opportunities of working with data collection and storage software that enables interactive data exchanges as opposed to working with static exports, based on the example of nodegoat. For this workflow a data collection and storage tool is required that offers any kind of web API (e.g. the nodegoat REST API, the SPARQL endpoint of Wikibase) and data analysis or visualisation software that is able to communicate with a web API. Exposing data via an API does not necessarily mean that data becomes publicly available: APIs can be configured to require authentication.

A nodegoat API allows you to expose a complete dataset or a subset of the dataset.[43] The exposed data can be generated based on its default configuration or with a custom configuration. This allows you to configure various 'views' on your data that are able to satisfy the needs of the analyses to be performed, and that is independent of the state of the data itself. These views allow for live preprocessing of data, which includes

[38] Alex Brey, "Temporal Network Analysis with R," Programming Historian 7 (2018), https://doi.org/10.46430/phen0080, Peeples, Matthew A. and Tom Brughmans (2023). Online Companion to Network Science in Archaeology. https://archnetworks.net, Accessed 2024-01-29.

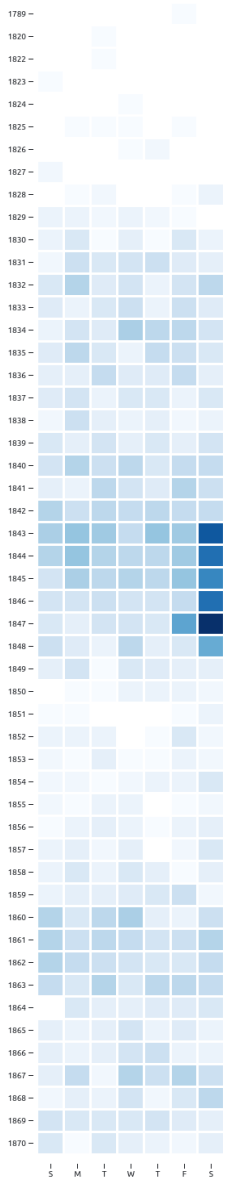
[39] Marten Düring, "From Hermeneutics to Data to Networks: Data Extraction and Network Visualization of Historical Sources," Programming Historian 4 (2015), https://doi.org/10.46430/phen0044.

[40] Pim van Bree, Geert Kessels (2013). nodegoat: a web-based data management, network analysis & visualisation environment, http://nodegoat.net from LAB1100, http://lab1100.com. For an introduction see https://nodegoat.net/guide.s/112/basicprinciples. For more advanced analysis and visualisation functionalities see, for example: Pim van Bree, Geert Kessels, 'New Analytical Features in nodegoat', 13th Workshop on Historical Network Analysis 'Networks Across Time and Space', 27-5-2019, https://nats.hypotheses.org/ and Pim van Bree, Geert Kessels, 'Temporally-aware dynamic network analysis: traversing nodegoat graphs', 19-07-2023, https://graphentechnologien.hypotheses.org/files/2023/05/GrapHNR-2023-30-Kessels-Temporally-Aware.pdf.

[41] See https://nodegoat.net/guide.s/146/export-data-as-a-csv-file and https://nodegoat.net/guide.s/148/export-data-to-gephi.

[42] https://nodegoat.net/documentation.s/98/query.

[43] A Clariana-Rodagut, A Cardillo, Quantifying women marginalisation in Ibero-American film culture during the first half of XX century: a quantitative proposal based on network science, arXiv preprint, https://doi.org/10.48550/arXiv.2307.13137. APIs also allow for the dynamic integration of research data in external applications, see: https://streetlife.amsterdamtimemachine.nl/.



edge generation based on multi-modal graphs and the ability to apply dynamic conditions.[44] Data entry and curation continues while forms of analysis and visualisation are being tested and explored.

By using query parameters, any data selection can be transformed from the calling analysis and visualisation software. Filters and scopes that can be configured within the nodegoat working environment, can also be configured by means of the API. This essentially bridges the gap between the data storage and data analysis tool as the latter is able to communicate with the former. By using the PATCH method of the nodegoat API, results of the analysis can also be sent back to the data store for filtering, weighting, and conditioning purposes.[45]

Programming languages that are well equipped to perform data analysis and data visualisation operations like R, Python, and JavaScript come with built in modules to interactively query web APIs.[46] Development environments like RStudio[47], Jupyter Notebook[48], and Observable[49] provide scholars with entry level examples and rich documentation, see figure 1.[50] A specialised tool like QGIS is a good example of visualisation software that can communicate interactively with an API.[51]

The open-endedness of this approach is also reflected in the tools that can be used for the storage of research data. Any database that offers a web API has the ability to be used in an integrated workflow. Other examples of database software that can be used in this manner include Wikibase[52] and Numishare.[53] If the use of spreadsheet software is unavoidable, the Google Sheets API allows for an integration of the gathered research data into a more dynamic workflow.[54]

A workflow in which research data and exploratory modes of analysis and visualisation are closely integrated brings many advantages to methods associated with historical network research. First of all, it gives scholars the opportunity to think about actionable data in the course of their research project. This contrasts with the unwelcome realisation at the end of a project that a date statement such as 'around 1680' or a location statement formulated as 'Springfield' are computationally unsound.

Figure 1. This visualisation has been generated in an interactive notebook of the data exploration platform Observable and runs on a request to a nodegoat API. The visualisation displays the amount of letters sent by the French writer Prosper Mérimée per year per day of the week and shows that he wrote, dated, or posted his letters mostly on Saturdays, see: https://observablehq.com/@lab1100/nodegoat-demo-daily-intensity-of-letters-interactive.

[44] Pim van Bree, Geert Kessels, 'Temporally-aware dynamic network analysis: traversing nodegoat graphs', 19-07-2023, https://graphentechnologien.hypotheses.org/files/2023/05/GrapHNR-2023-30-Kessels-Temporally-Aware.pdf.

[45] https://nodegoat.net/documentation.s/103/store#patch.

[46] For R see e.g. https://httr2.r-lib.org/, for Python see e.g. https://pypi.org/project/requests/, for JavaScript see e.g. https://developer.mozilla.org/en-US/docs/Web/API/Fetch_API.

[47] https://posit.co/download/rstudio-desktop/.

[48] https://jupyter.org/.

[49] https://observablehq.com/.

[50] For R see e.g. https://www.tidyverse.org/blog/2023/11/httr2-1-0-0/, for Python see e.g. https://medium.com/swlh/using-and-calling-an-api-with-python-494a18cb1f44, for JavaScript see e.g. https://nodegoat.net/guide.s/150/export-data-to-observable.

[51] https://nodegoat.net/guide.s/149/export-data-to-qgis.

[52] https://www.mediawiki.org/wiki/Wikibase/Installation

[53] https://github.com/ewg118/numishare

[54] https://developers.google.com/sheets/api/guides/concepts

Next, a more dynamic workflow allows for the testing of hypotheses or case studies early on, without the need to invest time in data export and data cleaning processes. Integrated workflows can also signify new questions that result from exploratory data visualisations during the course of a research project. Unexpected 'gaps' or clusters can be identified quickly and can offer new directions of research as the project progresses. Unsound data models, incorrectly configured attributes, and missing relationships come to light at a much earlier stage in an integrated workflow. These advantages improve multiple aspects of any historical network research project, and allow for a general application of source criticism and digital hermeneutics.[55]

This paper steers away from a workflow that rigidly separates data from exploratory modes of analysis and visualisation. Many questions, pitfalls, failures, and perhaps even insights can be discovered if workflows are implemented with a closer integration between data collection and data analysis practices.

[55] Fickers, Andreas, Juliane Tatarinov, and Tim van der Heijden. "Digital history and hermeneutics–between theory and practice: An introduction." Digital History and Hermeneutics Between Theory and Practice. Berlin, Boston: De Gruyter (2022): 1-22, p. 8.

Complex networks allow a quantitative analysis of historical networks by data mining the Wikipedia corpus

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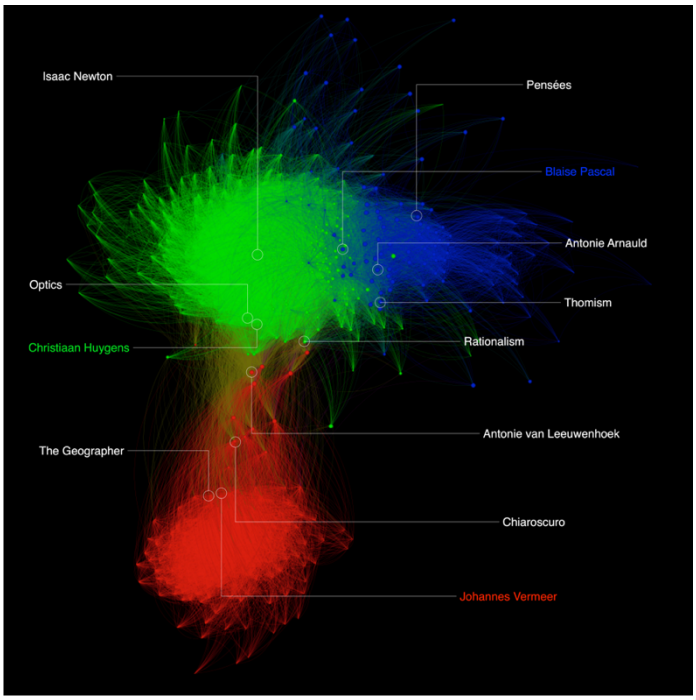
The development of revolutionary ideas, cultural breakthroughs, or paradigm shifts typically emerges from complex interactions among many people, concepts, and objects that structure social, historical, and cultural spaces. These interactions are difficult to quantify, and the increasing number of cultural elements to be considered would eventually make it hard, if not impossible, to fully understand the cultural dynamics using traditional tools. To overcome these limitations, several quantitative methodologies have been proposed recently (Schich et al., 2014; Goldfarb et al., 2015; Brown et al., 2017), some of them using Wikipedia as a suitable source for data mining and quantitative cultural research. Based on the formalism of complex networks theory, it has been recently shown that it is possible to convert the network of internal links on Wikipedia into a meaningful network of knowledge (Schwartz, 2021). Using this methodology, it has been possible to quantitatively analyse the cultural network that relates Pablo Picasso, Albert Einstein and James Joyce. This approach has been shown to successfully address a multiscale analysis that allows characterising individual nodes (degree and betweenness centrality, participation coefficient), clusters (size, density, openness) and the whole network (modularity, assortativity matrix). The same approach has also been applied to study the interactions among Michelangelo, Copernicus, and Pico della Mirandola in the Italian Renaissance (Miccio et al., 2022).



It is worth noticing that in these cases, we were studying the corresponding historical networks as representedon Wikipedia. Although this could represent a partial and biased view of history, the agreement between the results obtained using this methodology and the well-established historical knowledge makes this approach suitable for this kind of study. For the purpose of this research, the important point is how

people, ideas, and objects are related among them. Thus, the content of the Wikipedia articles is not relevant for the present study; only the links to other articles are significant. Moreover, the metrics we use to determine the relatedness between two articles are based on many links (hundreds or even thousands in some cases), making this method robust against noise and biases. We have shown in previous studies that the simple observation of what is connected to what, properly treated, can unveil relevant knowledge about the structure of cultural networks.

The success of this methodology applied to specific events (Schwartz, 2021; Miccio et al., 2022) encourages us to move from particular cases to characterising an entire historical period. Thus, the present work aims to quantitatively analyse a given historical period's cultural network (as represented on Wikipedia). In particular, we will focus on the interdisciplinary cultural network that connects art, science, and philosophy in the seventeenth century. This period is somehow in between the historical ages analysed in our previous works, allowing a direct comparison to prior results. Instead of focusing on specific cases (i.e., Johannes Vermeer, Christiaan Huygens and Blaise Pascal – see Figure), we propose a statistical approach by taking many triads to determine the average properties of the period. In this way, we can understand the flow of knowledge among different disciplines and quantify the individual behaviour of nodes and the collective characteristics of clusters and networks.

To achieve this challenge, we used the normalised Google distance to measure the structural relatedness between each pair of Wikipedia entries. Based on these metrics, we generated 465 undirected networks representing cultural maps of the Wikipedia articles related to the studied historical period. Averaging this set of networks allows us to perform a multiscale analysis to understand the global, cluster and individual behaviours. Thus, we found that the average normalised modularity is 0.862, higher than the value we obtained for the Italian Renaissance (0.77) and lower than that we observed at the beginning of the 20th century (0.88). This progressive increment of modularity agrees with the well-known rise of the disciplinary specialisation in the last centuries. The detailed analysis of the inter-cluster interactions reveals a power law distribution of the links, whereas a lognormal distribution is observed for the intra-cluster connections. At the level of individual nodes, the participation coefficient allows us to determine the most relevant agents for the studied period and to understand how the knowledge is shared among different disciplines. This approach allows a qualitative as well as a quantitative analysis of cultural networks, making appropriate use of visualization tools and mathematical calculations.

Thus, by combining ideas borrowed from knowledge discovery in databases and complex networks theory, the approach proposed here reveals the emergence of collective dynamics and finds subtle connections between elements (people, ideas, or works) present on Wikipedia. It is important to emphasize here that this approach is not limited to the use of the Wikipedia corpus. The use of artificial intelligence allows extending the results presented here to any database, provided it contains enough information. Hence, this approach provides new insights into the structure of cultural networks, reveals unknown characteristics of the different disciplines, and boosts quantitative studies in history and cultural dynamics.

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Containing complexity: Networks of expertise and the emergence of genetic epidemiology, 1900-1990

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In the years since the Human Genome Project's completion, it has become increasingly uncontroversial to describe the project as having inflated expectations. With genetic knowledge neither as comprehensible nor as utilisable as the genomic decade suggested, making sense of the human genome is now a computational endeavour reliant on bioinformatics (Salter and Salter 2017) and, increasingly, machine learning (Nicholls et al 2020). These techniques are hoped to unlock genomic variation and make real headway in complex causality, and have spurred new forecasting that by 2030, "the biological function(s) of every human gene will be known" and "the clinical relevance of all encountered genomic variants will be readily predictable" (Green et al 2020: 690).

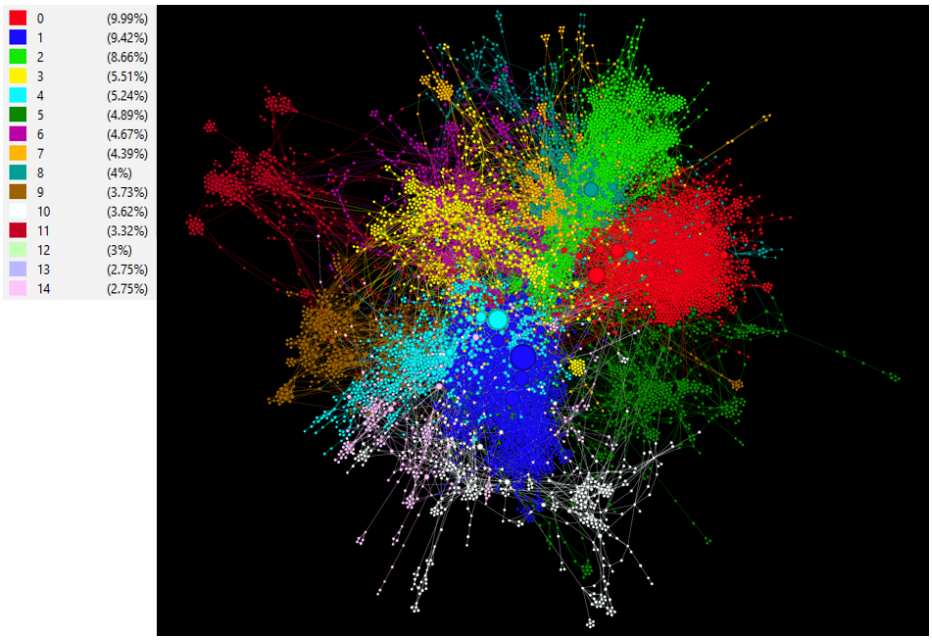

Figure 1. Citation network of literature relevant to the development of genetic epidemiology, showing only 13 largest clusters (n=7,309; m=17,064). Nodes positioned via ForceAtlas2. Node size proportional to indegree. Node colour depicts cluster membership of the 13 largest clusters.

This paper takes the contemporary problem of complexity in human genomic research backwards in time, by examining how earlier encounters with complex causality were contained within a particular subfield: genetic epidemiology. Genetic epidemiology is both a fairly young and a fairly unknown subfield in human genetics research, with a single flagship journal, Genetic Epidemiology, launched in 1984. However, some of the most influential publications in 20th and 21st century genetics are intimately connected with genetic epidemiology and its genesis, including the proposal for genome-wide association studies (Risch and Merikangas 1996) that ushered in the ongoing era of large-scale, population-based genomic analyses. In this analysis, we seek to uncover the unseen influence of genetic epidemiology by tracing how the subfield

developed over the course of the 20th century. More particularly, we suggest that subspecialties within the emergent discipline helped to "contain" problems involving complex causality in distinct networks of expertise, resulting in a weakly-connected interdisciplinary network that would later be threatened by replication crises during the initial years of the Human Genome Project (Risch 1990; Arribas-Ayllon et al 2010). However, we also suggest that stronger connections between statisticians and biometricians within this network helped support both the constitution of genetic epidemiology as a distinct subfield and the later translation of statistical genetic techniques into population-level analyses, as with the development of genome-wide association studies.

Using bibliometric and citation network analysis (Leng and Leng 2021), we recreate a publication history of genetic epidemiology, from the early 20th century up to the beginning of the replication crisis in the 1990s. Citation network analysis refers to the application of graph theory and network science to bibliographic data. Citation networks consist of nodes that represent individual papers, with directed edges between nodes representing citations from a citing to a cited paper. Such networks allow for the analysis and visualisation of the structure of the scientific literature into specific topics, fields, and disciplines. This structure is self-organising; papers on the same or similar topics cluster together into densely interacting literatures due to the tendency of authors to cite other papers directly relevant to their own (Price, 1965). To understand how a literature clusters into distinct topics of areas, modularity maximisation (Newman & Girvan, 2004) via the Leiden Algorithm is a common and well validated approach (Klavans & Boyack 2017; Traag et al., 2019). By these methods, citation networks have been used to produce 'maps' of literatures in a number of different areas. Recent examples include sustainability sciences (Kajikawa et al. 2014), oxytocin research (Leng & Leng, 2021; Leng et al. 2022), as well as emerging topics in energy storage (Mejia & Kajikawa, 2020) and immunology (Fujii et al. 2022). Beyond its use in literature discovery and survey, it is used to test for citation bias and error propagation in evidence-bases informing the evaluation of specific hypotheses (Greenberg, 2009; Leng 2018).

Our citation network consists of 10,412 articles (nodes) and 23,514 citations (edges), drawn from two searches of Web of Science indexing. The first search consisted of 97 terms and targeted epidemiological journals, returning a total of 2,889 documents. The second search consisted of 107 terms (including many shared) and targeted genetics journals, returning a total of 3,227 documents. From this total literature of 5,860 documents, we retrieved all associated metadata from Web of Science in March 2024, and restructured these data in the R statistical environment into: 1) a 'Node-attribute list' that contains (i) a unique ID for each unique reference string; (ii) WoS unique identifier number; (iii) DOI (if available); (iv) name of all authors; (v) title of paper; (vi) journal of publication; (vii) year of publication; (viii) total number of citations recorded by WoS); and (ix) total number of references recorded by WoS and 2) an 'Edge-list' built from the bibliographies of retrieved papers that contains two columns – Source and Target. Source contains the unique ID of the citing paper, while Target contains the unique ID of the cited paper.

In addition to our retrieved dataset of 5,860 nodes, we also include non-retrieved papers by constructing nodes from unique reference strings detected in the bibliographies of the retrieved papers. This expands our dataset to 92,327 nodes (5,860 retrieved and 86,467 unretrieved) connected by 140,947 citation links. We then refine this set first by restricting the network to the largest connected component of 88,454 nodes (~95.8% of set) and 137,678 edges (~97.7%), discarding 3,873 papers that neither cite nor are cited directly by the other retrieved papers in the largest interconnected component, and nor share common references to non-retrieved documents. We further refined the network to include only documents published before 1990, resulting in a dataset of 13,559 documents and 23,597 citation links. Again, we restrict to the largest main component formed, excluding unconnected documents from this structure – the network has 10,412 nodes and 23,514 edges, of which 2,280 are retrieved documents.

We clustered the network via modularity maximisation with the Leiden algorithm, resulting in 41 clusters at Q=0.786. For now, we focus on the 13 largest in terms of number of retrieved papers (see attached Figure 1) and categorize them by topic (see attached Table 1), which we discerned by reading a sample of the literature in each. For our preliminary analysis, we examine citation trends within the overall network relative to specific time intervals, exploring how papers accumulate citations over time and which clusters within the network are receiving most citations at given time periods. We calculate citation metrics using both cumulative counts and period-specific counts to understand citation trends per paper, using five-year time intervals: 1918-1930 (combined due to small number of total citations during this period), 1931-35; 1936-

1940; 1941-1945; 1946-1950; 1951-55; 1956-1960; 1961-1965; 1966-1970; 1971-1975; 1976-1980; 1981-85; 1986-1990.

Focusing on period-specific counts, we track several trends in citations that correspond to the emergent network of genetic epidemiology. Although prior to 1960 most papers in the dataset had very few, if any, citations, in the period 1965-1970 work in statistical genetics began to receive more attention, with the top-cited paper for this period, "Sequential tests for the detection of linkage" (Morton, N.E., American Journal of Human Genetics 1955), growing from 3 cumulative citations in the preceding period (1960-1965) to 14. More generally, of the 30 most-cited papers within this period, 13 fell within three clusters strongly associated with statistical genetic techniques (Cluster 0 and Cluster 4) and population-level analysis of genetic conditions (Cluster 8), and 7 within two clusters associated with genetic studies of chronic and complex diseases (Cluster 2 and Cluster 3). This trend continues in the next time period, 1971-1975, with 19 of the top-cited papers falling within Clusters 0, 4, and 8, and the top-cited paper for the period, "The inheritance to liability of certain diseases" (Falconer, D.S., Annals of Human Genetics 1965) showing a growth in cumulative citations from 7 in the period 1965-1970 to 18 in 1971-1975.

Our ongoing analysis continues this time period assessment through to 1990, and will involve more in-depth review of highly-cited literature and of the limitations of citation analysis. We plan to refine our network further by revising our search terms to include several terms missed in the initial searches, to capture the largest possible universe of relevant literature. Finally, we intend to examine how the largest interconnected component of the network changes over time, to assess how new developments in statistical genetic methods are referenced by empirical analyses in other disciplines.

Cluster	Total count	Retrieved count	Topic
1	981	219	Genetic linkage mapping
0	1040	204	Estimation of genetic and nongenetic factors in quantitative trait variation
2	902	177	Genetic aspects of various psychiatric disorders
4	546	153	Genetic linkage analysis
3	574	126	Genetic approaches to diabetes mellitus
8	417	120	Incidence and associations of suspected inherited or genetic disorders, particularly congenital
9	388	113	Polymorphism discoveries, largely in blood factors
5	509	109	Experimental genetics of quantitative traits (non-human)
6	486	96	Genetic aspects of cancer (particularly breast, colon and melanoma)
11	346	96	Experimental genetics of susceptibility and resistance to infectious disease (non-human)
10	377	88	Genetic linkage analysis and biostatistics (nonhuman)
14	286	80	Molecular genetics and molecular genetic linkage
7	457	76	"Formal" genetic epidemiology

Table 1. 13 Largest clusters based on retrieved count, with topic categories.

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Finance, business and Cultural Cold War: exploring transatlantic associationism's networks in post-war Italy

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In figure 1, we observe a bimodal network connecting some transatlantic and US cultural associations with the individuals who had formally joined them or who have participated to their activities as guests. The reference time span covers over a decade, from 1945 to 1956. This visualization is extracted from my doctoral thesis and serves as the starting point for my current post-doctoral research.

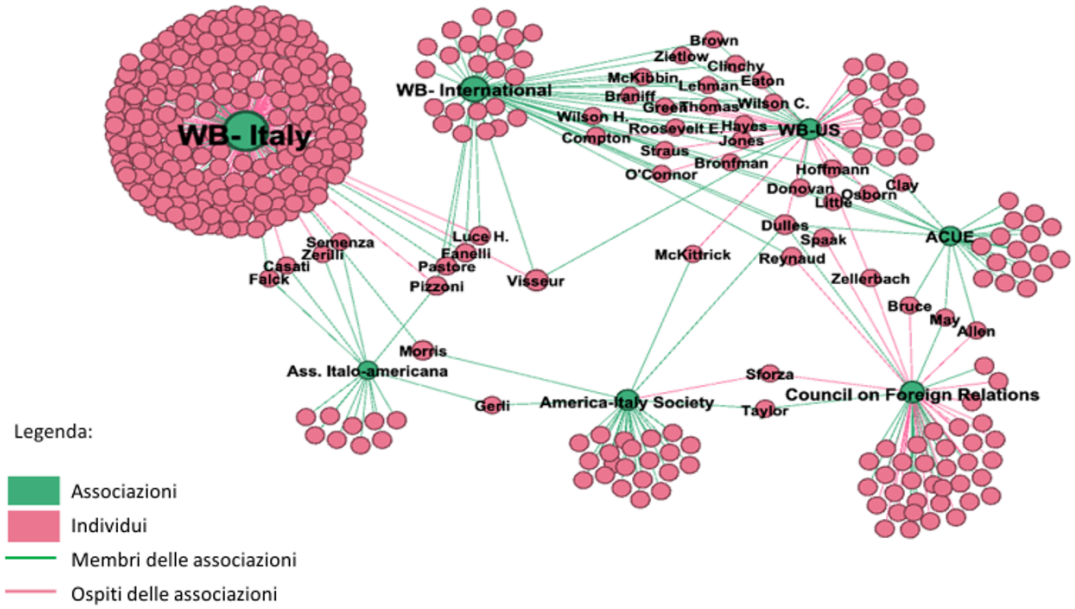

Figure 1. The graph shows a bimodal network. Green nodes correspond to associations, pink nodes correspond to individuals. Green arcs show a relation of membership between individuals and organizations, pink arcs show a relation of less formal participation to the associations' activities.

The dissertation was aimed to reconstruct the evolution of the relationship between the CIA Director Allen Dulles and the Italian Alfredo Pizzoni, President of the Credito Italiano Bank, since their collaboration during World War II when Dulles was still an agent of the CIA's predecessor, the OSS. (Piffer, 2005). The research conducted demonstrated that one area where Pizzoni and Dulles' relationship evolved was transatlantic associationism.

I therefore reconstructed such social context of transatlantic associationism that Pizzoni and Dulles shared, using associations' rosters. Thanks to the network visualization here shared, I could realize that even only focusing on a selected number of private cultural institutes and associations, plenty of intersections among people who gravitated around them emerge. Key figures who were particularly active in such environment are immediately highlighted by the graph's algorithm, opening the way to an undetected research path.

Such path is the one taken in my post-doctoral research, where I am exploring the connections between transatlantic associations and private cultural institutes active in Italy in the 1950s. My particular focus is on

the involvement of prominent figures in the Italian finance and business world within the realm of transatlantic associationism. Drawing from personal papers, such as those of Pizzoni, it becomes possible to reconstruct networks of associations like the World Brotherhood (WB in the graph), in the absence of a dedicated archive. Other key figures in this project include Arnoldo Mondadori, a significant publisher actively involved in building transatlantic ties, particularly with U.S. publisher Henri Luce, husband of the then-U.S. Ambassador to Italy, Clare Booth Luce, and Adriano Olivetti, founder of the eponymous company—one of the most significant in Italy at the time. (Decleva, 2021). Network analysis serves as a crucial methodology to reconstruct their involvement in associationism and identify ties within this panorama.

In connection with the conference's central theme, I will delve into how visualizations will be essential tools in my research to concretize considerations that would otherwise remain abstract and vague. (Grandjean, 2017; Kerschbaumer, Stark, Düring, 2020).

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Geospatial Network of Internees in Switzerland during the Second World War - A Proof of Concept

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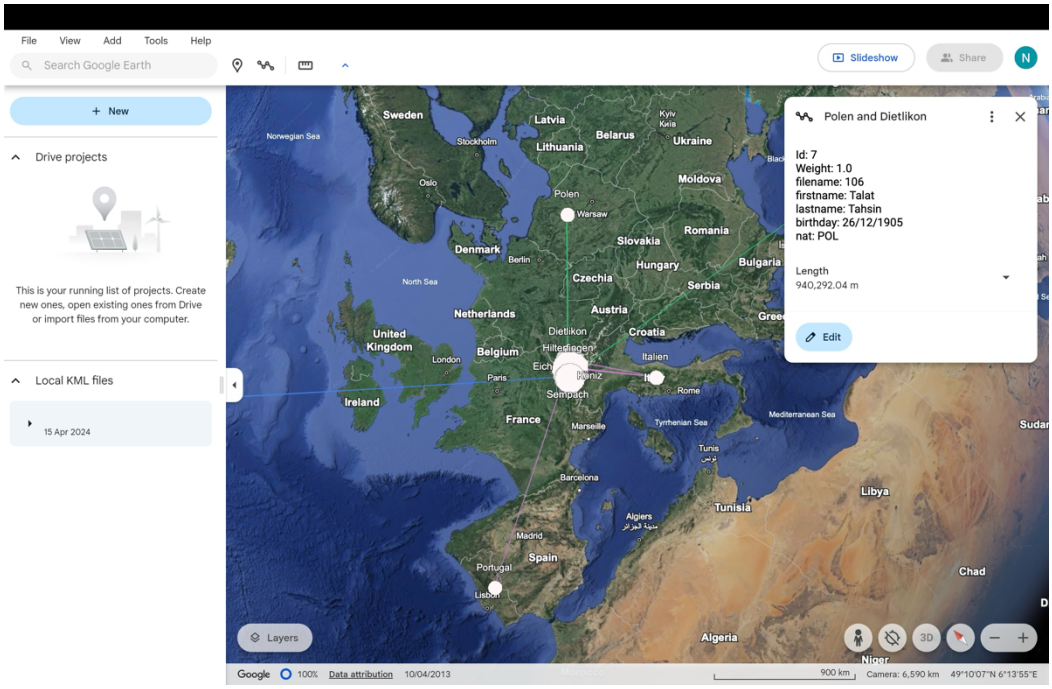
Advancing digitisation is heralding a transformative shift in the role of archives. Beyond the task of preserving physical documents, archives increasingly deal with born-digital documents or digital representations of the documents, presenting new opportunities to enhance the accessibility of their collections. Furthermore, there is the prospect of reimagining accessibility and tailoring methods to specific digitised collections. (Sahle 2007) As Kramer (2014) puts it, the boundary between a digital archive and the product of historical research and interpretation becomes permeable.

This paper explores historical network research as a potential tool for digital archiving from three vantage points. First, the method includes the extraction and enrichment of data from digital artifacts by linking or georeferencing and thus contributes to the metadata available for a collection through or in addition to the archival database. Second, resulting visualisations can serve as a user interface, which is more intuitive than the hierarchical archive catalogue and allows for additional metadata filters. Lastly, subsequent network metrics can offer historical insight, inspiring new avenues of research into collections.



It does so by presenting a proof of concept that is being developed by the Swiss Federal Archives (SFA) for a collection of index cards by the Eidgenössische Kommissariat für Internierung und Hospitalisierung (EKIH), each identifying one internee in Switzerland during the Second World War and containing more than 100'000 cards. These cards are phonetically ordered by surname in the archive's repository but also contain information on each soldier's place of origin and a list of each internment location. The recent digitisation of the letters K and L has paved the way for enhancing archival description through the creation of a pipeline that combines Google Vision API and Chatgpt4 for data extraction and classification. This

enhanced archival description improves accessibility for researchers seeking specific individuals. However, the resulting dataset also holds a historical macro perspective, which can be actualised by enriching the obtained data through georeferencing, visualising it as a GIS network of camps through which internees were transported and analysing calculated network metrics.

The dataset detailing the exact geospatial movements of people subjected to state-planned forced migration occurring both across and within Swiss borders is a compelling source for historical network analysis which had traditionally focused on international and voluntary migration as well as aggregated geospatial data. (Pitoski, Lampoltshammer und Parycek 2021, 2-3) Visualising these movements as a network might provide insight into how the Swiss state treated groups of internees of different nationalities and the opportunities for contact separate groups might have had with each other during their internment.

This paper discusses the main challenges that were posed by georeferencing historical placenames and placenames that have been misinterpreted by handwritten text recognition through the assistance of gazetteers and specialised machine learning algorithms and considers the benefit of using large language models for quantitative data extraction over more traditional methods such as layout analysis. The discussion also addresses the importance of presenting uncertainties in visualisations and how to make them explicit and comprehensible to users. (Dunn 2012)

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Gouverner à distance : analyse d'un réseau d'espionnage contre-révolutionnaire dans l'Europe de la Révolution et de l'Empire napoléonien

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L'analyse réticulaire est un outil majeur pour comprendre l'articulation de l'action individuelle avec une dynamique sociale ainsi que les modes de gouvernance à distance en situation d'exil auxquels nous nous intéresserons dans cette communication. Cette perspective invite à considérer les réseaux sous l'angle de leur intentionnalité et de leur situation dans un champ de forces, ce qui en fait des « dispositifs de communication » (Beaurepaire, Hermant, 2014).

Nous appliquerons cette notion au réseau de Fauche-Borel, libraire à Neuchâtel et espion dans l'Europe révolutionnaire et napoléonienne. D'abord approché par le comte de Provence, prétendant au trône de France en exil, l'agent passe ensuite au service de la couronne d'Angleterre. Un réseau aux ramifications internationales qui s'étend à l'échelle européenne jusqu'en Russie et en Suède, avec des extensions aux Etats-Unis, se développe en fonction des objectifs de ses promoteurs : dans un premier temps tenter de faire basculer le général républicain Pichegru dans la contre-révolution pour ouvrir les portes de la France aux armées coalisées établies outre-Rhin ; dans un second temps enrichir le réseau de renseignement britannique.

Les correspondances actives et passives que Fauche-Borel a laissées ont été exploitées à partir d'un modèle destiné à structurer les données qui ont été extraites des lettres puis à les visualiser. Le corpus est forcément incomplet puisqu'il dépend d'une part des aléas de la circulation de la poste dans ces temps de guerre (les missives peuvent être perdues ou interceptées), et d'autre part de la volonté du scripteur principal de conserver ou non ses brouillons et les lettres reçues. Etant donné que le contenu des échanges (le renseignement) est sensible, certaines lettres auraient pu être détruites par Fauche-Borel par mesure de sécurité, mais rien ne l'indique. Le réseau épistolaire, par nature, ne relie que les individus à distance et ne tient donc pas compte des rencontres physiques. Certaines de ces rencontres sont parfois évoquées dans la

correspondance, ce qui contrebalance très partiellement ce biais (mais en donnant des éléments informatifs qui ne peuvent pas être pris en compte dans la reconstitution des réseaux épistolaires puisqu'ils ne sont pas de même nature). Toujours est-il que la restitution du réseau à laquelle on aboutit n'est pas exhaustive et qu'elle est fortement égocentrée du fait des modalités de sa constitution. L'auteur lui-même, qui décide de l'archivage de ses lettres, est partie prenante dans ce processus.

Nous envisageons de travailler avec trois types de visualisation. La première sous forme de graphe utilise Vistorian qui permet de mettre en évidence la nature du lien qui unit les correspondants (lien intime, renseignement, demande de service) et son évolution dans le temps ; pour la seconde, qui prend en compte les données de géolocalisation, Kepler ou Palladio paraissent plus adaptés. Ces visualisations donnent à voir le réseau de Fauche-Borel dans sa dimension spatiale et temporelle. On comprend ainsi comment les lettres et les hommes circulent : d'abord via la Suisse entre le Saint-Empire et la France, puis par Hambourg pour relier la Suisse et la Grande-Bretagne, avec à chaque fois des ramifications secondaires. Ces circulations dépendent essentiellement de la situation géopolitique. On voit aussi deux phases de déploiement du réseau se succéder, ce qui n'est pas visible à la lecture des lettres. Dans un premier temps, le réseau, lié à l'affaire Pichegru, est ancré dans la zone rhénane : il relie indirectement le comte de Provence (en Rhénanie), frère de Louis XVI décédé, au général républicain (en France) en passant par Fauche-Borel (en Suisse). Dans un second temps, après l'échec du premier complot qui a été révélé au grand jour, le réseau se déploie brusquement et s'entend outre-Manche. En reprenant une bonne partie des liens initiaux, il connaît une extension beaucoup plus large en Europe. Fauche-Borel est désormais au service de la Grande-Bretagne. L'usage du curseur temporel permet de repérer les moments exacts où le réseau prend de l'ampleur et les acteurs qui, servant d'intermédiaires entre deux espaces hétérogènes, les mettent en contact. On comprend ainsi que ce réseau a répondu à deux intentionnalités successives, quoique liées : la première impliquait Fauche-Borel dans un rôle très précis, puisqu'il devait acheminer des lettres jusqu'à Pichegru et en rapporter des réponses qui étaient transmises à celui qui incarnait la monarchie française en exil, le comte de Provence, mais aussi au prince de Condé qui avait réussi à maintenir une force armée composée d'émigrés français. Le comte de Provence, qui se considérait comme détenteur légitime de l'autorité politique, et qui s'était entouré de « ministres », tentait de gouverner à distance par le biais de complots destinés à déstabiliser la République française. Une fois inclus dans le système beaucoup plus vaste du réseau de renseignement britannique, le réseau de Fauche-Borel prend une ampleur bien plus large et change d'intentionnalité : il travaille désormais aux plans de Londres pour mener des actions combinées dans les colonies, sur les fronts européens et sur le territoire français. Pour cela Fauche-Borel est chargé de transmettre les informations qu'il obtient d'Europe, même après être allé lui-même s'établir en Grande-Bretagne. On observe ainsi les individus circuler à l'échelle européenne, les réseaux s'y déployer, les intermédiaires y connecter des espaces hétérogènes.

L'analyse en réseau permet ainsi d'accéder au continuum social en évitant d'enfermer le réel dans des catégories – politiques en l'espèce – supposées étanches (Gribaudi, 1995). Dans le cas présent, le réseau de Fauche-Borel donne à voir les liens qui relient les royalistes attachés au modèle absolutiste ou aristocratique aux partisans d'une monarchie constitutionnelle, minoritaires parmi les émigrés, mais particulièrement représentés à Londres et en Suisse. Agissant au sein de ces réseaux, les acteurs favorisent la circulation des modèles politiques et les emprunts réciproques. On voit ainsi se dessiner dans leur complexité et leur perméabilité les réseaux de renseignement dans l'Europe de la Révolution française.

Le cas qui sera présenté lors de la conférence s'inscrit dans un projet de recherche en cours. Ce terrain d'expérimentation nous permettra de vérifier nos hypothèses et de tester l'apport des outils de visualisation à la compréhension du réseau.

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High Density = High Citations? Approaches for Tracking Knowledge Evolution

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Introduction

To study the formation and evolution of knowledge systems, a key aspect is the integration of local and global, individual and systemic knowledge processes (Renn 2020). The explanation of how, for example, a scientific field in the twentieth century emerged — often incorporating thousands of scientists — is a structural endeavour but must be relatable to individual or local micro-histories if one argues for their systemic dependency. We here discuss an approach to tackle this challenge empirically using specific methods developed within the framework of socio-epistemic networks (SEN) (Kaye et al. 2024). The framework is built on the assumption that knowledge is codified through the formation of cognitive, material, and social structures, representable via multi-layered, time-evolving networks (Renn et al. 2016). A SEN therefore comprises three interconnected layers: social, semiotic (or material), and semantic. The methods presented here are primarily focussed on language-based change, i.e. the semantic layer. As an example for the global perspective we use the case of the so-called "Renaissance of General Relativity" (Blum, Lalli and Renn 2020; Will 1989), while taking the works of physicist Hans-Jürgen Treder as an example for the individual perspective. We then look at three different but complementary methods to compare individual trajectories against the development of this global phenomenon to examine the relationship between the development of individual scholars' written works and the evolution of the disciplinary field they work in. In this case, General Relativity and Gravitation (GRG) research. While the results of combining a quantitative view of structural changes with local case studies are necessarily incomplete, we argue that such a quantitative approach can guide the exploration of individual trajectories within the larger picture, making certain aspects of these different individual trajectories comparable to each other.

Data

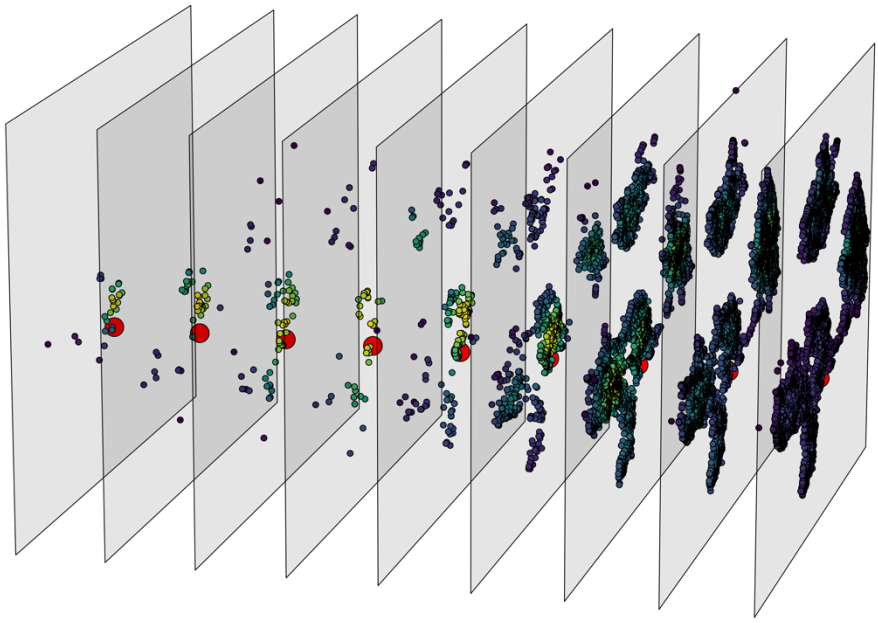
For recent periods in the history of science, the primary input for the SEN framework typically consists of large sets of (semi-)unstructured texts, such as scientific publications, as well as texts of other forms and provenance. The semiotic/material layer is therefore in most cases the initial one before the construction of the other SEN layers, since information about past events is usually provided by archival materials. In the example we discuss here, we focus on publications related to the field of GRG from 1911 to 2000, aligning our selection criteria with those developed by the project "The Renaissance of General Relativity in the Post-World War II Period" at the Max Planck Institute for the History of Science.[56] This alignment allows for the integration of our findings with those of the project. To identify authors who wrote in the period 1925-1970 on topics related to general relativity, (Lalli, Howey and Wintergrün 2020) created a set of articles and actors primarily based on data from the Web of Science, which led to 8296 articles in their GRG publication space. In contrast, we employed the Astrophysics Data System NASA/ADS, which

[56] https://www.mpiwg-berlin.mpg.de/project/renaissance-general-relativity. Most of the project's findings were published in the special issue "The Renaissance of Einstein's Theory of Gravitation" and in Alexander S. Blum, Roberto Lalli and Jürgen Renn, eds., The Renaissance of General Relativity in Context 16 (Cham: Springer International Publishing, 2020).

offered a more comprehensive coverage of GRG, particularly for non-English publications.[57] We extended the strategy to the year 2000, while using comparable search criteria. Our dataset contains around 160000 publications in total, but for our comparative analysis, starting with Treder's first therein listed publication, we are only interested in those from 1957 onwards (157455 publications). In methods 1 and 2, we analyse the textual content of our documents, which in this case consist of titles plus abstracts translated into English, and in method 3, we utilize the citation data provided by the ADS.

Methods

To examine the diachronic development of individuals versus the global development of this corpus and to analyse (language-based) changes on the semantic layer, we employ three different but complementary methods. By doing so, we investigate whether the tendencies of the results are similar across all methods or if they differ, and if so, in what aspects. The aim of this multi-method approach is to increase the robustness of the quantitative analysis, ideally leading to a more rigorous historical analysis.



1 — Density approach

Firstly, we look at local versus global variations in document embedding densities. Similar to BERTopic (Grootendorst 2022), we start by converting our texts into embedding vectors and reduce their dimensions for better visualization and clustering. We then identify clusters and label them using representative documents from each cluster, resulting in a time-dependent visualization where similar publications are grouped closely. To track changes over time, we apply Kernel Density Estimation (KDE) to analyse density changes around each vector. We calculate KDE in two-year increments, starting with the initial publication year of each document, and only include new publications added in each period, excluding earlier ones. This analysis then shows how the density around each vector changes over time, indicating the relative volume of similar content published or the attention given to related topics. This process allows us to track how the neighbourhood around each document evolves, whether the concentration of similar content increases, remains steady, or decreases. Figure 1 depicts a schematized version of this process for one document. This is applied to all documents in the respective corpus, facilitating a global comparison between individual documents and/or regions over time. By doing this, we can follow the trajectories of individual documents

[57] Nevertheless, the dataset exhibits the same issues that are common in most bibliographic datasets derived from online repositories, including incompleteness (e.g., full text, citation data), biases (e.g., language/geographic, collection focus), and inaccuracies in translation, among others.

or groups of documents, focusing on either content (topic combinations) or metadata (documents from specific authors, institutions, geographic locations, etc.).

2 — Information theoretical approach

Secondly, we employ an information-theoretic approach developed in computer linguistics (Bizzoni et al. 2020; Degaetano-Ortlieb and Teich 2018), based on relative entropy for the same selection of documents. We again divide the period under consideration, 1957-2000, into time slices of two years. Each of these slices is divided into a small corpus, created out of the publications of the individual, and a large corpus, representing the rest of the field of GRG, created out of all other publications in that slice. Out of the texts of both corpora, we then generate simple unigram language models. These are represented by independent relative term frequencies, i.e. for each time slice we have two distributions of word probabilities. These distributions can be compared by calculating pointwise and overall Kullback-Leiber Divergence (KLD) between them. KLD measures the extra bits required to encode using a non-optimal model. The more bits needed, the greater the difference between the two distributions. For each time slice we plot the divergence values, noting peaks and troughs in the KLD as indicators of significant deviation, and sort the pointwise KLD, identifying the terms that contribute most to the deviation. This helps to detect semantic change, assess its significance, and identify strongly contributing features, enabling us to generate independent but comparable results to the outputs of the first method. Additionally, we calculate pointwise and overall KLD for each interval compared to all other intervals. This diachronic comparison seeks intervals that deviate least and most from a given interval. For example, if the 1990-91 interval from the Treder sub-corpus is most similar lexically to the 1960-61 interval of the main-corpus, one might argue that Treder published on similar topics or used similar language in 1990-91 as the rest of the GRG field in 1960-61.

3 — Bibliometric approach

The third approach utilizes well-established bibliometric methods to control for the results of the other two language-based methods. Using co-citation networks, we track changing patterns to control for the global vector densities and divergences in language use. For that, we compare co-citation networks of individuals against the "mainstream" co-citation networks of their field. Again, we split our dataset into two-year time slices and follow their changes diachronically, aiming to reveal the extent to which an individual's co-citation pattern, or "Citation Identity" (White 2001), develops in comparison to global co-citation patterns, or the "intellectual base" (Chen 2006) of the field. By defining "mainstream" within the network as the most frequent co-citations across the entire network, we compare the created networks by calculating their Jaccard distance for each time slice.[58] These steps allow us to quantitatively evaluate how closely an individual's citation behaviour mirrors or deviates from that mainstream. The final step is then to examine if and how the perceived trends reflect the behaviour we see for the same individual with the other two approaches.

Case Study

As mentioned above, here we focus on the example of General Relativity and Gravitation (GRG) research. GRG as a field began to form and gain traction only after World War II, following a thirty-year period of stagnation in general relativity research. This revival of interest, termed the "Renaissance of General Relativity" overlaps with Treder's most productive years. We examine this concurrent development from 1957-2000, compare it with other individuals (here Joseph Silk) from the same period, and discuss limitations, problems, and potential other applications. We find that as time progresses, Treder uses language akin to that from the "past". This correlates with a relative decrease of document embedding density around his publications, i.e. a decline in research activity on the topics he addresses, as well as a decline in citations. In contrast, physicists like Joseph Silk and other highly cited authors use "future" language that shapes the use of language in the field of GRG. Concurrently, research activity around the topics they write about

[58] Another avenue we want to pursue are Network Embeddings, since they capture not just the presence of connections but their structural and contextual relevance.

increases (densification in embedding space). We can therefore track and compare individual or local trajectories of change within the global field of GRG.

Conclusion and Outlook

From the individual perspective, the hypothesis we aim to test with this combined approach is simplified: if many people write about what you write about (high density), your vocabulary is close to the vocabulary of the mainstream (low KLD), and your intellectual base is close to that of the mainstream (low Jaccard distance), and vice versa. A last step we plan to implement involves tracking direct citations to monitor the development of the reception of individuals within the global setting, potentially answering whether a correlation exists between high density, mainstream language, mainstream citation identity, and high citation count. The method can be transferred to other fields of research and will also be applied in settings beyond the highly formalised scenarios of scientific publications, such as in knowledge dissemination during migration processes or in the transition of knowledge from science to policy.

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Mapping Anglo-Swiss Travel Writing in the 17th and 18th Century

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As part of the SNSF project SwissBritNet: Swiss-British Cultural Exchange and Knowledge Networks 1600-1780, my PhD project focuses on Anglo-Swiss travel writing in the 17th and 18th centuries. Especially the 17th century has been neglected in Anglo-Swiss research, despite the existence of an intricate network of transcultural exchange and travel at the time (Larminie 2021, 169). The double focus on both British travellers in Switzerland and Swiss travellers in Great Britain will yield insights into reciprocity, points of negotiation and mechanisms of cultural exchange. Since Swiss travellers to Great Britain are under-researched, many of the accounts are manuscripts and neither digitalized nor transcribed. All extant sources, which amount to almost 100 accounts so far, will be catalogued in the SwissBritNet database in collaboration with hallerNet at Bern, and key texts will be made available. Further, the texts will be analysed with the help of software tools such as nodegoat in order to create diachronic geospatial networks and accessible interactive map visualizations as well as social networks. These will track itineraries and offer a point of entry for explorations of transcultural exchange, since maps "can be productive sites of questioning encounter for literary history and criticism" (Eve 2022, 114). Importantly, neither mapping nor travelling are 'neutral' in any way: The journeys, encounters and resulting dynamic networks that are visualized on the maps are to be seen as explorations of national and individual identity, given that "there can be no definition of the Self without an Other" (Youngs 2013, 159). Networks and maps are at their core heuristic tools which simplify data and the world into an abstract representation of what the map maker claims as truth (Crampton 2009, 34). In addition to the itineraries, key aspects of the texts are likewise tracked: what are they describing in their accounts of each location, who do they meet, who do they cite, how do they travel? This allows not only for a more in-depth meta-analysis of what travellers do but also reveals the complexities of social encounters and transcultural networks. In the context of our project, one of the open questions is which role travel literature, seen from a diachronic geospatial network point of view, plays in a multi-facetted discourse of Anglo-Swiss relations. I contend that it is a key genre whose study will enhance our understanding of the formation of identity. In my paper, I will present the use of nodegoat for the purposes of tracking the travel accounts with the examples of Thomas Coryate and Thomas Platter, demonstrating the use of geospatial as well as social networks in revealing transcultural exchange.

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Mapping the networks of the Accademia dei Nobili della Giudecca: a sous-champ of the 18th Venetian Reforming Era

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Introduction

In the 18th century, having progressively fallen under the control of the wealthiest fringe of the local patriciate, the Venetian Senate took all major political decisions in the homonymous Republic (Del Negro 1998, 20). The latter's administration relied on specialised magistracies, the offices of which were staffed by secretaries and numerous other employees - the former often citizens and the latter members of the common people (Rivoal 2022, 424-425). These magistracies were then run by patricians who regularly changed posts, as their cursus honorum consisted of a succession of fairly short-term offices. These magistrates, who had no specific training or in-depth knowledge of the issues of government, had little impact on the running of their bureaus, as they generally contented themselves with overseeing current affairs while awaiting their next post (Galtarossa 2021, 113).

Faced with the challenges of the eighteenth century, such as the evolution of political approaches, the transformation of horizons of expectation and the shift from reform-recovery to reform-improvement (Minard 2009, 8), Venetian leaders adopted two new strategies. They created ad hoc magistracies (Bressan 2006, 344) and introduced a new training programme for impoverished young patricians destined for civil service. This led to the restructuring of the Accademia dei Nobili (AdN) in 1768, 150 years after its foundation (Dooley 2003, 95).

The exercises that were carried out at such institute were aimed to endow young patricians with the official style, refined thinking, and familiarity with administration that were expected from 18th-century Venetian government officials and statesmen. In particular, these documents were used to train students to argue and debate over political and economic matters, such as the fideicommissum, the sale of the commons, and agricultural reform, while accurately mirroring the workings of state magistracies. The importance of such political and economic exercises on a segment of the Venetian political elites of the late 18th century has been recently highlighted by P. Lanaro (2017, 157-158) and J. F. Chauvard (2018, 252-263), especially regarding the legal debates on patrimony and inheritance of the 1770s and 1780s. Indeed, such endeavours have easily built on the momentous interest for the internal workings of educational institutions (Lave & Wenger 1991 [1990], 27-44) and their socio-political impact (Bourdieu, 2003, 23), especially referring to eighteenth-century associationism (Caradonna 2012, 2-4). The AdN represents a prime candidate for this kind of analysis, for, as one 19th-century commentator recognised, it gathered "those young noblemen [...] who would then de facto cooperate in the government of the Republic" (Raines, 1990, 162). Accordingly, this latter relationship between the AdN and the running of the late Venetian state begs for an extensive enquiry.

Documents and Methodology: Reconstructing a *sous-champ* of Venetian Reformism

Now, the concentrated nature of primary sources confers a further advantage of this object of study. The extensive, and primarily handwritten, proceedings of the AdN since its 1768 reorganisation can be found in a comprehensive archival collection of eight volumes at the Biblioteca Nazionale Marciana in Venice. In particular, these comprise 119 *argomenti* (= debates. 8 are missing) and 85 *scritture* (= comments. One *scrittura*

could be used for several arguments), for a total of 660 participations to 111 *argomenti* by 78 pupils. The temporal range of these exercises goes from 12th December 1768 to 16th October 1785 [fig. 1].

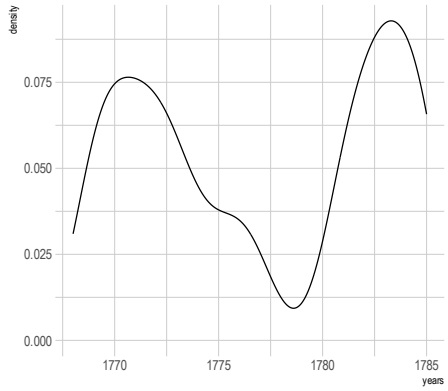

Figure 1. Temporal distribution of *argomenti* (density). Data: 91 obs. for the 119 argomenti, 8 missings and 20 undated.

By modelling the corpus of these argomenti carried out by these Venetian young patricians, it is possible to reconstruct a sous-champ of Venetian reformism. This analysis is based on three layers: M1, M2 and M3 (M for model), each corresponding to a different scale; each scale makes it possible to identify and understand phenomena specific to the objects studied (Morsel 2019, 136-142).

Each argument is a meeting point for individuals taking part in the exercise, in different roles (chairman, consultore, oppositore, savio or supplente), who are given a subject to discuss. Each subject is characterised by different variables. To do this, the descriptive record of the argomento is modelled: this is M1.

Then, for each argument, we have the documents corresponding to the contributions of each of the participants. From these documents, it is possible to access ideas and arguments on particular subjects; it is these documents that were used by Lanaro and Chauvard to understand the students' positions on the question of marriages and fideicommissum. For this dimension of the analysis (M2), we focus on the subset of 'economic' subjects in order to understand the role of the magistracies involved and the ways in which they cooperated. More specifically, we are particularly interested in the question of land ownership.

Finally, it is possible to link the objects identified by the analysis of the corpus of exercises of the Accademia dei Nobili to occurrences of these same objects in different corpora. This makes it possible to link the AdN to other institutions in the Venetian bureaucratic apparatus; to link the path of the pupils from the AdN to their political and administrative journey as members of the Great Council, the core of the aristocratic-oligarchic system of the Venetian Republic (Preto 1998, 91). This is M3.

For these three models, the core operation is the same: data is extracted from text (non-automatic processing for the moment, because of heterogeneous hands). Depending on the type of data, different tools are used, including network analysis, to understand both the ways in which individuals participate and the characteristics of given subjects. This network analysis is also supplemented by factorial analyses in order to compare classification results, but also to explore the texts using a semantic approach. (Moretti 2013, 179-240) This combination and comparison is a key element in the reconstruction of this sous-champ of Venetian reformism (Romele 2020).

The Three Models

Modelling the notices of each *argomento*, the activities of the *Accademia dei Nobili* are reconstructed as a network linking individuals (with different roles), subjects (and therefore interests and concerns - here the *scritture*), references (e.g. Montesquieu (1748), *L'esprit des lois*, one occurrence; Sandi (1772), *Principi di storia civile della Repubblica di Venezia dall'anno del N.S. 1700 sino all'anno 1767*, 36 occurrences), and institutions (responsible for dealing with this or that subject). The identification of magistrates and the classification of subjects is still in progress, which is why they are not further detailed in Figure 2.

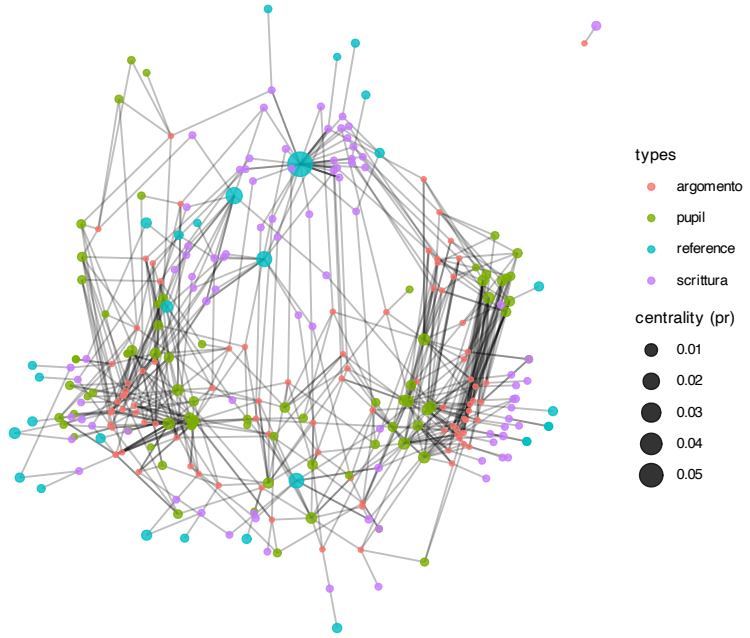

Figure 2. Network of the objects provided by the analysis of the notices. Notes: multidimensional scaling algorithm is used to map nodes' position and page rank centrality to define their size (Pedersen 2024; Csardi 2024).

Schematically, this graph (fig. 2) can be split into two halves, in order to study both interpersonal and thematic networks. For example, concerning the former, individuals do not all collaborate together and their presence is limited in time (fig. 3a and 3b). It is therefore possible to identify three types of participation: one-off, or even individual, participations; intense participations in terms of the relationships they generate, but short in time; and, regular participations over a certain period of time. This is due in particular to the roles played by the individuals during each *argomento*.

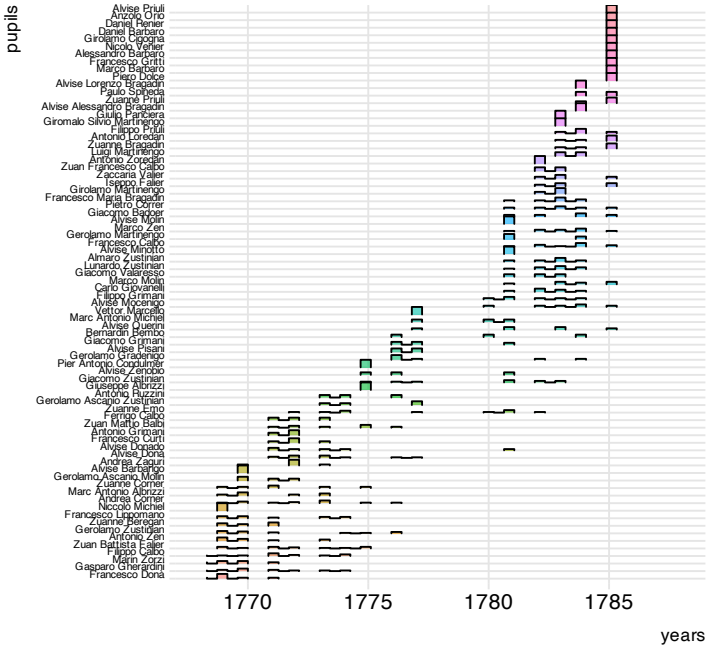

Figure 3a. Temporal distribution of the pupils' participation in exercises. Data: 78 pupils participate in 111 *argomenti*.

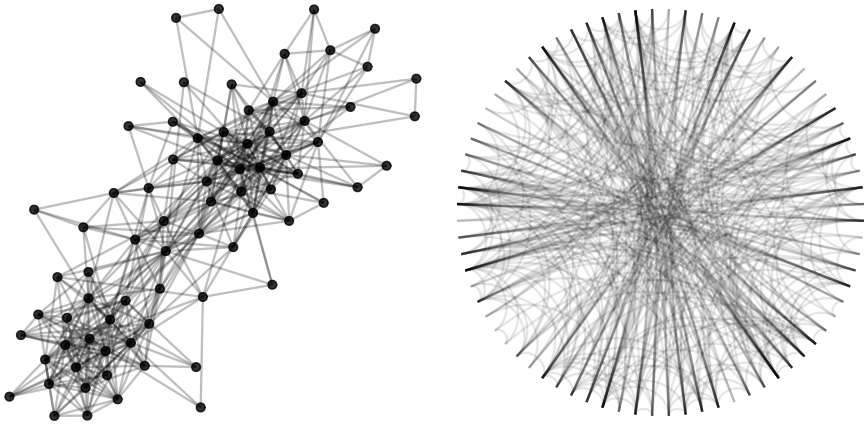

Figure 3b. Network of co-participation. Data: two representations of the relationships between the 78 pupils of the AdN. The first one has been obtained through the graphopt layout algorithm and the second one corresponds to a coord diagram (Pedersen 2024; Csardi 2024).

Then, we put aside the notices and narrow down the corpus to the writings of each *argomento* in detail. Here, it is possible to reduce the scale of analysis to look at what is happening at text level. We choose here to focus on a subset of *argomenti* in order to carry out an in-depth study of the developed arguments regarding economics, and more specifically land ownership (sale of ecclesiastical property, communal property, agricultural reform, etc.).

We have to admit that it would be very interesting to be able to compare this subset to all the texts in order to identify their specificities, but given the time cost of acquiring new data, and in the absence of a fully automated pipeline, this operation has been set aside for the time being.

Nevertheless, this limited analysis allows us to enter into the complexity of the arguments developed by the students. They put forward arguments that do not appear in the official productions of the courts they emulate, such as poverty regulation.

Finally, within the context of the HNR Conference 2024, the last stage of the project is to be understood as a declaration of intent, rather than a completed section of our research. This *ouverture* points to a future connection to be established between the interpersonal and thematic networks (M1), and the knowledge production (M2) proper of the AdN with actual coeval Venetian magistracies. In particular, references to most financial-economic bodies of the late Republic are regularly found in the *argomenti*. These include the *Savi del Consiglio*, the *Magistrati alla Provision del Denaro*, the *Provveditori alle Monete*, the *Savio Cassier*, and the *Deputati all' affrancazion della Zecca*. Yet, it is our intention to focus primarily on the *Deputazione ad Pias Causas* (internal to the *Dieci Savi alle decime*) and the *Deputazione all'agricoltura* (internal to the *Magistrato a' Beni Inculti*). Respectively instituted in 1766 and 1768, these two deputations played indeed crucial roles in the delineation and implementation of reforms concerning land ownership in the later years of the Venetian Republic.

As mentioned, the repeated implementation of network analysis, factorial analysis, and semantic analysis, in order to map the relationship between the AdN and the Venetian magistracies, should enable an assessment of the former's impact on the reformist policies of the latter. In fact, it shall provide answers to a number of interrelated questions on the modes of transfer of people and themes from one institution to another (replenishment? creation of new magistracies? *ad hoc* selection of individual pupils? *en bloc* transfer of pupil cohorts?), and, more generally, on the integration of new actors and ideas into government institutions, which have been traditionally accused of immobilism. This may also amount to both a reconstruction of the *cursus honorum* and the careers of former students of the AdN, and an exploration of changing Venetian governance practices towards specialisation.

Conclusions

Our study aims, indeed, to contribute both to the historiographical revision of a much-maligned polity, such as the 18th-century Venetian Republic; and, more widely, to the thriving scholarship on the transition from

theory to practice and from knowledge to policy within early modern and modern statehood and associationism.

In this respect, the reliance on historical network analysis proves as useful as ever. Through the quantitative modelling of the post-1768 corpus of the Accademia dei Nobili in Venice we are able to establish clear relationships between all chosen items of the analysis. Their mapping and clustering allows for the production of a relational structure and holistic view, which would have been otherwise unattainable through other, more analogue means. In fact, such an approach enables us to take into consideration the diversity of analysable items - people and texts in all their roles and types - inherent in the object of study. And the same holds true for the consequent need for different scales of analysis - texts, themes, interpersonal connections, interinstitutional links, etc.

Thus, provided that the successful translation of ideas into policies never equates to the successful implementation of said policies (Garner 2005, 204) - and even more so in the case of a country destined to disappear just three decades after the first drafting of such ideas - the present study investigates, nonetheless, a potential linchpin between economic thought and governmental practices in the late Venetian Republic. The replicability of its methods and results, however, could reach far beyond its lagoon.

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Networks of Displacement: Spatial and Temporal Dynamics of Post-WWII Migration and Resettlement

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The multi-phase process of spatial uprooting and violence-induced migration[59] caused by the Second World War is structurally characterized on a spatial and administrative level primarily by central locations[60] (hubs of displacement) where violence-induced migration is caused or negotiated. This uprooting posed major administrative challenges for states, NGOs, and, above all, international organizations such as UNRRA (United Nations Relief and Rehabilitation Administration) and later the IRO (International Refugee Organisation). While the majority of DPs (Displaced Persons) could be "repatriated" by the end of 1946, it was not possible for many DPs to simply return to their original place of origin.[61] Their fates were "administered" by the IRO. Depending on demographic characteristics as well as spatial and temporal circumstances, this process varied for different subgroups.[62]

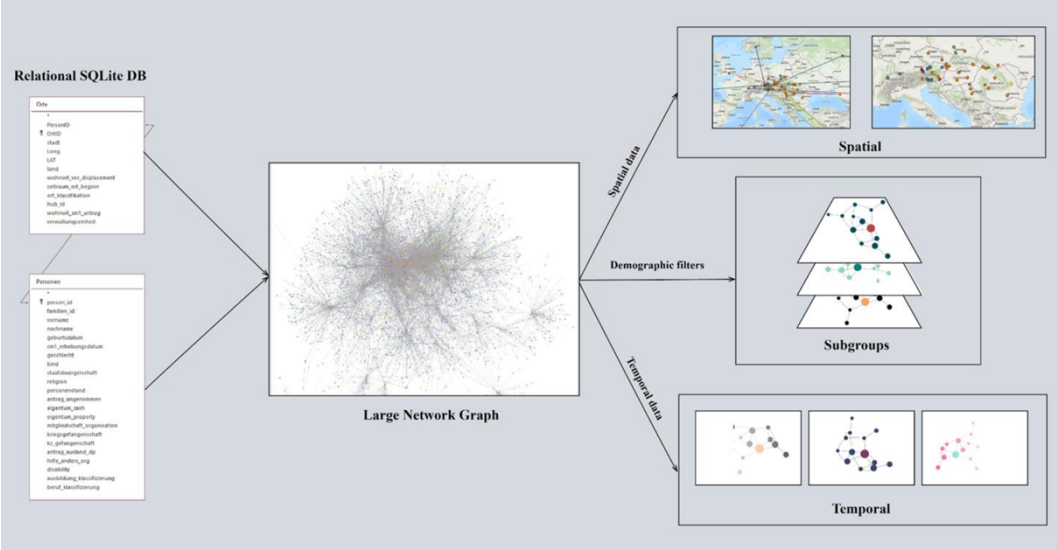

Figure 1. Sketch of the Research Model.

This group was largely dependent on the IRO and other international actors for their spatial mobility and supplies. From a source-technical perspective, this makes it possible to draw on a rich stock of micro- and macro historical documents. The registration files of DPs that have applied to the IRO for "Care and Maintenance" (CM/1 files) form the basis of this. They not only allow DPs to be classified demographically based on the data collected but also their migration history from before displacement to resettlement to be

[59] There are usually different variations of pre-impact, impact and, post-impact phases.

[60] Such as Concentration camps, DP Camps, Forced Labour Camps, Nursing homes, Places of Transit, and Resettlement.

[61] Ruth Balint, 2021: page 2.

[62] Michael Marrus, 1987: page 345.

traced in spatial and temporal detail and linked to central "hubs of displacement".[63] Based on this source material, a sample of DPs who were successfully resettled via Austria to countries all around the globe is transferred to a relational database and modelled as a multilayer network in which the hubs are the nodes and the migration routes of the DPs are the connecting edges. The sample contains about 600 of 3600 sufficiently documented families (Arolsen Archives) who were picked by using a stratified sampling approach, based on available Mass-Data (Birthplaces, Age and Gender). Based on this model, an explorative, analytical approach is pursued with the help of network analysis, geo-information systems, and event modelling to reveal spatial, administrative and temporal patterns of the displacement process in its entirety and for demographic subgroups and, as a result, to make them accessible for subsequent qualitative research. The research model, from data collection to modelling to analysis, is shown schematically in Figure 1. The paper thus presents a multidimensional approach to analysing violence-induced and managed migration in a historical and institutional longitudinal section by using different digital-tools such as IGraph/NetworkX, ArcGIS/QGIS, GeoPandas/Pandas and OpenAtlas in a complementary analytical fashion.

The aim of the paper is therefore to present a methodological approach of combining network and spatial analysis and to discuss its potential for exploratory data analysis. Furthermore, the challenge of visualizing temporally dynamic processes in static network graphs and maps will be discussed.[64]

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[64] Cf. Rainer Schützeichel, 2012.

Radical translators (Britain, France and Italy, 1789–1815) through the lens of a network visualisation

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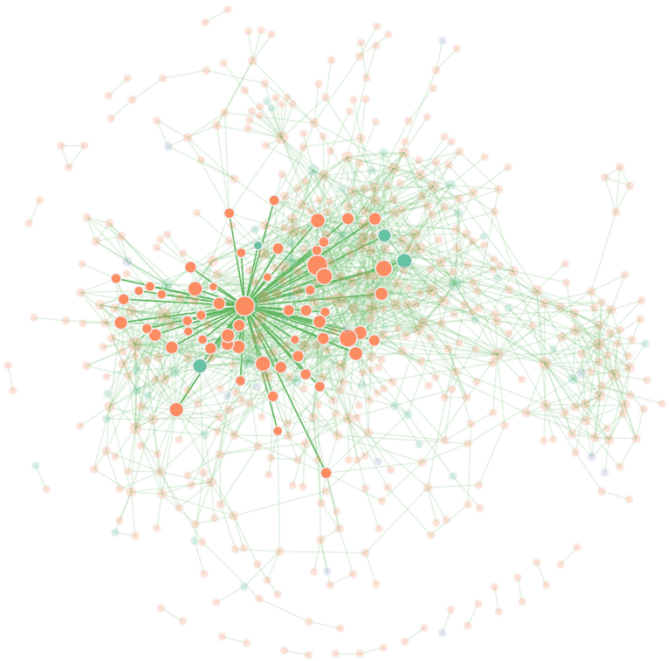
The Radical Translations (RT) - The Transfer of Revolutionary Culture between Britain, France and Italy (1789-1815) - project (Perovic et al. 2019-23), aimed to unravel the complex relationships of radical ideas during the 18th and 19th centuries, employed data models based in BIBFRAME and FOAF (King's Digital Lab 2020). By recording the information of translators - working across English, French and Italian languages - authors, publishers, and organisations involved in radical text translation, the RT project yielded valuable insights. With a quarter of the translators being anonymous, the RT project aims to bring lesser-known figures out of obscurity by mapping their social and intellectual circles.



At the time of writing, the dataset consists of 1505 agents (214 organisations - mainly publishers - and 1291 persons, of which 273 are anonymous), 237 events, and 1691 bibliographical resources (of which 947 are translations, 610 are source texts and 255 paratext records). The data model (King's Digital Lab 2020; Ciula et al. 2021) makes extensive use of values from standard vocabularies as mentioned above and controlled terms (e.g., FAST, Wikidata, VIAF, GeoNames, EDTF) for general data classification, for subjects and topics, for person names, for place names, and for dates. Project-specific classification schemes were also adopted drawing on terminology from the literature (e.g. with respect to the status of each translation as integral, partial, abridged, etc. and with respect to forms of paratext: titlepages, dedications, epigraphs, prefaces, addenda, notes, etc.). This granularity was introduced during the data collection process to grasp the variety of "18th-century translation practices", inclusive of "published translations (whole or partial), retranslations, indirect translations, texts presented as translations, and self-translations [... but also] also [...] projected, but unrealised or unpublished translations, announced, for instance, in short-lived periodicals or publisher's prospectuses" (Mucignat and Perovic 2023).

Similarly, to capture aspects of social, professional and political identity of activists, biographical information about translators include their contributing roles e.g. as translators, authors, publishers or journalists, as well as static attributes (dates, places of birth) and acquired or life-attributes (languages spoken, date of death, main place of residence and other important places of residences, the organisations to which they belonged, and the people they knew) (Mucignat and Perovic 2023).

This submission highlights the implementation of graph network methodologies, specifically focusing on the agents' (people, organisations) networks visualisations. Using biographical and bibliographical data, the visualisation implemented on the Observable platform[65] represents people (authors, translators, publishers) and organisations within the translation network. The graph edges signify relationships such as being based in a place, editorial connections, interpersonal relationships (knows), organisational memberships (member of), publication relationships (published), publication in a specific place, and translation relationships (translated).

The network geometry inherently abstracts complex personal trajectories into nodes and edges, offering a comprehensive yet simplified perspective. Although the visualisations are inherently incomplete and subject to change with ongoing data updates, they have proven indispensable in the iterative research process (Mucignat and Perovic 2023). The networks serve both descriptive and argumentative purposes, guiding the research by highlighting potential gaps, omissions, and biases in the data. For example, recording and examining the contextual information about cultural and political organisations (e.g. "networks of sociability" such as radical circles, printers, publishers, newspapers) to which translators belonged as well as the recurring places as "contact zones"(from key cities such as Milan, Paris and London to border areas, such as Oneglia and the Liguria region, and provincial towns, such as Newcastle and Norwich) has informed an alternative strategy to de-anonymisation tout-court. It deals with a process of drawing the contours around social, professional and political identities by bringing to the fore complementary "circumstantial evidence". Despite the limitations of the selection of agents in the data source and the "blunt instrument" of the 'knows' property in the FOAF model, the network also makes emerge the connections of "political solidarity" enabled by translation "across linguistic and national borders, even in times of war or political repression" (Mucignat and Perovic 2023). Finally, given the data collection on biographies was very limited in terms of time-indicators, the exploration of the networks complemented this gap offering visual traces to test hypothesis around people's movements and life stories.

By integrating graph networks into the research framework, this submission highlights the expanded dimensions of inquiry within the RT project. The visualisations enable an exploration of translators' networks, revealing collaboration patterns, influence dynamics, and the contextual landscape of radical activities during the period under study. This contribution aims to present the network visualisation design and build methods (Smithies and Ciula 2020; Ciula et al. 2023) as well as its role as a powerful tool for hypothesis verification offering insights into the intricate connections shaping history.

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Religious Networks in Late Babylonian Period (RelNet)

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The aim of RelNet, a newly launched project (*), is to generate knowledge about religious networks in Babylonia during the first millennium BCE using cuneiform documents as a basis. Texts of different kinds from both institutional and private archives and libraries contain a wealth of information on religiously motivated movements and on their participants, venues and itineraries. These sacred journeys created multiple ties between sanctuaries, cities... (nods & hubs) and divine and human participants, which link the hubs and nodes. In RelNet, religious networks entail connections between sanctuaries, gods, cultic equipment, temple personnel and participants in the ceremonies. These ties can operate in multiple scales, either in the same temple (movements in the course of a specific temple ceremony), in the same city (processions from one temple to another taking place in open spaces), or on a larger scale, between different cities within Babylonia (e.g. visiting deities and the personnel from their temples spending time in the city of Babylon on the occasion of important annual ceremonies such as the New Year Festival, etc.). Bearing in mind that not all religious ceremonies and movements had the same political/religious significance, each text considered will be "labelled" according to the type of festivity or ritual described in it.

As demonstrated by previous studies focusing on other regions and periods (Malkin 2011; McCorriston 2011; Collar 2013; Rutherford 2013), the analysis of cultic journeys is crucial to elucidate the social function of festivals and religious venues and to analyse the spatial dimension of rituals. I would add that this analysis is also fundamental to study the political implications of religious movements. Recent research has shown that social network analysis (SNA) in the study of religious phenomena is helpful to proceed beyond essentialist viewpoints towards more relational, contextual and multifaceted perspectives (Blake 2013; Knappert 2013; Knappert 2016). However, as some authors have noticed (Rutherford 2013: 9), the most important limitation of the "network" approach is the difficulty of representing the power relations and hierarchies that exist in religious networks. Nevertheless, if we turn from "abstract" SNA to a more concrete, spatially (in the sense of physical, not only social space) oriented approach which also considers the sociomaterial dimension of the network, we can get round this limitation. Indeed, the itineraries, direction and frequency of the movements and the number of links between them are crucial to elucidate the relative position of hubs and nodes. In addition, given that the ties operate in space and involve the movements of people, deities (their statues) and equipment from one place to another, the spatial approach of network analysis is fundamental, for it enables the mapping out of religious itineraries and the spatial organization of the cult. It is also necessary to understand networks as heterogeneous, so we can fully appreciate the multiplicity of relations and the material dimension of religious connections. Issues related to time scale and incompleteness of the textual data will also be considered. For these reasons, an indispensable part of the project is integrating geospatial information with SNA: all geographical information will be collected, organized, analysed and shared in a series of interactive maps built using a geographic information system (GIS), with the aim of obtaining a geospatial SNA. In order to do so, a database with all the information on the networks will be created on the basis of the documentary evidence referred to above (a corpus of approximately 500 texts), and the festivals and religious journeys will be scrutinized using different digital tools: Recogito, yEd, Filemaker, QGIS and Nodegoat. It should be noted that the linguistic structure of Akkadian does not allow for automatic data collection, so it is necessary to sift, with a more traditional approach, the information to be understood in the dataset.

From a methodological point of view, our project will take the following steps:

a) First we will input and catalogue the cuneiform texts and their metadata in the annotation platform Recogito, assigning units of topography (UTs) and actors (Acs) and establishing the relationships between.

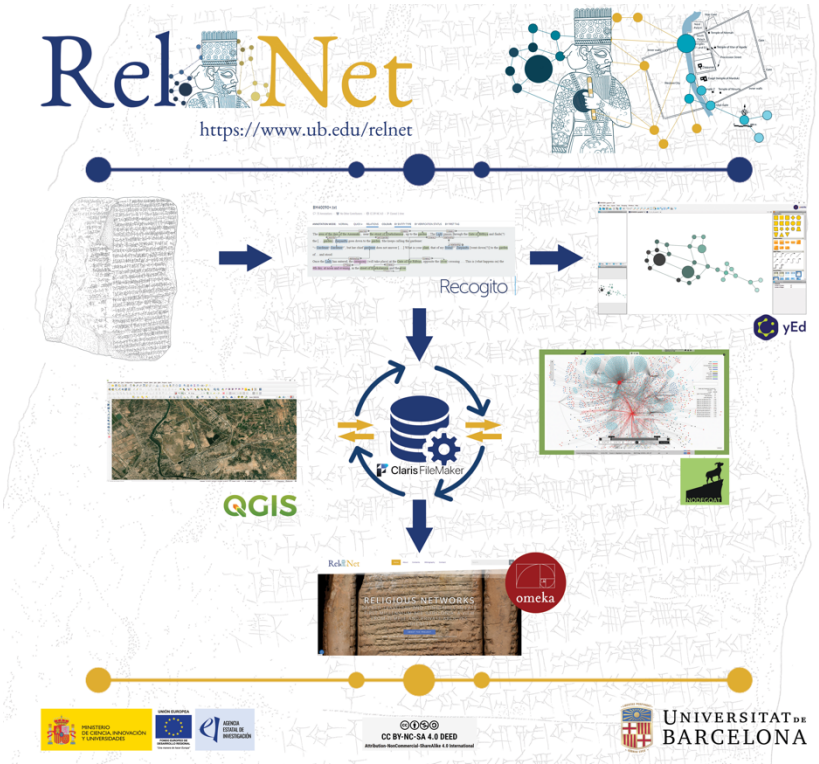
b) Then we will export the Recogito data by .csv and import it into the graph editor yEd to obtain a graphical representation of the UTs, Acs and their relationships in the form of diagrams.

c) We will also export the Recogito data by .csv and import it into the Filemaker database. Although it is our aim to use open research tools, none of the available open source databases seems to be as powerful as FM for our purposes.

d) From FM we will choose between two avenues to pursue:

- exporting the FM database to Nodegoat or
- exporting the FM database to QGIS.

In either case we will obtain a representation of the UTs and Acs and their relationships within a geospatial context. Also, the decision to choose one tool or the other will be made in the early stages of the project, since we do not wish to change the tools halfway through the project. Accordingly, we will first run several tests to determine which solution best meets our needs.



e) Lastly, as the final results will be open source, the FM data will be transferred to Omeka.

The main research lines of RelNet are:

- to identify patterns in the articulation of sacred movements or journeys, focusing on cultic topography and the relationships between different nodes and hubs in the resulting networks
- to provide data on the topography of worship in Babylonia, and on the contacts between different hubs and nodes
- to describe the relationships between the axes, their direction and regularity, and their possible modifications through time, identifying their causes
- to analyse the dynamics of cultic journeys in order to elucidate the social function of festivals and places of worship
- to clarify the extent of royal euergetism and its impact on religious networks.

The use of different digital tools and open access visualization platforms will enlarge the spectrum of approaches in the study of religious movements and enable a better visualization and broader dissemination of the results to stakeholders, including the scientific and academic community as well as the general public.

** RelNet started in February 2024. The project website is currently under development (March 2024) and will be partially accessible at the time of the conference (July 2024), when its various contents and some preliminary results (including images and maps) will be shown.*

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Representing discourses as networks: potential applications of TheSu XML in network analysis for the history of ideas and science

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Morrone Daniele. 2024. "Representing discourses as networks: potential applications of TheSu XML in network analysis for the history of ideas and science", *Historical Network Research 2024*, Lausanne, DOI: 10.5281/zenodo.12606611

This paper will discuss potential applications of the TheSu XML Annotation Schema in the history of ideas and science for purposes of network visualisation and analysis.

TheSu XML (Morrone 2023), "Thesis-Support", is an innovative tool for annotating declarative statements, or "theses", found in historical sources, like "the Earth revolves around the Sun" (Morrone 2022). Not limited to simple tagging of formal and thematic features of such claims, the model also allows linking the theses to their contextual "supports" (e.g., argumentative premises, explanatory remarks, introductions) and abstract "propositions" that broadly represent their content. By linking multiple theses to the same propositions, it is possible to connect identical or similar theses – along with their attached supports – within the same text or across different sources. The "Argumentative-Expository System" resulting from the annotation of all these interlinked elements forms a network that can be visualised and analysed.

The method is designed to aid in close reading of texts by revealing argumentative structures and rhetorical progressions, and to provide access to the contexts of claims to prevent misinterpretations. Representing the discourse conveyed in a text graphically as an argument map (cf. Stede and Schneider 2019, 36-43) can help understand the theses' interconnections, but challenges arise in optimising these maps for clarity and analyticity, especially when dealing with complex, densely interconnected discourses.

In contrast with argument map-like visualisations, whose effectiveness strictly depends on the number of their nodes and edges being sufficiently small, graphs intended for network analysis have the advantage of scalability, even providing greater insights with larger Argumentative-Expository Systems. Indeed, annotating claims concerning, for instance, the Earth's revolution around the Sun, and the reverse, across diverse sources over centuries may reveal patterns in claim co-occurrence, thematic clustering, roles in argumentation, and grounding in common or divergent demonstrations. Analysing such a network could uncover how frequently proponents of geocentrism engaged with heliocentric arguments, or how different astronomical arguments (based on observations, philosophical reasoning, or religious texts) were used to support opposing theories. All these patterns can potentially be used to identify historical trends or distinct traditions.

It is thus key to this paper's method to distinguish between two forms of automatic graph visualisation: one optimised for analyticity and close reading enhancement, and the other for quantitative network analysis, also at the potential expense of readability. Accordingly, the paper will discuss how to optimise the automatic treatment of TheSu XML data for generating both types of graphs.

In presenting a general overview of TheSu XML and its intended applications, the paper will draw on my experience annotating claims and arguments onto TEI XML editions of ancient philosophical-scientific texts (primarily from the collection Cerrato et al. 2019-2021). Building upon recent groundwork for ongoing historical research, it will focus on the chemistry of lead and lead white, with particular interest in how network analysis can reveal shifts in the understanding of their properties and applications across authors and time.

After showcasing annotation examples of ideas concerning lead and its white pigmentary product, the paper will discuss the design of a working Python script prototype for network conversion and graph representation of Argumentative-Expository Systems. This prototype uses the lxml library to convert

selected TheSu XML features into nodes, edges, and attributes of a directed graph in DOT format. The script generates two distinct outputs: first, a DOT document optimised for argument map visualisation through GraphViz, to enhance close reading and textual analysis of short passages or small combinations of these (see Figure 1); and second, a DOT document designed for import into Gephi to enable network analysis of larger datasets (see Figure 2).

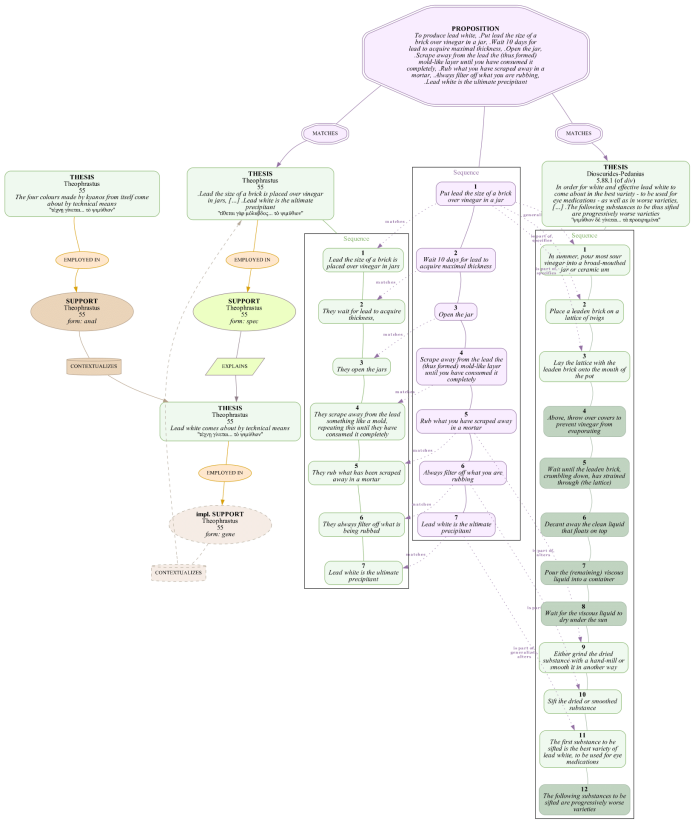

Figure 1. Example of an automatically visualised TheSu XML small argument map (GraphViz)

Two ancient recipes for making lead white (psimythion), reported by Theophrastus (De lapidibus 55) and Dioscorides (De materia medica 5 88.1), are represented as 'THESIS' nodes and analysed in their respective steps, in turn represented as subordinate nodes connected in a sequence. The two recipes are connected to an abstract 'PROPOSITION' node representing the content of Theophrastus's recipe for comparison purposes: each step of Theophrastus's and Dioscorides's recipe is thus connected to the step(s) matching it (either exactly or with specified differences) in the abstract recipe's sequence.

Theophrastus's recipe is also connected to its immediate context of enunciation, through the inclusion of 'SUPPORT" nodes in the network. The recipe is not presented in isolation: it is explicitly presented as a specification of the claim that "lead white comes about by technical means", in turn introduced by an analogy with the claim that "the four colours made by kyanos from itself come about by technical means".

Each of these nodes may theoretically be also connected to its context, as well as to abstract 'PROPOSITION' nodes for comparison with similar claims occurring in other points of the same text or in other texts. In the present case, the passages represented in the network do not include argumentation, but only exposition and contextualisation.

The purpose of this argument map visualisation is to facilitate the analysis and comparison of the two recipes in their contexts, enhancing the close reading of the passages in which they are embedded. It was created via a Python script through automatic conversion of selected features of a TheSu XML annotation of the

two authors' passages into nodes, edges, and attributes in DOT format and their subsequent display through GraphViz.

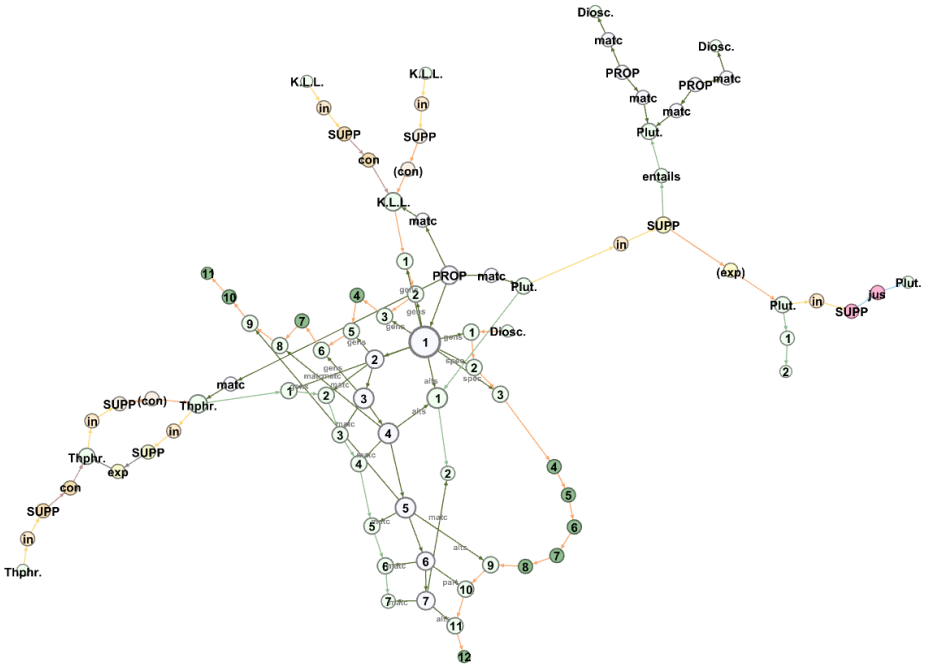

Figure 2: Example of an automatically visualised TheSu XML network of claims and arguments (Gephi)

This Gephi network expands the analysis of the two ancient lead white recipes (Theophrastus, De lapidibus 55; Dioscorides, De materia medica 5 88.1) already visualised in Figure 1. Green "thesis" nodes again represent the recipes, analysed in steps and related to an abstract 'PROP' node representing the content of Theophrastus's recipe, and are partly related to their immediate context of enunciation through 'SUPP'. This visualisation shows how the conversion of TheSu XML data to a Gephi network overcomes GraphViz argument map scalability limitations, enabling different insights and quantitative analysis.

The network, still small but exemplary, includes a modern replication attempt of Theophrastus's recipe (with creatively inserted extraneous steps) and its immediate context in the paper reporting it (see the 'K.L.L.' nodes, from Katsaros et al., 2010). Additionally, it analyses a concise two-step recipe reported by Plutarch ('Plut.' nodes), which only shares an altered combination of steps 1 and 4 from Theophrastus's ("and certainly lead is among the naturally cold substances, as when rubbed with vinegar it sends forth the most cooling of deadly drugs, lead white", Quaestiones convivales VI 5, 691b).

The network connects Plutarch's thesis, "the most cooling of deadly drugs is lead white", to propositions partly matching its content ("lead white is a cooling substance" and "lead white is a destructive substance"). These propositions connect to similar claims in Dioscorides, occurring near his description of the recipe (De materia medica 5 88.6). Importantly, the network highlights that these claims are not directly linked to Dioscorides's recipe by argumentative or expository functions in the text.

This visualised network can be extended indefinitely with longer passages and richer corpora for the purposes of historical analysis. It was generated via the same Python script as Figure 1, which converts selected features of a TheSu XML annotation into a DOT format optimised for import into Gephi. The network was arranged using the ForceAtlas2 layout and manually modified for suitability within this abstract.

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Shaping British Digital Art: the Global Network of the Computer Arts Society, 1968–1985

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In the latter half of the 20th century, digital art emerged as a revolutionary field of technology and creativity, redefining the boundaries of artistic expression (Mason 2008). This period witnessed the foundation of the Computer Arts Society (CAS) in London, the United Kingdom, in October 1968 and active until 1985, which became a global platform for fostering the intersection of technological innovation and artistic endeavour (CAS 2024). It brought together a growing community of artists, programmers, engineers, scientists, and researchers from different fields of practice through code writing workshops, conferences, talks, exhibitions, festivals and their PAGE bulletin, and CAS contributed significantly towards the development of British digital art and even the field of global digital art (Arreola, Gardner, and Lenz 2024). Revealing how digital art practices were shaped during this foundational period is not only important for understanding the evolution of this field, but also crucial for contributing to the current debates on global networks of contemporary digital art (Shanken 2016; Harris 2017; Zebracki and Luger 2019).

This short paper presents a work-in-progress research to the central question: How do interdisciplinary and global networks influence the digital art practices within the Computer Arts Society (CAS) from 1968 to 1985?

In order to address the question, this collaborative research, conducted between the Victoria and Albert (V&A) Museum and University College London (UCL), visualises for the first time, the global network of individuals involved within the field, drawing from the V&A's rich repository of historical materials, which comprises of 287 computational art objects and extensive archives that trace the origins of pioneering figures and movements in digital art.

Data collection and network visualisation

We extracted the data from the original archives, and the dataset was built by categorising individual's attributes based on their roles (e.g., Composer, Artist, Computer Programmer), networks (e.g., Computer Arts Society, American Society for Cybernetics), mediums of work (e.g., Music, Painting, Film), and regions they were based in. For example, one of the founders of CAS, Alan Sutcliffe, was a computer programmer, and he belonged to two networks - Electronic music studios Ltd and Computer Arts Society. His medium of work was music, and he was based in the UK.

For constructing the network, we assigned a weight to each individual based on their number of attributes, and each individual will be represented as a node on the network graph, with more attributes resulting in a larger node size. This methodological choice quantitatively represents the accumulated characteristics of individuals and allows for a new understanding of the CAS landscape based on its archives and information available. For example, Herbert Brün has a weight of 7, and Lillian Schwartz has a weight of 4, indicating different levels of known attributes and connectivity within the network due to their diverse roles and affiliations.

Edges (or relationships) between nodes were calculated by the number of attributes the two individuals had in common, with a higher number of shared attributes indicating a stronger connection. For example, Eduardo Mac Entyre and Isaías Nougués had 4 attributes in common, as they were both artists based in Argentina affiliated with networks of Grupo de Arte y Cibernética and the Computer Arts Society, showing

a stronger relation. This approach enables the visualisation to reflect on the multiple characteristics and relationships between individuals, facilitating an analysis of multi-layered patterns.

The network was created using the Flourish online platform, colour-coded with the regions they were based in (see Figure 1).

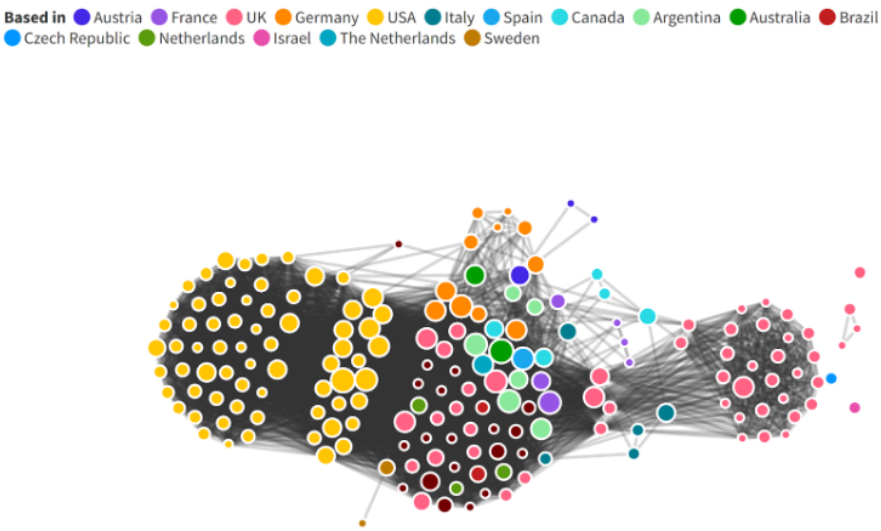

Figure 1. Network visualisation of the individuals in the Computer Arts Society (1968 - 1985), and the network is constructed based on individual's common attributes, colour-coded with the regions they were based in. Network created using Flourish platform, and the online version can be found from: https://public.flourish.studio/visualisation/16788992/

Figure 1 represents a work-in-progress network based on initial data gathered from the archives. The data is incomplete, with more information to be added by mid-May 2024 after further archives review, especially to include important events. Despite missing values, Figure 1 provides an overview of how 185 practitioners are connected based on their category (including artists, engineers, mathematicians or researchers in academia or industry), medium (including dance, music, sculpture, multimedia ect) and groups these were associated with (e.g. Grupo de Arte y Cibernética, Bell Telephone Laboratories, ect..).

Findings

The network visualisation reveals, for the first time, a global landscape of CAS with widespread influence and diversity of digital arts practices that were happening much wider than the territory of the United Kingdom.

With further analysis of the distribution of individuals across regions and their betweenness centrality based on the visualised network, we are now able to gain new insights into the role of geographic location in the development of digital arts. Betweenness centrality measures the importance of a node in a network, revealing how often it serves as the crucial passage connecting different nodes or clusters together, much like how a bridge connects separate lands (Brandes 2001). We found that the relationship between individuals' regions and their values of betweenness centrality suggests that geographic proximity to centres of technological innovation and artistic communities facilitated collaboration and exchange of ideas.

Specifically, the analysis reveals that individuals from certain regions, e.g., Austria, Canada, Argentina, played more significant roles in the dissemination and innovation of digital art practices within CAS, as indicated by the betweenness centrality values. Table 1 below shows an aggregated overview distribution of regions where the individuals from the Computer Arts Society (1968 - 1985) were based in. It highlights the average betweenness centrality and average attributes, reflecting the network centrality and average characteristics of each 'based in' region, respectively. The table also shows the total number of individuals considered ('No. People') and the distribution across four main categories: 'Artist', 'Engineer', 'Scientist', and 'Other categories', in percentage terms. From the table, we can see the importance of physical and institutional spaces in the development of digital arts, which aligns with previous discussions, such as in Brown and Gere

(2008) and Mason (2008), but it also raises interesting new findings about the diverse contributions and the predominance of certain regions and professions within the Computer Arts Society, and how this interdisciplinary nature and geographical spread of contributors affect the formation of this community?

Based In	Avg Betweenness Centrality	Avg Attribute	No. People	Artist	Engineer	Scientist	Other categories
Argentina	24.51	4.50	6	100.00%	0.00%	0.00%	0.00%
Australia	27.93	6.00	2	50.00%	50.00%	0.00%	0.00%
Austria	117.42	2.33	3	33.33%	0.00%	0.00%	66.67%
Brazil	0.00	2.50	2	50.00%	0.00%	0.00%	50.00%
Canada	109.69	3.20	5	20.00%	20.00%	0.00%	60.00%
France	98.11	2.67	6	33.33%	16.67%	0.00%	50.00%
Germany	74.30	3.45	11	27.27%	9.09%	27.27%	36.36%
Italy	99.01	2.80	5	20.00%	0.00%	0.00%	80.00%
Spain	36.67	6.00	1	100.00%	0.00%	0.00%	0.00%
Sweden	93.41	2.00	2	0.00%	0.00%	0.00%	100.00%
The Netherlands	36.67	5.00	4	25.00%	0.00%	25.00%	50.00%
UK	81.96	2.22	50	4.00%	4.00%	0.00%	92.00%
USA	80.04	2.55	67	5.97%	2.99%	0.00%	85.07%

Table 1: An aggregated overview distribution of regions where the individuals from the Computer Arts Society (1968 - 1985) were based in.

For example, Austrian and Canadian artists emerge as influential, with the highest betweenness centralities of 117.42 and 109.69, respectively. Despite a smaller number of individuals based in these countries, individuals from Austria and Canada present a significant influence in connecting different parts of the network, suggesting that artists from these regions were important contributors to the transmission of British digital art ideas and practices.

Individuals from Italy and France also show high betweenness centralities of 99.010 and 98.11, highlighting their roles in the European digital art scene. Their central positions in the network show the importance of European contributions to the development and dissemination of British digital art within CAS.

People from the United States (USA), with a mean betweenness centrality of 80.04, despite having the highest number of individuals (67) based there, indicates a broad but perhaps more evenly distributed influence across its members. This reflects the USA's key role in the British digital art movement, serving as a major hub for technological innovation and artistic exploration.

Argentina and Brazil are shown as predominant connecting countries between CAS and the Latin American digital art community with key figures in the region such as Antonio Berni and Eduardo MacEntyre producing exchanges between CAS and Grupo de Arte y Cibernética in Buenos Aires (with betweenness centralities of 36.67 each).

Conclusion

In conclusion, the interdisciplinary and global networks within CAS significantly influenced the development and dissemination of digital art practices from 1968 to 1985. The calculated numbers and regional analyses provide a quantifiable measure of these influences, revealing a complex web of international collaborations that drove the digital art movement forward.

More specifically, our findings demonstrate the importance of international and interdisciplinary networks in shaping British digital art practices within CAS. Artists from regions outside the UK, such as Austria, Canada, Italy, and France, were very important bridges in connecting across the network, thus facilitating the exchange of ideas, techniques, and innovations. This global exchange contributed to the vibrancy and diversity of digital art practices, highlighted the role of CAS as a connector in the international digital art community.

This work-in-progress network visualisation of previously unstudied archives contributes to the understanding of CAS's evolution and global reach and with it the history of British digital art for the first time in this way. The emergence of British digital art was not an isolated phenomenon only within the UK, on the contrary, it was linked to the global and interdisciplinary exchanges facilitated by CAS from multi-layered perspectives. These attributes and interactions of individuals were important in fostering a culture of innovation, where the fusion of computational processes and artistic vision led to the creation of new art forms.

By continuing our data gathering and research, we hope to contribute to the scholarly understanding of digital art's origins with additional and more detailed uses of network visualisations to map the connections within CAS against case studies. Our future work will contextualise these findings within the broader narrative of British digital art's evolution and offer a new perspective on the development of British digital art.

As we uncover more about the mediums, networks, and categories of practitioners we will be able to uniquely map out the relationship between the arts and sciences and the role of research institutes and industry labs in the development of digital art in Britain. This will be especially meaningful to trace and study the role of regional geographic proximity as an influence on digital art practices within CAS. We expect also to delve deeper into the pronouns used by and refer to the practitioners in our sample as well as their approximate birthdays. We currently have this demographic information on just under 30% of individuals, but with our further planned data collection and modern machine learning methods that enable name-to-gender inference, we may be able to reflect on how personal characteristics influenced and changed the interdisciplinary networks of digital art since the 1960s.

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The assistance of the Church to the Jews in Milan during the Second World War

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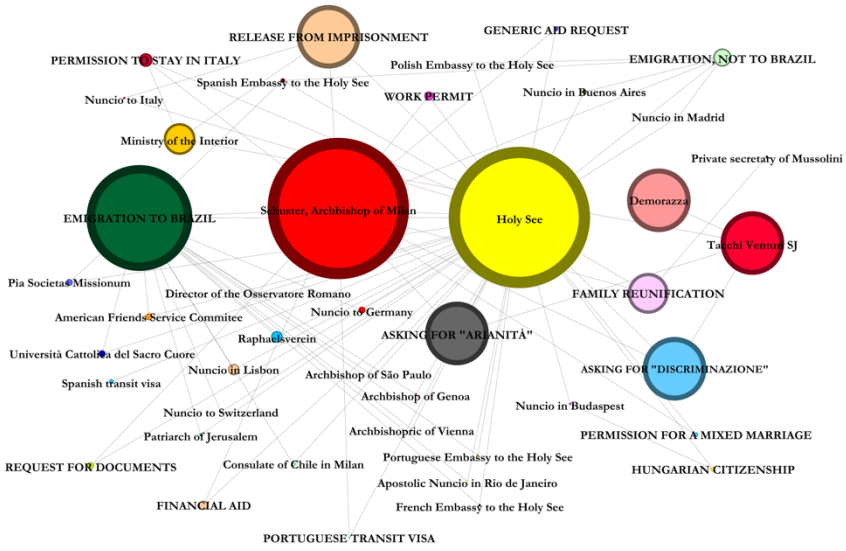
The racial laws introduced in Germany, and later in Italy and in the countries under the Nazi military occupation, made Jews, either converted or not, ask the Church for help. Indeed, foreign Jews living on the Italian soil were forced to leave the peninsula and all the Jews were subjected to increasing discriminatory measures. Since autumn 1938 those who were deemed to be Jews had to leave their job, were marginalised by the society, could not marry "Arian" people and their children were only allowed to attend Jewish schools. Furthermore, many other measures were introduced in the following months. In this tragic situation the Pope represented a fundamental reference point for those who were persecuted for racial reasons because of his moral authority and of the importance of the Vatican in the international scenario. The well-known caution of Pius XII in the relationships with the European totalitarian regimes did not hamper the assistance activity of the Church to save as many Jews as possible from deportation (Miccoli 2007). The notion of network naturally fits these rescue operations. The core of this network was the Holy See, but an essential role in the relief effort was played by bishops and priests. These "peripheral nodes" were indeed in charge of making the Holy See aware of the requests of the Jews and of hiding and helping them to run away after the implementation of the Final Solution.



We present here the content of a substantial archival source conserved in the Archivio Storico Diocesano of Milan which contains more than 300 dossiers involving Cardinal Schuster and the Holy See and regarding Milanese Jews. Usually the applicants contacted Schuster, either directly or with the help of local priests, who would have forwarded their requests to the Holy See; sometimes, however, the applicants wrote straightforwardly to the Secretariat of State which would have later asked the Archbishop of Milan for information. Some people desired to migrate to Brazil, Argentina, England, and the USA and some asked for the help of the Pope in setting their interned relatives free or for receiving the "discriminazione", a sort of exemption from some of the Italian racial laws. Others wished a revision of their "racial" position, considering themselves "Arian". Still others wanted to rejoin their relatives which had emigrated or been interned in concentration camps. All these dossiers date back to the period between 1938 and 1941, and

they properly outline the situation of Jews in Italy before the occupation of northern Italy and Rome by the Nazi army in 1943 who were living isolated and in economic and social tragic conditions. The foreign Jews who had failed to emigrate were interned in local concentration camps. However, the deportation of Italian Jews to the eastern lagers would have started only after the 8th of September 1943 when the Italian interim government, led by Pietro Badoglio, signed the armistice with the Allies. Jews' condition got worse after Mussolini was released from imprisonment on the Gran Sasso, the creation of Italian Social Republic and the nazi occupation.

The documents of the Archivio Storico Diocesano of Milan allow us to better understand the role of the Church in the assistence before fall 1943; they show the existence of a dense assistance network whose branches changed according to the kind of request. On the one hand, the assistance provided by the Curia of Milan cannot be fully understood without considering its cooperation with the Vatican; on the other hand, however, the humanitarian action carried out by the Pope and his entourage could not have been realized without all the nodes of the network.

The fuel of this network was represented by institutional and personal relationships between the members of the Court of Rome and the local clergy. Each node played an essential role without which the network as a whole could not have worked efficiently.

In the last decades historians had partially reconstructed the role of the Holy See in the Second Worl War scenario, and its attitude towards persecuted Jews thanks to the materials stored in the archives of the Ministry of Foreign Affairs of those nations which had relations with the Holy See and to the Actes et documents du Saint Siège relatifs à la Seconde Guerre Mondiale, an eleven-volume collection of documents from the Vatican historical archives published between 1965 and 1981. In 2020 Pope Francis decided to open for public access the documents of Pius XII's pontificate. This choice let the researchers understand better some contentious aspects of Pacelli's papacy. Since 2022 some studies have been published (Kertzer 2022; Riccardi 2022; Santos 2022; Valbousquet 2022) which already showed the richness and importance of those documents which are crucial to explain Pacelli's diplomatic line and the humanitarian work of the Church during the Second World War.

The assistence provided by Italian bishops to those who were persecuted for racial reasons was partially reconstructed too. The assistence offered to Jews in Rome and the cooperation between the bishop of Florence, Elia Dalla Costa, and DELASEM, a Jewish assistance organization, have already been investigated (Cavarocchi and Mazzini 2018; Riccardi 2008). However, what happened in the northern part of Italy has not been studied yet, except for the activity of archbishop Pietro Boetto in Genoa, and, in particular, what was done by archbishop Schuster to help Jews is almost unknown. In this work we aim at reconstructing the assistence network organised in Milan, the biggest diocese in Europe, and the relations between the local clergy, the Holy See and its representatives around Europe. The application of network analysis to these studies allows us to examine these documents in a different way, considering both the nodes and edges and the structure of the network. The graphic representation realised with Gephi well shows the complexity of Church's assistence net, the relationships between the representatives of the Pope and those of the Italian or foreign governments such as ambassadors and consuls. It is also evident the key role played by Schuster which is involved in the management of all the dossiers. A great advantage provided by this approach is also the possibility of analysing how the number of each kind of request evolved between 1938 and 1943. Most of the requests (233) were finalized to get the chance to expatriate to Brazil, thanks to the three thousand visas devoted to converted Jews, granted by Getulio Vargas upon the request of the Holy See. There are also several requests aimed at obtaining the "discriminazione" or a revision of the racial position. The actors involved changed according to the type of request, with the exception of the Holy See and of the Curia of Milan which were always directly engaged. The network analysis could properly be applied to describe also the assistence networks organized in other areas of the peninsula. Comparing these networks to each other, identifying both constancies and differences, could be very interesting and useful as well.

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Using citation networks for viewpoint plurality assessment of historical literary corpora: The case of the Medieval Rabbinic corpus

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The digital networking sphere enables analysis of author groups, defining in-group dynamics, and mapping out inter-group relationships (Baumann et al., 2020). While intellectual diversity and inclusiveness is one of the important principles of modern scholarship, it is intriguing to explore the extent to which these principles apply to historical communities of leaders and intellectuals. This paper introduces a novel methodological framework aimed at assessing the degree of viewpoint plurality of historical scholarship communities, through an in-depth analysis of the citations used in their literature, which has become possible due to the recently developed advanced computational analysis techniques (Romanello, 2016; Colavizza, 2017; Rodrigues Alves et al., 2018).

To this end, we developed a set of new network-based indicators based on standard network metrics, such as 1) resource diversity: the number of distinct external resources from other communities in the network out of all the distinct cited resources; and 2) citations' external outdegree: the number of the outgoing citations of other communities' resources out of all the outgoing citations. These indicators are applied both at individual author and community levels.

Through this amalgamation, we aim to tackle queries like: How extensively does an individual or a group harness content from its counterparts? How diverse are their referencing habits? Are there universally accepted resources?

As an implementation of the proposed methodology, we automatically analyzed a large corpus of Rabbinic Halachic literature from 10 to 15 CE and constructed a citation network of authors and books. The network comprises over 750,000 citations extracted and mapped from hundreds of significant books penned by approximately 140 Rabbinic authors who cited over 250 scholars and hundreds of volumes from the early Jewish writings originating from diverse regions such as North Africa, Spain, Provence, Italy & Balkan, France, and Ashkenaz (mostly modern-day Germany) that maintained intellectual ties of various kinds during the period (Ta-Shma, 2000).

The proposed network-based quantitative analysis provides an exploration into the patterns of intellectual exchange, enabling us to trace the multi-directional influences between various rabbinic authors and communities (see Figures 1-3). The figures reveal distinctive citation patterns among different communities. Notably, the French community, characterized by the lowest number of outgoing citations, demonstrates a remarkable emphasis on internal references. Furthermore, it attracts a considerable number of incoming citations from Spain and Ashkenaz. In contrast, the Italian community emerges as particularly open-minded and inclusive, boasting the highest proportion of external outgoing citations, reflecting a willingness to engage with a diverse range of viewpoints.

In summary, even though this is a Medieval literature produced by religious leaders (who as such might be perceived as closed-minded and conservative), we found that most of the authors and communities cite many more external resources from other communities than their own. Although the reasons for the

discovered phenomena could be explored by domain experts, our methodology remains domain agnostic, making it suitable for any sufficiently inclusive and comprehensive corpus.

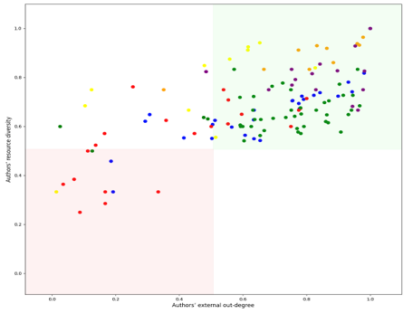

Figure 1: Authors' plurality based on the integration of the two proposed citation-based indicators – resource diversity and citations' external outdegree.

Figure 2: Cross-community citation heatmap. Cell shading intensity in each row represents the external outdegree scores, i.e. the percentage of the outgoing citations of the different communities by a given community.

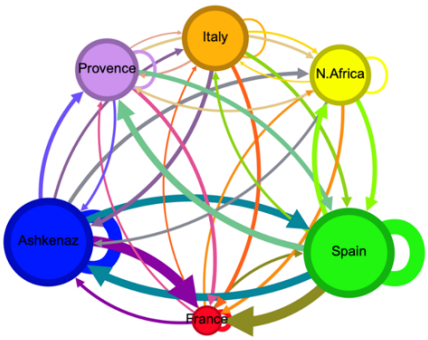

Figure 3: Community-level citation network visualization. The size of the nodes is proportional to the number of outgoing citations of the represented community, the thickness of the edges is calculated based on the number of outgoing citations of different communities.

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Viewsari: New Perspectives on Historical Network Analysis in Giorgio Vasari's The Lives Using Knowledge Graphs

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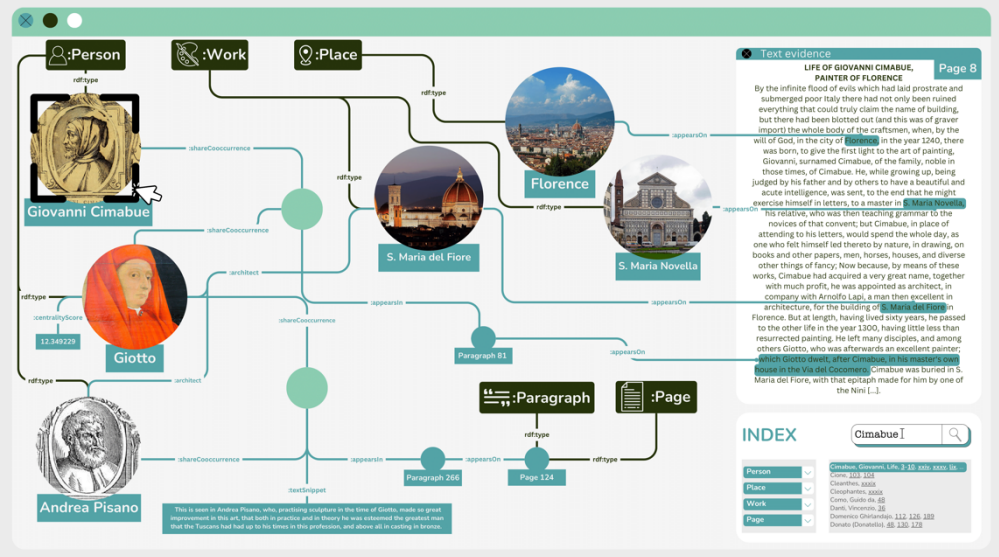
Art historians who want to explore the complex relationships of Michelangelo and other Renaissance artists can use network analysis. These relationships can be used to reconstruct an interdependence between collaborations and shared artworks, social practices, or artistic movements.

However, hermeneutics and context sensitivity are critical to interpreting the results (Novak et al. 2014; Van Vugt 2017, 35–36). Knowledge graph (KG) technologies offer new perspectives for historical network research. Transcending the limitations of binary relationships, they combine and integrate heterogeneous data, define relationships, and enrich the network with numerous contextual insights (Dörpinghaus et al. 2022). They also address the need for structured modeling of multilayered social networks and their publication as linked (open) data (Bornhofen and Düring 2020; Grandjean 2019).

This project builds directly upon these considerations and introduces a methodological proof-of-concept in the form of an interdisciplinary KG. It is based on a social network automatically generated by Santini et al. (2022) from an English translation of Giorgio Vasari's The Lives of the Most Eminent Painters, Sculptors, and Architects (Vasari 2008) using named entity recognition, coreference resolution, and statistical association from the co-occurrence of names in paragraphs. They also extracted further named entities, such as places, artworks, motifs, historical events, etc., which this project reuses for additional contextualization.



Originally written in Italian, The Lives was published in 1550 and expanded in 1568. The text provides biographical descriptions of Renaissance artists, including detailed descriptions of their lives, patronships or collaborations, works, and artistic styles. Remaining a valuable resource for scholars and anyone interested in the period, Vasari's texts have significantly shaped the modern understanding of Renaissance art and artists. Art historical research has established the text in its multitudinous variants and commented on its

content (Burioni 2017; Pon 2014). This sheer number of editions and translations of Vasari's work speaks volumes about the importance of the text and the necessity to construct a KG as a structural presentation of the content, which systematically prepares the biographies for questions such as historical network research, the disclosure of dependencies, and visual exploration, but also comparative studies between Vasari's work and narratives about Renaissance art through other historical resources or the reappraisal in existing research work.

The KG functions as a renewed gateway to Renaissance art through Vasari's perspective, transforming The Lives into a flexible and scalable graph of interconnected resources. Complemented by an interactive web-based visualization and a SPARQL endpoint, it supports researchers in exploratory searches for artists and related concepts by fostering serendipitous findings (Waitelonis and Sack 2012, 2). An ontology functions as a baseline data model, covering three conceptual dimensions of the domain: work-level metadata, instantiations of this work, and textual/content details (Bornhofen and Düring 2020; Daquino and Tomasi 2015; Grandjean 2019; Haslhofer, Isaac, and Simon 2018). This ensures efficient encoding of contextual information. Extracted data and their relations can be connected to provenance information, facilitating context-dependent interpretation through provided evidence (Novak et al. 2014, 244; Kuczera 2022, 15). Viewsari enables network analyses of data in the KG within the web application through a social network layer that reconstructs direct relations between nodes and edges. This way, scores such as the Eigenvector centrality or the weight of connecting edges can be calculated directly from the RDF data (Birkholz, Julie M. and Meroño-Peñuela, Albert 2020).

In the process of modeling our ontology, we face questions of effective alignment: at this point, we consider the reuse of existing ontologies like the Historical Context Ontology (HiCO) (Tomasi et al. 2015) to merge descriptive metadata about Vasari's work with content (co-occurrences, text snippets, named entities). This step contributes to interoperability and adheres to the FAIR principles (Wilkinson et al. 2016). Equally relevant are questions concerning multimodality, format options, and data schemas for integrating facsimiles and their corresponding textual transcriptions.

Linked data is crucial for enrichment and contextualization. The connection to other resources enables gathering distributed knowledge, e.g. authority data via Wikidata (Vrandečić, Pintscher, and Krötzsch 2023) or NFDI4Culture (Sack et al. 2023), facilitating retrieval and discovery through information systems and opening the network to external applications.

With Viewsari, connections between artists, artworks, motifs, and historical events that may be hidden from traditional textual analysis will come to light, allowing deeper insights into the construction of, for example, artistic movements or the evolution of social practices. Researchers can analyze the co-occurrences of Michelangelo in a traditional social network and perform conceptual queries with contextual information. Viewsari – as an integrated tool of ontology, KG, and web application – opens up new ways of accessing and discovering the many perspectives of the text and allows new dimensions of understanding.

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Visualization of Early Islamicate Scholars' Network

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Because of the fragmented material found in biographies, early Islamic texts are especially valuable for comprehending the intellectual history of the time and have a structure that makes historical networks possible. Although there are few manuscripts from the first three hijrī centuries to the present (Schoeler, 2022, 81), understanding the flow of knowledge during these centuries is made easier by the chains of transmission (isnāds) found in later circulating literature (Muther et.al., 2023, 2; Saraçoğlu, 2023, 20-24). Texts that have been circulating since the third hijrī century contain chains of transmission that date back to the time of the Prophet Muhammad. These chains involve individuals passing along knowledge fragments (narratives). Names and phrases that signify knowledge sharing between these people make up isnads. By digitizing names and their relationships and creating a network structure, the participants in the era's intellectual history become visible. Isnads have great historical significance as a result.

Although several studies (Kızıl, 2013; Yılmaz, 2020; Pavlovitch, 2020; Saraçoğlu, 2023) have graphically shown the relationships between scholars based on isnāds. However, it is very impossible to manually consolidate a book's all isnads. Network analysis is therefore very useful for social scientists. Historical ties can be reinterpreted using social network analysis of isnads, and main actors can be found using centrality measures. The visualization options that network analysis provides for isnad representation are another important contribution.

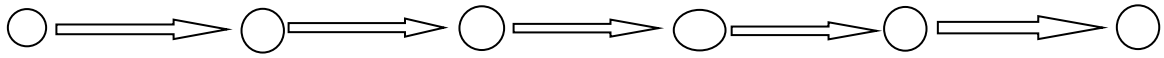
In this article, we discuss converting isnāds text to data, and visualization of the transmission networks in the framework of Ibn Ṣa'd's Kitābu't-Ṭabaqāti'l-Kabīr. The first two volumes of that book are among the earliest sīra texts of Islamic historiography. 2,258 isnad chains of nearly 2,000 rāwis/transmitters in these volumes (Saraçoğlu, 2023, 112) were regarded as a social network to explore the main sources of that book. In this network, the rāwis in the isnads are actors, and their connections formed by their narrative relationship through akhbarana, haddathana, 'an etc. are the ties. It is possible to develop a structured data set with the rāwies names and their relations in an isnād chain as below.

أ **أَخْبَرَنَا** مُحَمَّدُ بْنُ عُمَرَ، **أَخْبَرَنَا** إِبْرَاهِيمُ بْنُ إِسْمَاعِيلَ بْنِ أَبِي حَبِيبَةَ، **عَنْ** دَاوُدَ بْنِ

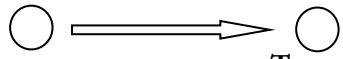
الْحُصَيْنِ، **عَنْ** عِكْرِمَةَ، **عَنِ** ابْنِ عَبَّاسٍ، **قَال...(متن)**

Muhammad b. 'Omar said to us, Ibrāhīm b. Ismāīl b. Abū Habība said to him, and he [heard] from Dāvūd b. al-Husayn, from Ikrima from Ibn 'Abbās, and he said…. (text)

'Ibn Abbās	Iqrima	Dāvūd b. al-Husayn	Ibrāhīm b. Ismāīl b. Abū Habība	Muhammad b. 'Omar	**Ibn Sa'd**
d. 68/687-88	d. 105/723	d. 135/753	d. 165/782	d. 207/823	d. 230/845



Rāwī A	**Rāwī B**	**Rāwī C**	**Rāwī D**	**Rāwī E**	**Author**
End of isnād					**Author**
Ibn ʻAbbās					Ibn Saʻd
(d. 68/687-88)					(d. 230/845)



Source	**Target**
Rāwī A	Rāwī B
Rāwī B	Rāwī C
Rāwī C	Rāwī D
Rāwī D	Rāwī E
Rāwī E	**Author**

Source	***Target***
ʻIbn Abbās	Iqrima
Iqrima	Dāvūd b. al-Husayn
Dāvūd b. al-Husayn	Ibrāhīm b. Ismāīl b. Abū Habība
Ibrāhīm b. Ismāīl b. Abū Habība	Muhammad b. ʻOmar
Muhammad b. ʻOmar	**Ibn Saʻd**

After converting the isnāds from text to data in this manner, it might now be able to combine hundreds of isnāds to identify the information flow. For example, by giving id numbers to the names of the rāwīs and using the number of narration transmissions between them as weights, it can display the 162 isnāds that converge on Ibn ʻAbbās in Ibn Saʻd's sīra text. We can construct this network as a directed network since we are aware of who gets the information from whom.

It is evident that network modeling presents a wealth of opportunities for comprehending early information transfer, yet there may be certain challenges when trying to visualize long-term historical networks. The information transmission processes across the first three hijrī centuries are depicted in this network, and comprehending different concerns requires an awareness of the relationships in chronological order. Assessing the impact of network analyses on visualizing isnads, particularly with this sample group featuring lengthy Arabic names and covering an extensive historical period, appears to be meaningful.

This article focuses on visualizing isnads utilized in the investigation of information transmission mechanisms throughout the first three hijrī centuries by utilizing social network analysis. To begin, the capabilities and constraints of current network programs will be examined to demonstrate the generation-to-generation transfer of information throughout time. We will investigate which layouts work best for illustrating the chronological flow in these kinds of historical networks. Furthermore, issues with visualization resulting from Arabic names' length will be discussed. To do this, a variety of visualizations based on data gathered from the chains of transmission included in the sira part of Ibn Ṣa'd's Kitābu't-Ṭabaqāti'l-Kabīr will be made using Pajek, Gephi, and Isnalyser.

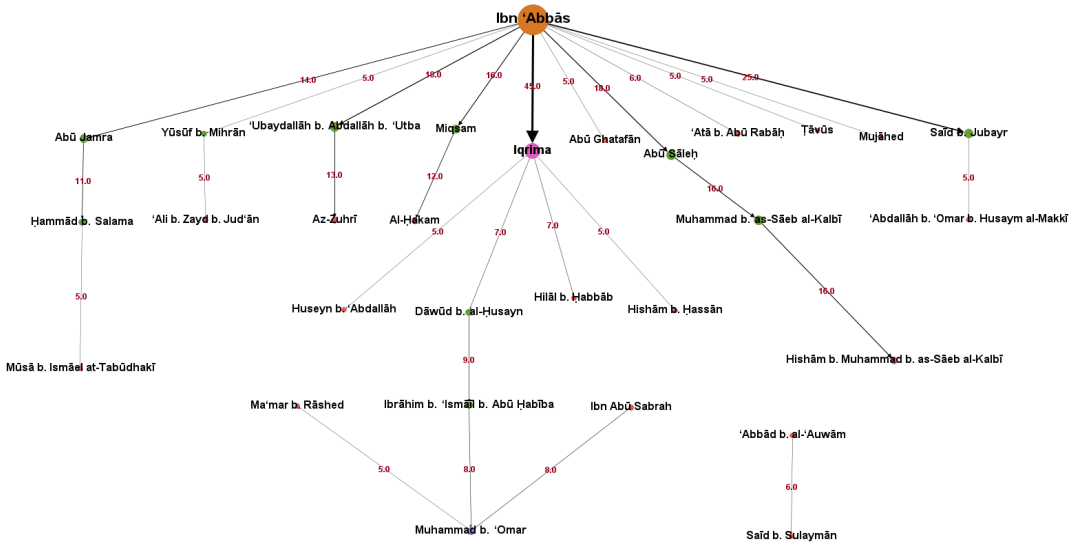


Figure 1. (Saraçoğlu, 2023, 276) This graph was created in Gephi with the Yifan Hu layout and then manually edited to roughly organize the chronology of the information flow. This small network contains 162 isnāds, 30 nodes, 28 edges, and 305 relations between them)

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