



HAL
open science

Historical and Archaeological Network Data

Claire Lemerrier

► **To cite this version:**

Claire Lemerrier. Historical and Archaeological Network Data. Brughmans, Tom; Mills, Barbara J.; Munson, Jessica; Peeples, Matthew A. The Oxford Handbook of Archaeological Network Research, Oxford University Press, pp.347-362, 2023, 9780198854265. 10.1093/oxfordhb/9780198854265.013.20 . halshs-04300404

HAL Id: halshs-04300404

<https://shs.hal.science/halshs-04300404>

Submitted on 22 Nov 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Preprint, author version of a chapter published as:
Claire Lemerrier, « Historical and Archaeological Network Data »,
in Matthew A. Peeples, Jessica Munson, Barbara J. Mills et Tom Brughmans
(dir.), *The Oxford Handbook of Archaeological Network Research*,
Oxford, Oxford University Press, 2023, p. 347-362.

21. Historical and archaeological network data

<https://doi.org/10.1093/oxfordhb/9780198854265.013.20>

Claire Lemerrier, CNRS Research Professor of History, Centre for the Sociology of Organisations,
Sciences Po, Paris

Abstract: This chapter addresses the shared peculiarities of historical and archaeological network data. It lists the main types of sources that have been fruitfully used to produce historical data on interactions and relationships. It presents the main questions that we should keep in mind during the construction of network data, understood as a process of translation of a source into relational terms. The first four parts present four types of historical network data and their archaeological equivalents: data based on legal and quasi-legal records, networks of words from texts, two-mode networks from membership lists, and data built from past narratives on past ties. The fifth part addresses research projects that use several types of sources and the last part lists general practical advice applicable to any type of historical and archaeological data.

Keywords: source criticism, co-occurrences, two-mode networks, big data, correspondence, narrative

Introduction

Formal network analysis methods were already applied to historical data in the 1980s and 1990s, mostly by sociologists (e.g. Rosenthal et al. 1985; Padgett and Ansell 1993). These scholars used historical data because they were interested in change and because it was difficult to carry out field work over a sufficiently long period to produce longitudinal data. Since the 2000s, more and more network research based on historical data has been published, authored by historians as well as sociologists, geographers, computer scientists and others (Düring 2013). Conversations on the peculiarities of historical network data, however, mostly remain unpublished. This chapter tries to remedy this situation by taking stock of historical network research from the point of view of data, across all periods, topics, and types of sources. It discusses the construction of data as a process of abstraction that requires source criticism.

Why would this be useful for archaeologists? Historical and archaeological data (two overlapping types of data) share three peculiarities. First, they are used to produce knowledge about the past rather than the present, and their users are generally interested in change. Therefore, the last part

of this chapter briefly discusses ways to deal with time and dates. Secondly, historical and archaeological data derive from materials (artefacts, archives, books, etc.) that are *preserved traces* of human and non-human activity (Lucas 2010). This differs from field studies in which researchers interact with their nodes, for example by asking persons about their friends. In such cases, sociologists and anthropologists know that their self-presentation and phrasing will influence the answer. Historians and archaeologists face different dilemmas. Traces were created (or not) and preserved (or not) for reasons independent of our scientific questions: the researcher did not influence these processes, for better or worse. They build their own data and interpretations, but cannot change the source and do not know exactly how it was produced (a feature shared with “big data” that is automatically extracted from online interactions). A third peculiarity is often mentioned: we have a problem with missing data! However, when sociologists are in the room, they are quick to point out that field data is not complete either (Kossinets 2006). Missing data is in fact not specific to historical and archaeological data, and it should not prevent the use of network analysis methods; but it is another reason to perform careful source criticism.

This chapter lists the main types of sources that have been fruitfully used to produce historical data on interactions and relationships, each of which has archaeological equivalents. It addresses the main questions that we should keep in mind during the construction of network data from traces of interactions and relationships. This construction is a process of abstraction, or translation: we do not *extract* edges from sources. Rather, we translate the source into relational terms; we decide on rules that allow us to create one possible abstraction among others – a network abstraction (Collar et al. 2015; Munson 2019).

Certificates of past interactions or relationships

Why do certain past interactions or relationships leave textual traces that are then preserved and transformed into data by historians? The original function of such texts was often to record an interaction or a new relationship in order to certify it. The text, whether drawn up by a legal professional or not, could be used as evidence, hence its preservation. The equivalent in archaeological data can be found in inscriptions, signatures and stamps (see Cline and Munson chapter). Three types of legal or quasi-legal sources have often been used in network analysis: those that record kinship relations, economic transactions, and collaborations.

Historians have used legal records of marriage, godparenthood, and other kinship relations for a long time, but treating kinship ties as networks is an opportunity to represent them in a fresh way, different from stemmata. For example, anthropologist Douglas White used nodes to denote marriages and edges to represent individuals, making it easier to notice specific alliance patterns (e.g. in Brudner and White 1997). Network studies have transformed views on inequality or on relations between cultural and religious groups in specific contexts. For example, Robert Michael Morrissey (2013) collected ties of marriage and godparenthood in Kaskaskia, on the French-Illinois borderlands, from 1695 to 1735. As most marriage records did not survive, he used censuses, baptismal records and notarial records. Comparing the positions of individuals who were described as French, Native American or mixed-race in the sources, he disproved ideas about “fur trade marriages”.

Records of credit or sales drawn up by legal professionals or kept in the accounts of merchants and landlords are the other main source of network data on inequality (Gestrinch and Stark 2015). Historians have generally focused on individuals, families or firms as nodes in networks of transactions, but economists and geographers have used published statistics to describe bilateral trade between all countries (Dedinger and Girard 2017; Smith and White 1992). Records of commercial transactions also document past transportation networks. For example, César Ducruet’s team sampled more than 700,000 vessel movements between nearly 9,000 ports since the 1890s from the insurance newspaper *Lloyd’s List* (Ducruet et al. 2015).

Finally, diverse sources, sometimes produced in order to ascertain intellectual property, certify collaborations among scientists or artists. Network studies are rare in the history of technology, but some rely on co-patenting data. For example, Fleming et al. 2007 listed more than 35,000 inventors from an official list of “utility patents” granted in the United States from 1975 to 2002 to explore the correlations between the structure of co-invention ego-networks and the subsequent career of inventors. Historians of the arts and of sciences have studied older networks of collaboration. Yael Rice (2017) used marginal inscriptions identifying the designers and colorists of sixteenth-century Mughal illustrated manuscripts to explore the organisation of workshops and the formation of a style. Historians and sociologists of science have traced the trajectories of disciplines or paradigms by building datasets on PhD supervisors and juries (Godechot 2011; Sigrist and Widmer 2011).

Scholars thus use legal and quasi-legal records of kinship, economic transactions, and scientific or artistic collaboration to study the interactions or relationships that these documents were supposed to certify – or, as some would say, to create. Indeed, in many social contexts, you are not married, a landowner or a doctor unless a document confers this status on you. Seen from this perspective, the records were exhaustive at the time of their creation. Of course, since then, some have disappeared, and we probably do not have the means to input all their contents into a database anyway. But theoretically, our network would be complete in the sense that even if some other actors considered themselves as being married, having inherited land, or having had a PhD adviser-advisee relationship, the authorities and many contemporaries thought otherwise. Even when we use such seemingly neutral records to build our data, it is therefore important to state whose definition of the relevant ties we are following. Quite often, the preserved sources only leave us with the option of working with the dominant legal definition of the time, but we should acknowledge this and try to establish how broadly shared this definition was, and whether alternative recording practices existed (e.g. for religious minorities).

In some cases, such as patenting and accounting, registration was not compulsory. It is important to acknowledge that we analyse (part of) a network of co-patenting, not co-inventing, or a network of registered credit, not credit generally – especially as some actors might be more central in the former than in the latter. For example, in his network study of the papyri of Aphrodito in sixth-century Upper Egypt, Giovanni Ruffini (2008) found high centrality indices for relatively unknown figures. The papyri were the archives of a wealthy family and contained diverse legal documents. The central figures were literate individuals, including scribes and notaries. Ruffini concluded that their social prominence was more than a mere artefact of the documentary evidence, but it is important that he explicitly tackled the question, as his source did necessarily over-represent legal professionals and literate persons (Ruffini 2008:212–218). Records inform us on what was at stake in their production (who had access to writing and who chose to document what) as much as on their ostensible contents.

Networks of words

Are there any historical sources that are more direct traces of ties – that not only certify these ties, but are not separable from them? It is admittedly the case if we consider relations between words, rather than between persons or places: these word-to-word relations do not exist independently of

the source. Words can be defined as co-occurring if they appear in the same text, paragraph, sentence, etc. Co-occurrences have often been studied as networks – for example to describe changes in the vocabulary of State of the Union addresses since 1790 (Rule et al. 2015). Beyond co-occurrences, relations between nouns can be defined through verbs and prepositions. Charles Tilly used nineteenth-century British petitions to visualize changing relations between social groups and authorities *as they were described in these texts* (Tilly 1997). Corinne Bonnet’s project “Mapping Ancient Polytheisms” applies the same method to “onomastic sequences” of divine epithets drawn from epigraphic and literary sources, in the Greek and the Western Semitic worlds during the first millennium BC (Mapping Ancient Polytheisms Team 2017). In these two cases, even though relations between words are created by the writing of the source, researchers study them in order to gain access to social phenomena that existed outside of the texts. Moreover, the findings are influenced by the choices made to include or exclude certain texts from the dataset.

Therefore, the study of historical networks of words (or texts, as in citation networks) involves similar issues and decisions as those arising in the study of networks of persons or places. It is especially important to take the intentions of the authors of the texts, as well as the rules of the genre, into account. The Odyssey was not composed in order to position Poseidon or the nymphs in a network of divine epithets. If patterns in this network differ from those in later Greek inscriptions, it might be due to differences across genres as much as across periods.

[Figures 21.1 and 21.2 about here]

Two-mode networks from lists

Many network studies use their sources “against the grain,” documenting ties from texts that were not created in order to record those. Instead of studying credit through credit records, for example, they use information that is more or less inadvertently provided by the source on the topic of interest, as when an epic poem tells us something about the names of gods and goddesses. Networks extracted from lists are a frequent example of this reading against the grain.

Membership lists, along with citations, are among the historical data most frequently used in network analysis. Like citations, lists are reasonably easy to input, sometimes already digitized, and have given birth to a cottage industry of network studies of socio-political organisation that often pay little attention to the sources and their biases. A pioneer in the network study of firm

boards thus warned against the routine use of this type of data, emphasizing the need for more explicit hypotheses (Mizruchi 1996). Of course, this is no reason to abandon the systematic study of lists in terms of two-mode networks. This work has brought important insights into the history and sociology of firms and economic elites (for example Sheehan 2005), of associations that published lists of officials (for example David et al. 2016), and of resistance movements, thanks to lists reconstructed from police sources, personal archives and oral history (for example Osa 2003). Systematic investigations of lists of authors in literary journals made it possible to test hypotheses on the porosity of national and religious boundaries (Verbruggen 2007) and to draw out comparisons between national poetic fields (So and Long 2013).

Whatever the list – board members, leaders in a resistance movement, poets publishing in a magazine – the key question is: how do we interpret the co-presence of individuals on the list? The question is similar to those raised by archaeological co-occurrence networks, i.e. the co-presence of artefacts in a site: what does it indicate? (Peeples et al. 2016) In order to make sense of lists, we have to make hypotheses as to what might have caused the co-presence, what it exactly entailed (e.g. being aware of the other listed persons, meeting in the same room, interacting verbally, being allies, etc.) and what its consequences might be. Depending on these hypotheses, the same network indicators will have different meanings. In any network study, readers need to know why the ties are supposed to matter substantively, and whether we are trying to explain why these ties came to be or which influence they had on other phenomena (Munson 2019). In the case of co-occurrence networks, the need for hypotheses is compounded by the fact that the evidence is particularly indirect: we do not observe a trace of past interactions or relationships, but something that could be construed as a “proxy” for these ties. The reader is therefore entitled to a particularly careful explanation of what the co-occurrences are supposed to indicate.

Sociologists are more familiar to thinking in terms of hypotheses than historians. Perhaps for this reason, some boldly used historical sources against the grain, creating proxies of ties; but the best ones clearly stated that they did, explaining why and which limitations this entailed. For example, Karen Barkey used early modern Ottoman court records to infer relations between villages from interactions between persons (one testifying for or against the other) (Barkey and Van Rossem 1997). Emily Erikson digitised the records of more than 4,500 ship voyages in the context of the East India Company in the seventeenth and eighteenth centuries. From the trajectories of each

possible dyad of ships, she inferred that some captains had changed course following the discussion of commercial opportunities with other captains— hence a network of (probable) flows of information (Erikson and Samila 2018:1043–1045).

Past narratives on past ties

It is reasonably certain that the producers of most sources discussed thus far did not intentionally try to create a specific image of the network in question. Lists of opponents in state records are a possible exception: agents of repression could have received more or less explicit instructions to maximize or minimize the length of such lists. Such police records on “dark networks” could be described as narratives on ties. Representing them as networks only amounts to viewing the information that the person who ordered the report received in a different light.

Even though formalization gives an air of added objectivity, data built from narratives on ties remains different from data based on traces of interaction. I use the word “narratives” here not to denote literary fiction, but to single out the sources whose authors intended (among other purposes) to convey a specific view on the very ties that we, as researchers, are interested in. Those could also be called “intentional” sources (Howell and Prevenier 2005: 18–21) in the context of network research, as opposed to the “unintentional” sources that we read “against the grain.” In addition, the intention of narratives is not to record all ties, as in legal records (a different type of intentional source on ties), but to emphasize some. This should not prevent us from using data drawn from narratives, but it should inform their construction and interpretation.

The status of the source as a past narrative on past ties – neither a legally prescribed, nor an inadvertent trace of these ties – is even more apparent in correspondences. Most letters include narratives on interactions and relationships. It should always remain clear that data constructed from these narratives only represents the sender’s worldview – or, more accurately, their expression in the context of this correspondence. A pioneering paper in historical network analysis used Cicero’s letters in order to measure relationships between two social groups: senators and knights. The authors emphasized the biases of this source: they were not worse than in more traditional qualitative analyses of the same source, but quantification had not erased them (Alexander and Danowski 1990:320).

As their authors' intentions differ, several narratives on the same past ties are likely to produce different networks. There is a small group of papers that consider these differences not as an annoying bias, but as an object of research. Peter Bearman's team built networks of events from oral history narratives, for example on the revolution and counter revolution in a Chinese village (Bearman et al. 2002). Two events are connected if they are temporally ordered and logically linked. Considering a set of narratives that share some common events as a network gives rise to new interpretations. Narratives of Carib attacks on Colonial Forces in the sixteenth century have been re-examined in the same way (Shafie et al. 2017). However, this approach does not help if what we want to study is ties between persons or places, not events.

A more generally applicable aspect of Bearman's strategy is the idea that researchers should not simply aggregate all different accounts of the same ties. They often do so in the hope that the more data, the better. This hope is based on the idea that the many biases will cancel each other out; but there is generally no reason to believe this. Worse, carelessly aggregating data from different sources makes it more difficult to take these sources' respective biases into account. Bearman's insight is that we can learn something if we consider the biases not as an inconvenience, but as a source of information. He first presented it in a study of genealogies drawn up for noble families in early modern England (Bearman 1993). A nobleman could be described as the cousin of a noblewoman in one account, but not in another. Instead of trying to decide which source was more reliable, Bearman built a network of "kinship claims" (distinct from biological or legal kinship): a cousin-cousin edge could be non-reciprocal. As aristocrats tended to insist on their kinship ties with the most prestigious families, this amounted to reconstructing a social hierarchy. In the same spirit, sociologists studied texts written by poets to describe the poetic field: emic narratives on stylistic ties (Dubois and François 2013). They found that some prestigious poets were always described as associated with the same group of peers, while descriptions of other ego-networks were inconsistent. This indicates different degrees of institutionalization of stylistic categories.

[Figures 21.3 and 21.4 about here]

Comparing sources rather than just adding them up

Why should archaeologists care? Most artefacts can be considered as traces of interactions and relationships, but do not include narratives on ties – with the notable exception of epigraphic

sources (see Cline and Munson). There are however at least two good reasons for archaeologists to confer with historians who have addressed the challenges of discursive sources.

First, some archaeologists have the opportunity to confront data built from narratives and from excavations. Søren Michael Sindbæk studied place-to-place relations in the Viking period, based on the *Life of Anskar* on the one hand and on the co-occurrence of archaeological artefacts on the other hand (Sindbæk 2007). Similarly, historian Isabelle Rosé reconstructed (parts of) the ego-network of Queen Emma in the tenth century, using a narrative source as well as the joint signing of charters (Rosé 2018). Comparing the two sources rather than just adding them up provided information on their biases, hence on past attitudes toward some ties. But those are rare examples: the scarcity of evidence in many contexts leads researchers to indistinctly collate all the data at their disposal into the same datasets and network graphs. A wider conversation across disciplines on this type of comparison would be quite useful.

Secondly, archaeologists do in fact use textual data, including narratives on ties more often than most of them think. Whenever they build network data from pre-existing databases or from published reports rather than directly from sites or artefacts, they have to engage in textual source criticism. In many cases, the person who produced the original data is or was a fellow archaeologist trying, more or less, to record everything. But as they worked in a different context and were not interested in ties *per se*, we could think of them as the equivalent of producers of legal records, i.e. inquire into their definition of ties and nodes and into causes of omission from their records. In other cases, the excavation report is so different from current practice and seemingly non-exhaustive that we could interpret it like a narrative: to look for the author's motives and avoid aggregating it with other data.

Archaeologists and historians could therefore exchange ideas about fruitful ways to jointly use two or more types of sources with different biases to study the same question. When they use datasets built from heterogenous sources and/or in heterogenous ways, they should treat datasets in the same way historians treat historical text. This especially entails:

- considering the dataset itself as the product of intentional choices as to what to emphasize and what to omit, based on sources that were themselves either intentional or inadvertent traces of past interactions or relationships, or past narratives on them; understanding, as far as possible, how the primary sources were created and preserved *and* how the composite

repository was in turn created and transmitted; using this information to identify likely biases and to explicitly state how these biases might affect results;

- experimenting with the data itself: not only by aggregating data from diverse sources, in the hope of obtaining more data or of correcting data from one source using another, supposedly more accurate source; but also by disaggregating composite datasets in order to compare network patterns reconstructed from different sources, to measure their degree of correlation, and to interpret the differences in terms of biases. This experimentation might reveal otherwise undocumented elements of the history of the sources and repository: it can be an integral part of source criticism. It is also possible to experiment in order to assess the effect of missing data on interpretation (Peeples et al. 2016:74–78).

Where, what, who, when: practical advice on data construction

Apart from this admonition to resist the temptation of a naively additive construction of data, what lessons can historians and archaeologists draw from network studies using historical data? Table 21.1 summarizes specific advice for each type of source addressed in this chapter. Four additional recommendations apply to all types of sources.

Table 21.1: Building network data from historical and archaeological sources

Type of source	Examples of ties	Archaeological equivalent	Important questions to address
Certificates of tie	Marriage, economic exchange, collaboration	Inscriptions, stamps	Who did not use/have access to certification? Who defined the ties? How?
Text	Word co-occurrences	Words in inscriptions	Which versions of which texts do I include in my data? Do I hypothesize that the text reflected, influenced, or was influenced by a social practice, and if so, which?
Lists	Co-presence on the list	Co-presence in a place	Who drew up the list, and for what purposes? What was left out? What could have caused the co-presence? What could be the consequences of the co-presence?
Narratives on ties	Friendship, support, hatred, influence	Archaeological reports as narratives	Whose worldview are we observing? What was the intention of the author? Which nodes or ties did they omit, put forward, etc.? How did they categorize them?
Composite data built by previous researchers	All possible ties	Composite data built by previous researchers	All of the above; dataset identification/search strategy and context (purpose, possible agenda) of the aggregation itself

First, do not hesitate to add as many variables as you can think of to the edge list (Düring 2015), and fill your columns with details. You might later collapse everything under “kin,” or “were cited in the same text,” but you will be able to recategorize or exclude edges, depending on your questions. Keep track of the source for each edge. This implies that the dataset that you extract from the source (not the simpler one that you will input into your network software) should have one row *per mention of a tie* (in a specific source, at a specific date, with a specific designation, etc.), and not one row per tie.

Secondly, think carefully about what you are *not* observing. What are the boundaries of your network that derive from the limitations of the sources, and what are the boundaries that you have set yourself? Papers on network methods devised for field studies (such as Laumann et al. 1983) are not much help here. Historical data occasionally lends itself to a “socio-centric” study, i.e. you start with a list of nodes and looks for the existence or absence of a type of tie in each dyad (as in So and Long 2013). Even more rarely, you may carry out an “ego-network” study, i.e. start from a node (*ego*), list all the nodes (*alters*) that have a specific type of tie with ego, then look for the existence or absence of this type of tie in each dyad of alters (as in Düring et al. 2011; Rosé 2018). Almost none of the studies that I have cited before fall under any one of these two classical categories. The blossoming field of “network studies” on sender-receiver ties in correspondences often mentions “ego-networks,” but, strictly speaking, the term does not apply, because we generally cannot know whether the correspondents of ego wrote to each other (Grünbart 2005). We could call most networks constructed from historical data “source-centric,” as the researchers list all the ties of a certain type *mentioned by their source* and treat them as edges. They then derive a list of nodes from the list of edges and consider that the edge is absent from the dyads for which they found no mention. This has consequences in terms of interpretation, and this process creates specific structural features: for example, there are no isolates in a source-centric network (unless it is a one-mode network derived from an original two-mode network).

Thirdly, take some time to think about your nodes. Many researchers will pause to define what they call “friendship.” Fewer will take the trouble to explain what a “city” was or was not. However, choices as to the inclusion of suburbs or the historical definition of a “country” have consequences (Dedinger and Girard 2017; Ducruet et al. 2018:343) – as does the definition of a “site” in archaeology. Researchers working on narratives have to decide whether to focus on living humans or to include named animals, gods, etc., as nodes (Sindbæk 2007:63). Finally, some nodes remain anonymous or have very common names: should we aggregate them all, keep them separate or delete them? The best way to go is to experiment with different solutions and check whether this influences substantive results – as did Bronagh Ann McShane (2018:19–22), when confronted with anonymous recipients in her study of the correspondences of nuns.

Fourthly, taking time into account in network studies is always a challenge (Lemercier 2015). Taking time seriously begins with thinking about which dates and durations we know (do they

apply to edges or to nodes?) and what to do with the missing data. Historians are less accustomed to making explicit hypotheses about dates than archaeologists (Peeples et al. 2016:67–69), but it can be a fruitful experiment (Rosé 2018). Network research should also pay more attention to the difference between interactions (characterized by one date or a short duration) and relationships (longer-lasting potential for interaction). Think of the distinction between an event and a state (Munson 2019:41), as in “being married” as opposed to “marrying.” When edges can be dated in one of these two ways, successive snapshots of the network often bring illuminating results (see e.g. Ducruet et al. 2018; So and Long 2013). It might be worth experimenting with time spans of different durations, whether those are overlapping or distinct; or with keeping or deleting edges that end or nodes that cease to exist before each observation window (Düring et al. 2011). Sometimes, what matters most for the interpretation are the dates attached not to edges but to nodes (their date of birth, for example). In this case, using an axis to represent time in visualizations might reveal important patterns (Rule et al. 2015). This representation is especially meaningful when edges always link the older to the younger, as with filiation, citation, etc. (Bearman et al. 2002; Brudner and White 1997; Rosenthal et al. 1985; Sigrist and Widmer 2011). Finally, when the same node is observed over different periods, as is often the case with an association or journal, stratigraphy, a visualization method borrowed from archaeology, is a good way to observe change (Lemerrier 2015:203–205). It uses one node per observation period for each entity (association, site, etc.).

In order to better deal with time, as with other complications (and beauties) of historical and archaeological data, we thus need to be precise and cautious in data construction, which will allow us to boldly experiment with visualizations and calculations, and still produce meaningful interpretations.

Suggested reading

Düring, Marten

2013 HNR Bibliography. *Historical Network Research* (blog), January 27, 2013. <http://historicalnetworkresearch.org/bibliography/>, accessed August 28, 2020.

Graham, Shawn, Ian Milligan, and Scott B. Weingart

2016 *Exploring Big Historical Data: The Historian's Macroscope*. Imperial College Press, London.

Lemercier, Claire

2015 Formal Network Methods in History: Why and How? In *Social Networks, Political Institutions, and Rural Societies*, edited by Georg Fertig, pp. 281–310. Brepols Publishers, Turnhout, Belgium.

References

Alexander, Michael C., and James A. Danowski

1990 Analysis of an Ancient Network: Personal Communication and the Study of Social Structure in a Past Society. *Social Networks* 12:313–335.

Barkey, Karen, and Ronan Van Rossem

1997 Networks of Contention: Villages and Regional Structure in the Seventeenth-Century Ottoman Empire. *American Journal of Sociology* 102:1345–1382.

Bearman, Peter, James Moody, and Robert Faris

2002 Networks and History. *Complexity* 8(1):61–71.

Bearman, Peter S.

1993 *Relations into Rethorics. Local Elite Structure in Norfolk, England, 1540-1640*. Rutgers University Press, New Brunswick, New Jersey.

Brudner, Lilyan A., and Douglas R. White

1997 Class, Property, and Structural Endogamy: Visualizing Networked Histories. *Theory & Society* 26:161–208.

Collar, Anna, Fiona Coward, Tom Brughmans, and Barbara J. Mills

2015 Networks in Archaeology: Phenomena, Abstraction, Representation. *Journal of Archaeological Method and Theory* 22: 1–32.

David, Thomas, Alix Heiniger, and Felix Bühlmann

2016 Geneva's Philanthropists around 1900: A Field Made of Distinctive but Interconnected Social Groups. *Continuity and Change* 31:127–159.

Dedinger, Béatrice, and Paul Girard

2017 Exploring Trade Globalization in the Long Run: The RICardo Project. *Historical Methods* 50:30–48.

Dubois, Sébastien, and Pierre François

2013 Seeing the World through Common Lenses? The Case of French Contemporary Poetry. In *Constructing Quality: The Classification of Goods in Markets*, edited by Jens Beckert and Christine Musselin, pp. 174–193. Oxford University Press, Oxford.

Ducruet, César, Sylvain Cuyala, and Ali El Hosni

2018 Maritime Networks as Systems of Cities: The Long-Term Interdependencies between Global Shipping Flows and Urban Development (1890–2010). *Journal of Transport Geography* 66:340–355.

Ducruet, César, Sébastien Haule, Kamel Ait-Mohand, Bruno Marnot, Laura Didier, and Marie-Anne Coche

2015 Maritime Shifts in the World Economy: Evidence from the Lloyd's List Corpus, eighteenth to twenty-first Centuries. In *Maritime Networks: Spatial structures and time dynamics*, edited by César Ducruet, pp. 134–160. Routledge, Abingdon, New York.

Düring, Marten

2013 HNR Bibliography. *Historical Network Research* (blog). January 27, 2013. <http://historicalnetworkresearch.org/bibliography/>, accessed August 28, 2020.

2015 From Hermeneutics to Data to Networks: Data Extraction and Network Visualization of Historical Sources. *The Programming Historian* (4). DOI:10.46430/phen0044, accessed August 28, 2020.

Düring, Marten, Matthias Bixler, Michael Kronenwett, and Martin Stark

2011 VennMaker for Historians: Sources, Social Network and Software. *Redes* 21:421–452.

Erikson, Emily, and Sampsa Samila

2018 Networks, Institutions, and Uncertainty: Information Exchange in Early-Modern Markets. *The Journal of Economic History* 78:1034–1067.

Fleming, Lee, Santiago Mingo, and David Chen

2007 Collaborative Brokerage, Generative Creativity, and Creative Success. *Administrative Science Quarterly* 52:443–475.

Gestrich, Andreas, and Martin Stark (editors)

2015 Debtors, Creditors, and their Networks: Social Dimensions of Monetary Dependence from the Seventeenth to the Twentieth Century. *German Historical Institute London Bulletin Supplement* No 3.

Godechot, Olivier

2011 How Did the Neoclassical Paradigm Conquer a Multi-disciplinary Research Institution? Economists at the EHESS from 1948 to 2005. *Revue de la régulation* 10. DOI: 10.4000/regulation.9429, accessed August 28, 2020.

Grünbart, Michael

2005 'Tis Love that has Warm'd us. Reconstructing Networks in 12th-century Byzantium. *Revue belge de philologie et d'histoire* 83:301–313.

Howell, Martha C., and Walter Prevenier

2005 *From Reliable Sources: An Introduction to Historical Methods*. Cornell University Press, Ithaca, New York.

Kossinets, Gueorgi

2006 Effects of Missing Data in Social Networks. *Social Networks* 28:247–268.

Laumann, Edward O., Peter V. Marsden, and David Prensky

1983 The Boundary Specification Problem in Network Analysis. In *Applied network analysis*, edited by Ronald S. Burt and Michael J. Minor, pp. 18–34. Sage, Beverly Hills, California.

Lemercier, Claire

2015 Taking Time Seriously: How do we Deal with Change in Historical Networks? In *Knoten und Kanten III. Soziale Netzwerkanalyse in Politik- und Geschichtswissenschaft*, edited by Marten Düring, Markus Gamper, and Linda Reschke, pp. 183–211. Transcript Verlag, Bielefeld, Germany.

Lucas, Gavin

2010 Time and the Archaeological Archive. *Rethinking History* 14:343–359.

Mapping Ancient Polytheisms Team

2017 About the Project. *Mapping Ancient Polytheisms. Cult Epithets as an Interface between Religious Systems and Human Agency* (blog). <https://map-polytheisms.humanum.fr/about-the-project/?lang=en>, accessed August 28, 2020.

McShane, Bronagh Ann

2018 Visualising the Reception and Circulation of Early Modern Nuns' Letters. *Journal of Historical Network Research* 2:1–25.

Mizruchi, Mark S.

1996 What Do Interlocks Do? An Analysis, Critique, and Assessment of Research on Interlocking Directorates. *Annual Review of Sociology* 22:271–298.

Morrissey, Robert Michael

2013 Kaskaskia Social Network: Kinship and Assimilation in the French-Illinois Borderlands, 1695–1735. *The William and Mary Quarterly* 70:103–146.

Munson, Jessica L.

2019 Epistemological Issues for Archaeological Networks: Mechanisms, Mapping Flows, and Considering Causation to Build Better Arguments. In *Social Network Analysis in Economic Archaeology – Perspectives from the New World*, edited by Tim Kerig, Christian Mader, Katerina Ragkou, Michaela Reinfeld, and Tomáš Zachar, pp. 37–50. Verlag Dr. Rudolf Habelt, Bonn, Germany.

Osa, Maryjane

2003 *Solidarity and Contention: Networks of Polish Opposition*. University of Minnesota Press, Minneapolis.

Padgett, John F., and Christopher K. Ansell

1993 Robust Action and the Rise of the Medici, 1400-1434. *American Journal of Sociology* 98:1259–1319.

Peeples, Matthew A., Barbara J. Mills, Randy Haas, Jeffery J. Clark, and John M. Roberts

2016 Analytical Challenges for the Application of Social Network Analysis in Archaeology. In *The Connected Past: Challenging Networks in Archaeology and History*, edited by Tom Brughmans, Anna Collar, and Fiona Coward, pp. 59–84. Oxford University Press, Oxford.

Rice, Yael

2017 Workshop as Network: A Case Study from Mughal South Asia. *Artl@s Bulletin* 6(3):50–65.

Rosé, Isabelle

2018 Around Queen Emma (ca. 890-934): Networks, female biographical itinerary and documentary questions in the early High Middle Ages. *Annales HSS* 74: 817-847.

Rosenthal, Naomi, Meryl Fingrutd, Michele Ethier, Roberta Karant, and David McDonald

1985 Social Movements and Network Analysis: A Case Study of Nineteenth-Century Women's Reform in New York State. *American Journal of Sociology* 90:1022–1054.

Ruffini, Giovanni Roberto

2008 *Social Networks in Byzantine Egypt*. Cambridge University Press, Cambridge, United Kingdom.

Rule, Alix, Jean-Philippe Cointet, and Peter S. Bearman

2015 Lexical Shifts, Substantive Changes, and Continuity in State of the Union Discourse, 1790–2014. *Proceedings of the National Academy of Sciences* 112:10837–10844.

Shafie, Termeh, David Schoch, Jimmy Mans, Corinne Hofman, and Ulrik Brandes

2017 Hypergraph Representations: A Study of Carib Attacks on Colonial Forces, 1509-1700. *Journal of Historical Network Research* 1:52–70.

Sheehan, Brett

2005 Myth and Reality in Chinese Financial Cliques in 1936. *Enterprise and Society* 6:452–491.

Sigrist, René, and Eric D. Widmer

2011 Training Links and Transmission of Knowledge in 18th-century Botany: A Social Network Analysis. *Redes* 21:347–387.

Sindbæk, Søren Michael

2007 The Small World of the Vikings: Networks in Early Medieval Communication and Exchange. *Norwegian Archaeological Review* 40:59–74.

Smith, David A., and Douglas R. White

1992 Structure and Dynamics of the Global Economy. *Social forces* 70:857–893.

So, Richard Jean, and Hoyt Long

2013 Network Analysis and the Sociology of Modernism. *boundary 2* 40(2):147–182.

Tilly, Charles

1997 Parliamentarization of Popular Contention in Great Britain, 1758-1834. *Theory & Society* 26:245–273.

Verbruggen, Christophe

2007 Literary Strategy during Flanders' Golden Decades: Combining Social Network Analysis and Prosopography. In *Prosopography Approaches and Applications. A Handbook*, edited by Katharine S. B. Keats-Rohan, pp. 579–599. Unit for Prosopographical Research, Oxford.

Figure 21.1: Example of use of a certificate

(Adapted and translated) extract from an official register of marriages
On January 2, 1850, Jean Dupont, carpenter, born in Steenvorde [...], living in Lille, [...] married Marie Michel, seamstress, born in Lille [...], living in Lille [...]
On January 3, 1850, Augustin Legrand, day laborer, born in Loos [...], living in Loos, [...] married Jeanne Durand, maid, born in Caëstre [...], living in Lille [...]
[...]

-> A network of migrations between towns
"Migration" defined as a movement by married people between their birth and marriage, creating a tie between the place where they were born and the place where they lived just before marrying
Layout based on geographical positions; white/grey/black based on main language spoken in each place (according to a different source).



Figure 21.2: Example of use of word co-occurrences

Extract from a column by economist Milton Friedman in the magazine *Newsweek*, June 1979

As I was daydreaming the other day, I fancied that I heard President Carter give the following talk:
"For many years, your government has been trying to fine-tune monetary and fiscal policy in order to avoid both unemployment and inflation. A growing number of people - inside government and outside - have concluded that such fine-tuning has not worked. It has not prevented repeated recessions. It has not prevented worse and worse inflation. "Our government's failure in this important area inevitably raises questions about its performance in other respects. [...]"

-> A network of co-occurrences between words
Corpus (collected by Tiago Mata): columns by Friedman in *Newsweek*, 1975-80
"Co-occurrence" defined as presence in the same sentence; "sentence" defined based on length and punctuation; calculations performed by the R package IRaMuTeq. Graph restricted to substantive words used > 100 times

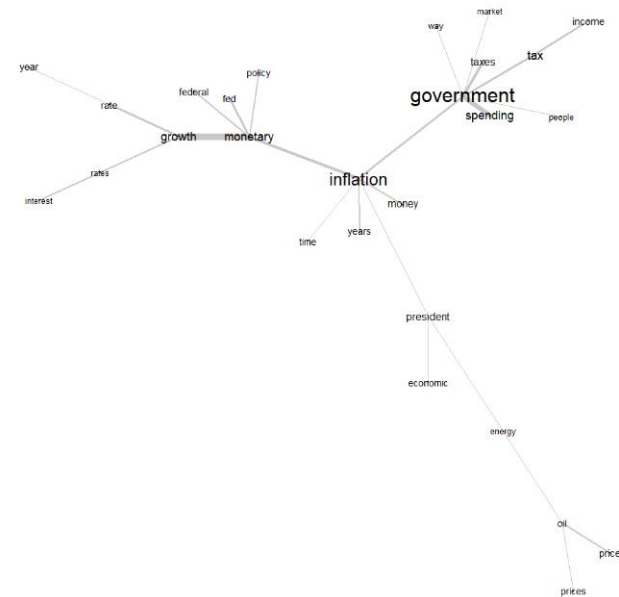


Figure 21.3: Example of use of a list of names

(Adapted and translated) extract from a stock exchange directory published in 1980
OPFI-Paribas (bank)

François Morin	President of the Board
Raymond-Maurice Doumenc	Vice-president of the Board
Gustave Rambaud	Board member and executive officer
Paul Baseilhac	Board member
Jean-Pierre Bouyssonnie	Board member
Hubert de Nonneville	Board member
[...]	

-> A network of shared board members (“interlocking directorates”)

The nodes represent financial firms among the 120 French firms with the highest market capitalization in 1979. The edges represent shared board members (wider edges represent more than one person). “Board” includes the board *per se* and the executive committee.

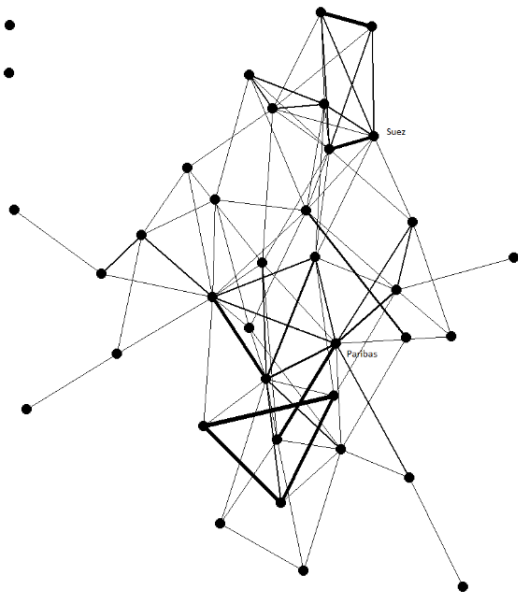


Figure 21.4: Example of use of a narrative

Extract from the correspondence of Libanius (fourth century A.D.) (from Letter 906, translated by Lieve van Hoof, who also identified the actors mentioned in brackets)

To Proculus. The man who has composed and taught many speeches [sc. Eusebius 24/xxii]... is being forced to become a councillor instead of a teacher, against the decision of the council and of the divine emperor [sc. Theodosius 4/0]. He has letters of both, and if your father [sc. Tatianus 5/i] commands that he show them, he will do so. So keep intact for yourself and your father the reputation you both have as lovers of rhetoric, and keep intact for me my collaborator, whose help disguises my old age: get angry and do not allow so impious an action to start at a time when the two of you hold office.

-> A network of ties of different types used to procure resources

Drawn by Lieve van Hoof, reproduced with her kind permission

The nodes represent actors or groups of actors. The edges represent different types of interactions or relationships, such as “has helped”, “has harmed,” “is the son of”, “likes”, etc. Wider edges represent ties that are mentioned more than once.

