

## Networks, Maps, and Time: Visualizing Historical Networks Using Palladio

Melanie Conroy <mrconroy\_at\_memphis\_dot\_edu>, The University of Memphis

### Abstract

Many tools can produce maps, graphs, and charts that may differ in seemingly minor ways. Data visualization tools are one type of “middleware” that can be all but forgotten when one is presented with final products such as papers and presentations containing visualizations [Drucker and Svensson 2016]. Since the output of various software packages is sometimes similar, it is easy to forget the assumptions that went into the diagram, the dataset, and the software when looking at the final product — or even while using the tool if one becomes sufficiently accustomed to the interface. In this review, I revisit the visualization suite Palladio — which Miriam Posner has called a “Swiss Army knife for humanities data” [Posner 2014] — and the many projects that have made use of Palladio’s core features in the years since its launch. I examine the strengths and limitations of Palladio, as a network and map-making tool for exploring data and for rapidly prototyping diagrams, designed with an iterative process in mind. I contrast this iterative mentality with the analytic sensibility of tools like Gephi and Cytoscape, and review the primary features of Palladio with one primary case study (my own visualizations of the French Enlightenment network) and examples of how the features have been used in other digital humanities projects. Palladio is very useful for qualitative studies of data that include geospatial and chronological dimensions, especially when the data are tagged with different types of qualitative metadata, but it also tends to impose a historical geographical view on the data by foregrounding geospatial relationships, time, and other historical considerations.

### Introduction

Data visualization is a complex process because creating a single visualization requires an understanding of principles of design and mathematics, as well as the content that is being visualized. For humanists, finding collaborators in data science and design can be a practical and financial challenge. Fortunately, there are some tools and tool sets which can aid with the design process and prototyping of diagrams. In this tool review, I revisit Palladio [Humanities + Design Lab 2014], a digital humanities package developed in the Humanities + Design Lab at Stanford University in a collaboration with the DensityDesign Lab in Milan. Palladio has now been available for more than five years and has been used to visualize everything from the appearances of “ladies orchestras” in Europe from 1870 to 1918 [Koivisto 2019] to participants in Black Tech from 2014 to 2018 [MikeR 2019]. I have surveyed as many projects using the tool as I could find and will include examples of use cases and feedback on the tool from projects worldwide.

Palladio is a tool for filtering data and quickly producing diagrams that display data spatially and alongside temporal dimensions like timelines and timespans; it lacks the network analytics of software packages built for mathematical analysis. The online app allows for the presentation of multifaceted data, such as network data with date ranges or categories like network type with location data. Palladio was developed in the Humanities + Design Lab by Dan Edelstein, Nicole Coleman, Ethan Jewett, Giorgio Caviglia, and others to fulfill partially the vision for “Knot,” “an interface for the study of social networks in the humanities” [Uboldi et al. 2013]. The Palladio tool suite lends itself to qualitative studies because the visualizations that it produces (maps, network graphs, tables, and galleries) are familiar to most humanists. Producing iterative versions of such diagrams for the sake of quick comparison between them is a good way to explore multifaceted data that have not been curated for one use or with one particular hypothesis in mind — a collaborative research process which has been referred to as “design thinking” [Ciuccarelli 2014]. As such, Palladio is a powerful tool for exploring data and patterns qualitatively. Unlike many other network graph packages, like Gephi

[Bastian et al. 2009], with which it shares some network graphing features, Palladio does not have the capacity for network analytics and is limited in choices such as graph layouts, which are not customizable in Palladio but are in Gephi. Rather, Palladio presents an overall good fit for historical case studies. It is in this respect that Palladio is a kind of “middleware” — in the terms of Drucker and Svensson — or a software solution that makes important design decisions for the user and makes some of these design decisions less apparent to viewers of any resulting visualizations [Drucker and Svensson 2016].

Palladio was developed for use by historians and those working in related disciplines like area studies, art history, literary history, and media and cultural studies, in which historical time and space are useful concepts. The discussions which led to the creation of the tool followed a lab model: that is, “analyzing best practices, employing design research methods, engaging in peer critiques, involving usability testing and user evaluations, and further expanding the role of infoVis to the content of service design and the trends of design for social good” [Shen 2018, 22]. The lab model, which is collaborative and open-ended, has frequently gone by the trendy name “design thinking” but is really just an abstracted form of the design process, which, in the case of Palladio, meant an ongoing collaboration between humanists and designers. The focus on ease of use, combining types of diagrams, and quick prototyping came out of Mapping the Republic of Letters [Humanities + Design Lab 2019] [Edelstein et al. 2017], a large project of which many component projects are historical, as well as a 2012 Humanities + Design Lab workshop that focused on the visualization of time and networks, “Early Modern Time & Networks.” While those activities did not share a single methodology or set of research questions, they, for the most part, dealt with social networks in Early Modern Europe and the Americas from 1500 to 1800. The diversity of research projects presented a variety of use cases, from correspondence networks to travel itineraries to galleries of individuals’ photos. The involvement of DensityDesign was decisive for both the use of Mike Bostock’s d3.js library in visualizations and for the focus on prototyping and flexibility of tools. Like DensityDesign’s other open source web tool, RAWGraphs [DensityDesign Lab 2013], Palladio provides “a missing link between spreadsheet applications (e.g. Microsoft Excel, Apple Numbers, OpenRefine) and vector graphics editors (e.g. Adobe Illustrator, Inkscape, Sketch)” [DensityDesign Lab 2019]. Whereas Palladio generates mainly maps and network graphs, RAWGraphs can produce a wide range of charts from box plots to scatterplots to treemaps [Mauri et al. 2017]. As Yvette Shen has observed, RAWGraphs “adopt[s] clean and crisp aesthetics” of modern graphic design influenced by the Bauhaus School and the International Typographic Style with “geometric layout, orderly typography, effective use of white space, and simple color composition” [Shen 2018, 6–7]. Palladio similarly makes use of a modern graphic design style for both the interface and outputs.

Since historians often have set archives or pre-established datasets but do not necessarily have preconceived ideas of what patterns they will find in the data, priority was placed on the ability to rapidly prototype diagrams to see whether interesting patterns appear, as well as the ability to filter data in order to look at subsets. Simplicity of the interface allows for the quick creation of diagrams that are highly legible in print format or as static images online; visualizations can be exported as SVG files to be refined in vector graphics editors like Adobe Illustrator or Inkscape. The maps and diagrams produced in Palladio are not copyrighted and can be printed in commercial and non-commercial works, unlike maps produced in Google Maps, for example. Palladio can also be used to produce tables and galleries that allow individual records to be explored via filtering by categories, timespans, and timelines. By moving between the maps/graphs and tables/galleries, researchers can find patterns in the data and then identify which records are a part of the patterns. Thus, the focus in using Palladio is on moving between diagrams and between types of diagrams rather than drilling down on one type of visualization or graph.

## Features and Case Studies

In the interest of showing how this prototyping works and also explaining some of the features of Palladio, I will walk through some examples of diagrams produced in Palladio and discuss features like filtering that can be used to rapidly prototype diagrams. I will also give examples from other projects and comments from other researchers who have used each feature in their work. Since they are the most popular features, I will focus most of my commentary on maps and network diagrams. Other demos that review aspects of Palladio include Posner (2014) and Marten Düring’s review in the *Programming Historian*, where he concludes that it is “platform-independent and particularly easy-to-use” [Düring 2015]. Düring’s demo includes sample data and a thorough discussion of how to structure network data for visualization

in Palladio, which I will not be able to treat here. The data used in my visualizations are correspondence and demographic data from the Electronic Enlightenment Project and the Groupe d'Alembert [Comsa et al. 2014]. The metadata are enriched according to the methods described in the article "The French Enlightenment Network" [Comsa et al. 2016]. The French Enlightenment Network dataset is available online in multiple formats, with examples of diagrams in various formats here: <http://bit.ly/VisualizingFEN>. It is worth knowing that the dataset is a list of individuals with basic demographic data (name, birth and death places and years, nationality, gender, etc.) and also placement into one or more networks such as "Letters\_Philosophical" for writers on philosophical subjects, and "Aristocracy" for members of the nobility.

First, a few words about setting up the software and creating a dataset. Palladio is available as an installable software package or as a web tool; the web tool is available at <http://hdlab.stanford.edu/palladio/>. Either way, access is through a web browser. The first step to creating a visualization is to select "Create Project" and input data. There are several ways to input data into Palladio. Data can be imported from a Google spreadsheet, a proprietary tablature file (TAB) or the more common tab-separated values table (TSV) or comma-separated values table (CSV), or copied and pasted from other applications like Microsoft Excel, Numbers, TextWrangler, or TextEdit. Data that are pasted into the online form and uploaded are then automatically recognized as text, numbers, dates, coordinates. If the data type is not recognized or misrecognized, that can be corrected by clicking on the pencil icon to open the data verification window and change the data type. Columns can be hidden by clicking on the eye icon; if they are hidden, it will not be possible to visualize the data in that column until the column is made visible again. The filename and the name of the data table can be changed.

Within the data verification window, there is a preview of the data. There are two more functions to be aware of: 1) splitting multiple values and 2) extending the data table. Palladio supports multiple values, such as multiple tags for the same record; for example, the city of Berlin could be tagged "German" and "Large city" by creating a column for cities and a column for city characteristics; within the "city characteristics" column would be "German;Large city" if the delimiter were a semi-colon. Using multiple values in a cell is useful for unstructured datasets where the rows and columns might be pre-determined but where researchers might want the freedom to add values as the dataset is created. For instance, most people might have one nationality, but a few might have more than one. In this case, most cells would contain one value, like "American," but the nationality cell of a binational could contain two values, like "American;Mexican," that would be readable as separate values. The delimiter (any character, often a comma or semi-colon) can be selected within the data verification window; consecutive delimiters can be treated as one so that a comma and a space are counted as one.

The second feature, extending the data table, is useful if the dataset contains more than one table, or if the dataset has many repeated values which are consistently associated with the same values. One use case is for LatLong coordinates; where the primary dataset contains the same place multiple times, LatLong coordinates can be associated with those places by extending the "Places" column with a data table consisting of the "Places" as text and another column of coordinates. Similarly, metadata about texts and their authors can be kept on separate spreadsheets and combined within Palladio as long as there is one column in each data table that matches the values in a column in the other table.

Once the dataset is imported and verified, the next step is to choose a type of visualization. Not all visualizations work for all data types. Map View needs coordinates. The Network Graph View needs at least two columns of data and should only be used if there is a consistent logic of connection between these two columns. Since Palladio doesn't allow for much customization of graphs, the eventual product will be a bipartite graph with two types of nodes or entities. The edges, or links, cannot be weighted. The Gallery View requires images. Tables are very versatile and work well with large datasets. For this reason, it is important to think about what to do with Palladio before producing a dataset. Palladio is very flexible in importing data, but once it is imported, extending the data table may be the only way to add missing data types, and data cannot be edited within Palladio. I will now look at how to produce the four kinds of diagrams and some notable features of each. Mark Braude produced a very brief overview of features with screenshots [Braude 2014]. A more technical overview of features is available in Humanities + Design Lab (2014).

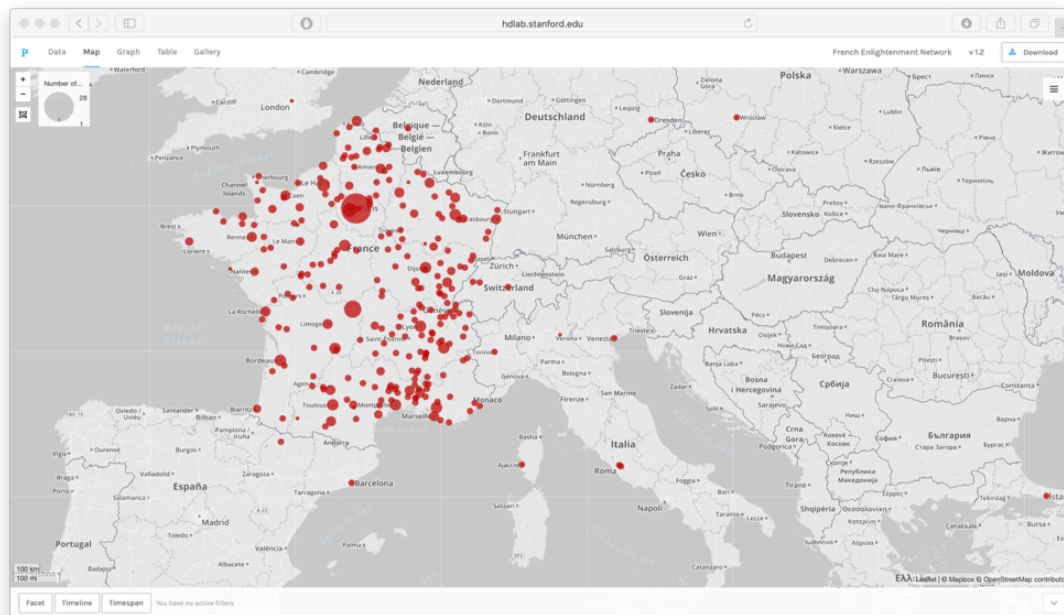
## Two Kinds of Maps: Points Versus Point-to-Point

First, I will look at the Map View in Palladio. There are two map types: 1) maps with points sized according to defined quantities, which are useful for displaying static geographic information, and 2) point-to-point diagrams, which are more useful for showing movement or change over time. Maps can be used to compare the weight, or influence, of cities, as well as travel and communication between cities and other geographical points. The data for both of these map types can be filtered to show a subset of the data, according to categories chosen by the user.

10

The first type of diagram (Figure 1) consists of points on a map. Producing diagrams of this kind requires LatLong coordinates for all locations. Such maps can easily display quantities associated with a particular place — for example, quantities of people, events, or items. Points maps are recommended for data on population, the production of books, the number of events, and so on. The nodes can be sized by the number of records at each LatLong. Figure 1 shows the predominance of Paris as a birth place for members of the French Enlightenment network. While the size of smaller points can be hard to make out, numbers of records and the names of places can be displayed on a tool tip so that hovering over each circle reveals the name and number of records at each point. Unlike in a list, it is easy to visually compare the weight of regions. Here the weight of the southeast is notable, despite the relative insignificance of each point in comparison to the total numbers for Paris. It is also visible that Lyon, at the center of the map, is a significant location for the birth of members of this group, although the central region otherwise has few important locations.

11



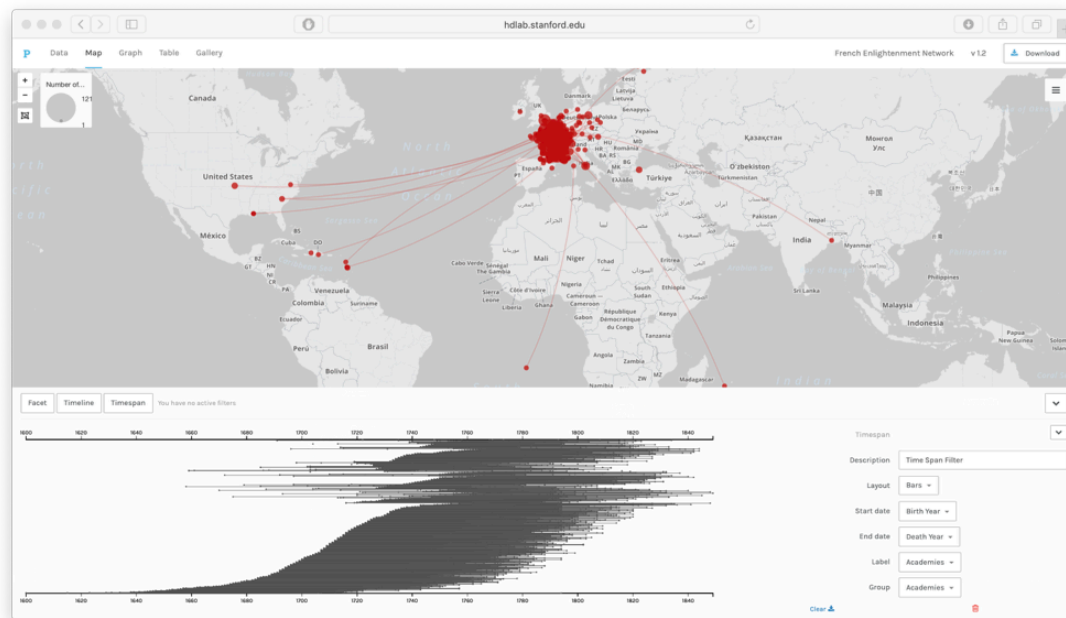
**Figure 1.** Birth Places of Members of the French Enlightenment Network

The strength of the points map is how easily it generates a simple geographic visualization. A list of places with LatLongs can be inputted in the data panel and visualized within seconds. Alternatively, a dataset can be uploaded with only the names of places and a separate table with LatLongs can be linked to the dataset. Doing so is recommended for large datasets with repeated places. Finally, a list of places with LatLongs could be uploaded with numerical values, such as the number of people born there. The flexibility of the tool means that many types of data can be visualized. It also means that an identical visualization can be produced in multiple ways without modifying the data. One limitation is that latitude and longitude coordinates must be in the same cell separated by a comma; both values must be combined before importing the LatLong data into Palladio.

12

The second kind of map is a point-to-point diagram (see Figure 2). Point-to-point maps are particularly useful for humanities research because they show network connections in a way that is intuitive to humanists by overlaying them on a map.

13



**Figure 2.** Linked Birth and Death Places of Members of the French Enlightenment Network with Timespan

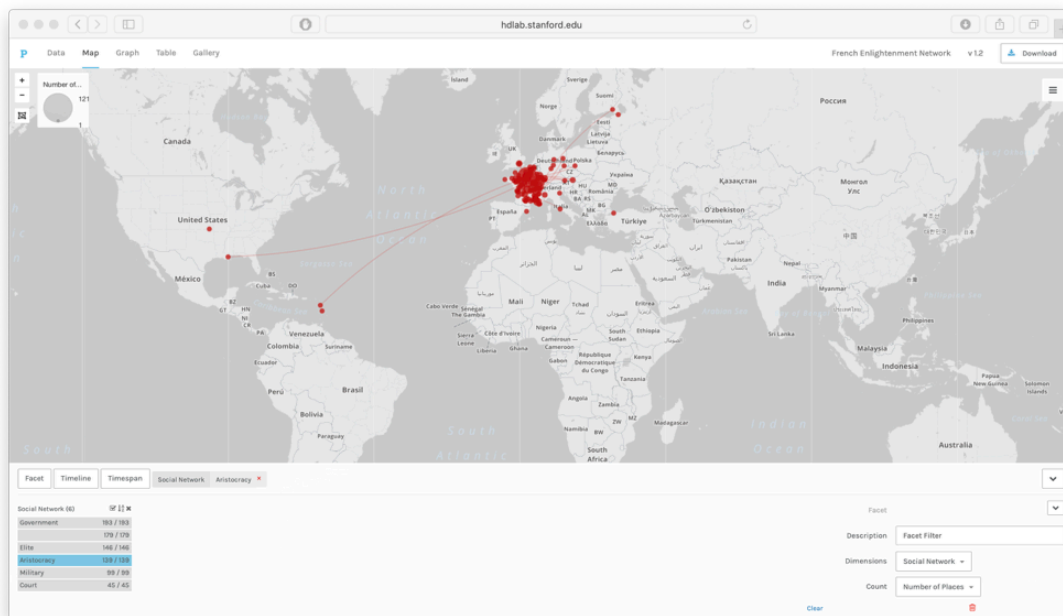
Point-to-point maps are ideal for displaying trajectories, such as travel, or communication between population centers, such as the sending of letters. This map type requires LatLong coordinates for two distinct locations. The edges — the connections between points — could represent any number of other network relationships between two locations. The points are sized according to the total count of the items associated with that location. Features that users found lacking include the lack of directionality in point-to-point maps [Jensen et al. 2014] and an inability to produce interactive maps and diagrams [Posner 2014].

14

## Filtering

While maps are not new tools for humanists, digital technology allows for more sophisticated and rapid comparisons between subsets of data. Palladio makes filtering data easy and quick; in fact, producing a different map takes only a few seconds. In the case of the French Enlightenment Network, the individuals have been coded by gender, nationality, social networks (Elite, Aristocracy, Military, Court), professional networks (Artisan, Finance-banking, Cultural, etc.), and knowledge networks (Letters, Sciences, etc). These individuals also have birth years, death years, birthplaces, and death places associated with them, where this data is known. Filtering allows us to look at a series of maps and compare them easily. Figure 3 shows the linked birth and death places of aristocrats in the French Enlightenment Network.

15



**Figure 3.** Linked Birth and Death Places of Members of the French Enlightenment Network Filtered (Aristocracy)

In order to filter data, a third column should include the categories of places to be visualized; in this case, the birth places can be filtered by the gender of the participants in the French Enlightenment or by their participation in other networks like academies and salons. By comparing maps filtered by category or timeline/timespan, we can look for patterns in subsets of the data.

16

In Figure 4, the linked birth and death places are displayed on a map alongside a timeline of death years as a bar chart. The timeline can be opened or closed with the arrows on the right side. It can also be deleted by clicking on the red icon of a garbage can.

17



**Figure 4.** Linked Birth and Death Places of Members of the French Enlightenment Network with Timeline by Gender

In this diagram, the data points are grouped by gender. The light grey bars represent the number of women's deaths in that year and the dark grey bars represent men's deaths in that year. As we can see, there are many more men in the dataset who died in all years, and sometimes no women, yet the women who do appear in the dataset were more likely to die in later years, and very few women died in the early part of the eighteenth century. This supports the idea of women becoming more important in correspondence networks later in the century. Within Palladio, the timeline can also be filtered by selecting part of the timeline. In that case, only some of the point-to-point trajectories will be seen on the map. The data can also be grouped by other categories like nationality and social networks so that we can compare the geographic and temporal distribution of those groups using the Time Line and the Map View together.

18

The Map View with a Time Line has been one of the most popular combinations. The Sphaera project uses Palladio (among other tools) to investigate “the process of emergence of new epistemic communities” [Valleriani et al. 2019]. They use the Map View with a Time Line to visualize the “geotemporal distribution of the production of the treatises” in their corpus. Braude's demo video “Monte Carlo arrival” [Braude 2015] shows how to use Palladio's point-to-point map and a timeline to create a video showing historical growth over time. A similar effect can be used by advancing the timeline and taking snapshots of the map or network and then labelling the images. The Map View has also been used by various projects to map data from the Early Modern Letters Online data; one example is “Samuel Hartlib's social relationships” on a map with a Time Line [Tuominen et al. 2018].

19

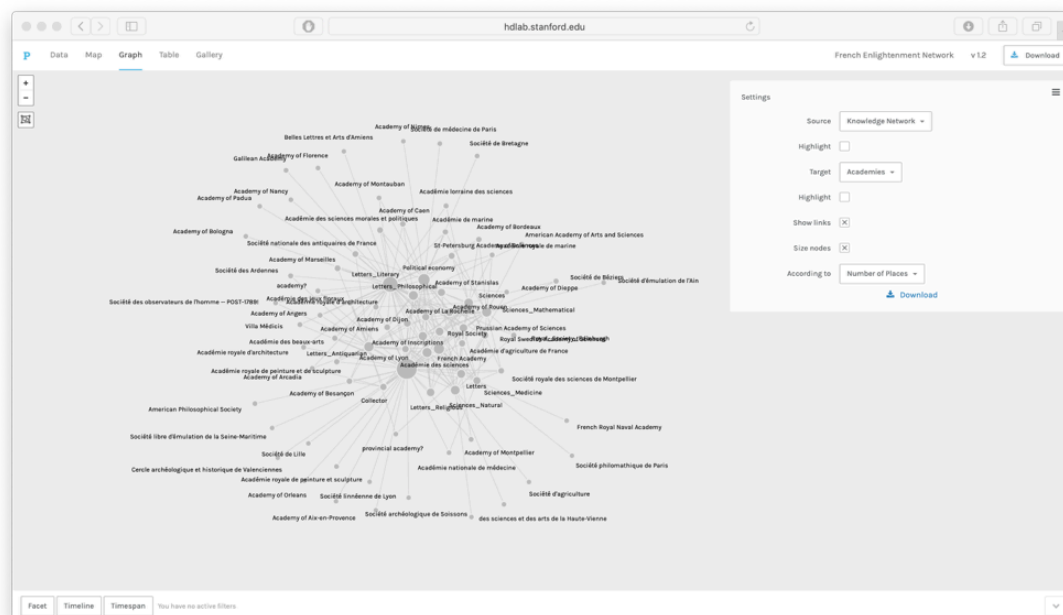
## Network Graphs

The second type of data visualization to discuss is the Graph View, which is useful in the study of networked people or things. A network can link people, places, books, or any other entities that are connected to one another. People or groups are commonly nodes in graphs of social networks. Network graphs are helpful in seeing connections between people or groups. They also aid in understanding how groups are structured. A network graph is a set of points (called nodes), connected by links (called edges). There exist related software packages for network analysis — notably Gephi, a computer program designed for the quantitative study of networks that is a more customizable version of the network function in Palladio. Palladio's network feature has been used to map the movement of Chinese immigrants from the village of their origin to destinations in Canada, mostly on the West Coast, recorded between 1886 and 1949 [Zhang and Cho 2018]. Zhang and Cho found that there was a clustering effect where immigrants to a particular destination were more likely to come from the same villages in China. That said, Palladio does not allow for the computation of clustering coefficients or other analytics that would work at a larger scale to draw out such relations in a larger dataset.

20

For this demo, I choose “Graph” from the top menu. Figure 5 shows the academy affiliations of members of the French Enlightenment Network with the knowledge networks of academy members. Each edge shows a knowledge network that is present in an academy. The nodes are sized according to the number of members of the academy or knowledge network. The edges represent knowledge networks that share members of academies — in other words, this network graph shows the interrelation of “fields” and academies, not just the disciplines which are represented in the academies but all of the major interests of academy members, including those that are not represented in the academies.

21



**Figure 5.** Network of Academy Affiliations and Knowledge Networks

Finally, the network graph can be downloaded as an SVG file to further customize the vector graphics or to integrate the vector graphics into another visual document. The simple design of the Graph View highlights Palladio's modern sense of design and a lack of scientific complexity, which can be refreshing from a design standpoint but, perhaps, frustrating if taken from the standpoint of a scientific researcher seeking to encode the maximum amount of information into the data, rather than make a clear and comprehensible diagram which follows modern design aesthetics.

## Tables

A third data visualization, the Table View, is used for creating lists and reordering data according to various categories. This function is available in spreadsheet software like Excel, Google Sheets, or OpenRefine, but the tables function in Palladio is easier to use and does not require the use of formulas or macros. The data table can also contain more than one column that is rearranged according to the categories in the first column. Finally, the data table can be filtered easily.

Data	Map	Table	Gallery
French Enlightenment Network v1.2 <a href="#">Download</a>			
<b>Knowledge Network (2 of 12 rows displayed)</b> <a href="#">Academies</a>			
Sciences_Natural		Full Name Reversed	
Academy of Dijon, Académie d'agriculture de France, Académie des sciences, Prussian Academy of Sciences, Academy of Lyon, Société royale des sciences de Montpellier, Academy of Stanislas, Royal_Society_Edinburgh, Royal Society, French Academy, Royal Swedish Academy of Sciences, Société d'agriculture, des sciences et des arts de la Haute-Vienne, Academy of Amiens, Société d'agriculture de Lyon		La Marche, M. –, Leclerc, Georges Louis, comte de Buffon, Beugnot, Claude, Dodart, Denis, Claret de La Tourrette, Marc Antoine Louis, Magnot, Piern Liotard, Pierre, Duncan, Dr Daniel, Privy, D. Emmanuel, Vauguelin Des Yvetaux, Jean, Dugun de Francueil, Louis Claude, Marsigny, Jean de, Maupertui René de, marquis de Maisons, Cisternay Du Fay, Charles François de, Varrenne de Fénelo, Philibert Charles Marie, Claret de La Tourrette de Fleuries, Philippe, Formeusse, M. – de Louis Claude Dupin de Francueil, Hellet, Jean, Cabanis de Malçacagnac, Jean Baptiste, Desmarest, Nicolas, Commençon, F patriarch of Antioch, Guyot, Alexandre Nicolas Dupuy, marquis de Malche-Villecomte, Dionisius, G., Desportes, M. –, Cuvier, Baron Georges Léopold I Charles Joseph, Rozier, François, Saint-Hilaire, Louis Henri Pascal de, Baron de Faugères, Leblanc de Pressé, Achille Guillaume, Gouan, Antoine, Robin Bernard, Geoffroy, Jean Nicolas Olsain, La Felles, Louis Guillaume de, Clappier, Pierre, Sage, Bathazar Georges, Faujas de Saint-Fond, Barthélemy, I Camus, Gabriel Etienne	
Sciences_Medicine	Royal Society, French Academy, Academy of Sciences, Académie d'agriculture de France, Academy of Inscriptions, Académie nationale de médecine, Société philomathique de Paris, Prussian Academy of Sciences, Academy of Rouen	Jaucourt, Louis de, Cabanis, Pierre Jean Georges, Du Monchaux, Pierre Jean, Menuret de Chambaud, Jean Jacques, Barthez, Paul-Joseph, Bourguet, Claude, Pomme, Piern, Coste, Jean François, Passerat de La Chapelle, Claude François, Helvétius, Jean Claude Adrien, Bagieu, Jacques, La Virolette, Louis Anne de, Desrochers, Louis, Revillon, Claude, Daran, Jacques, La Montagne, Etienne de, Le Cat, Claude Nicolas, Gay, Jean Antoine, Bagard, Charles, Guide, Philippe, Guillery, Pierre, Saingemadin, – de, Janin de Combe-Blanche, Jean, Vieussens, Raymond, Aignan, Rev. François, Duncan, Dr Daniel, Sénac, Jean Baptiste, Gondron, Claude Deshaies, Bertin, Euxippe Joseph, Chomet, Jean Baptiste Louis, Offray de La Mottrie, Julien	
Sciences_Mathematical	French Academy, Royal_Society_Edinburgh, Academy of Stanislas, Académie des sciences, Royal Society, Prussian Academy of Sciences, Académie royale de marine, American Academy of Arts and Sciences, Academy of La Rochelle, St-Petersburg Academy of Sciences, Academy of Rouen, Academy of Dijon, Société royale des sciences de Montpellier, Académie d'agriculture de France, Royal Swedish Academy of Sciences, Académie de marine, Société d'émulation de l'Ain, Société de Médecine, Academy of Bordeaux,	Leclerc, Georges Louis, comte de Buffon, Duhamel Rev. Fouchy, Clairaut, Alexis Claude, Bouvard, Michel Philippe, Jacquier, François, Papin, Denis, Baulin, Francisque, Targe, Jean Baptiste, Le Compasseur Crèpié-Montfort, Gaspard, marquis de Courtoivien, Le Rond d'Alembert, Jean, Grandjean de Bapstie, Jean Paul, Bossut, Charles, Berthelot, Charles, Darquier de Pellepoix, Antoine, Le Tomellier de Breuille, Gabrielle Émilie, marquise Du Châtelet-Lomont, Desparcous, Antoine, La Condamine, Charles Marie de, Nollet, Jean Antoine, Le Cat, Claude Nicolas, Cisternay Du Fay, Charles François de, Maupertuis, Pierre Louis Moreau de, Pitot, Henri, Le François de Lalonde, Joseph Jérôme, Diderot de Senne, Rostignoll, Jean Joseph, Dionis Du Sâjour, Achille Pierre, Carnot, Lazare Nicolas Marguerite, Romme, Charles Gilbert, Laplace, Pierre-Simon, Bailly, Jean Sylvain, Caritat, Marie Jean Antoine Nicolas de, marquis de Condorcet	

**Figure 6.** Table of Academies and People by Knowledge Network

The first step to creating a table in Palladio is to choose a row dimension. The row dimension provides the categories according to which the rest of the data table will be re-sorted. If the underlying data have multiple values in the same cell and have been split, the row categories will reflect that. The example in Figure 6 shows for the French Enlightenment Network the knowledge network categories (i.e. Sciences\_Natural, Sciences\_Medicine, Letters, Letters\_Literary, etc) split by a semi-colon delimiter to create a total of 12 rows. The next step is to choose the category, or categories, for the other column dimensions; here I have chosen academies (which were split by a delimiter) and full names, reversed (which were not). While these same functions can be performed in Excel, adding and removing dimensions is quick and easy in Palladio, once the data are loaded. The primary purpose of the tables function is to examine the data up close. Having found patterns in the map or graph windows, such as connections between two places on a map or between a field of study or an academy on a network graph, we can easily see which people or entities are implicated in the table function. In fact, using filters, we can even examine simultaneously the connection between people, academies, and places.

French Enlightenment Network v1.2 [Download](#)

Knowledge Network (12 of 12 rows displayed)	Academies	Full Name Reversed
Sciences_Natural	Académie des sciences, Royal Swedish Academy of Sciences, Royal Society	Dodart, Denis, Jaucourt, Louis de, Longueil, Jean René de, marquis de Maisons, Cisterney Du Fay, Charles François de
Sciences_Medicine	Royal Society, Royal Swedish Academy of Sciences	Jaucourt, Louis de
Sciences_Mathematical	Académie des sciences, Royal Society, Prussian Academy of Sciences, American Academy of Arts and Sciences, Academy of La Rochelle, French Academy, St-Petersburg Academy of Sciences, Academy of Stanislas, Académie d'agriculture de France, Academy of Inscriptions, Royal Swedish Academy of Sciences	Clairaut, Alexis Claude, Le Rond d'Alembert, Jean, Grandjean de Fouchy, Jean Paul, Le Tonnelier de Breteuil, Gabrielle Émilie, marquise de, Boulanger, Nicolas Antoine, Dionis Du Séjour, Achille Pierre, Bailly, Jean Sylvain
Sciences	Académie des sciences, Academy of La Rochelle, Royal Society, Academy of Stanislas, St-Petersburg Academy of Sciences, Academy of Inscriptions, Royal Swedish Academy of Sciences	Grandjean de Fouchy, Jean Paul, Longueil, Jean René de, marquis de Maisons, Cisterney Du Fay, Charles François de, Le Tonnelier de Breteuil, Gabrielle Émilie, marquise Du Châtelet-Lamont, Bourguignon d'Anville, Jean Baptiste, Dodart, Denis, Philippe de Pillet, Étienne André, Jaucourt, Louis de
Political economy	Académie d'agriculture de France, French Academy, Academy of Inscriptions, Académie des sciences, Academy of Caen, Academy of La Rochelle, Academy of Rouen, Académie de marine, Royal Swedish Academy of Sciences	Moustier, Étienne François Elie de, comte de Moustier, Bailly, Jean Sylvain, Girardin, Alexandre François Louis de, comte de Girardin, Turgot, Anne Robert Jacques, Du Pont de Nemours, Pierre Samuel, Lebrun, Ponce Denis Ecouchant, Stahl, Anne Louise Germaine de, Baronsse Stahl von Holstein, Hérault de Séchelles, Marie Jean, Chardon, Daniel Marc Antoine, Augt, Antoine Jean Baptiste Robert, baron de Murgen, Lafosse, Jean, Friéron, Louis Marie Stanislas, Roland, Marie Jeanne, vicomtesse de La Platière, Mercier, Louis Sébastien, Voyer de Paulmy, René Louis de, marquis d'Argenson, Lamoignon de Malesherbes, Chrétien Guillaume de
Letters_Religious	French Academy, Académie des sciences, Academy of Inscriptions	Prieur, abbé Jean Louis, Boyer, Jean François, évêque de Mirépoix, Orléans de Rothelin, Charles d'
Letters_Philosophical	French Academy, Academy of Rouen, Académie des sciences, Academy of Caen, Academy of Lyon, Prussian Academy of Sciences, St-Petersburg Academy of Sciences, Royal Society, American Academy of Arts and Sciences	Rohan-Guéméné, Louis René Édouard de, cardinal de Rohan, Stahl, Anne Louise Germaine de, Baronsse Stahl von Holstein, Naigron, Jacques André, Helvétius, Claude Adrien, Anquet, François Marie [Votrain], Le Rond d'Alembert, Jean
Letters_Literary	Villa Médicis, Académie royale de peinture et de sculpture, French Academy, Academy of Stanislas,	Watelet, Claude Henri, Fuzle de Voisenon, Claude Henri de, La Condamine, Charles Marie de, Baculard d'Arnaud, François Thomas Marie de, Herbiguy, Henri Lambert d', marquis de Thibouville, Petit de Bachaumont, Louis, Orléans de Rothelin, Charles d', Niccoboni, Marie Jeanne, Dumesnil, Marie Françoise, Favart, Charles Simon, Collé, Charles, Thomasseau de Cursay, Jean Marie Joseph, Nivelle de La Chaussée, Pierre Claude, Tubières-Girmonard de Pestels de Levis, Anne Claude Philippe de, comte de Caylus, Falconet, Étienne Maurice, Barbon Mancini-Mazarini, Louis Jules, duc de Nivernais, Anquet, François Marie [Votrain], Voyer de Paulmy, René Louis de, marquis

Facet Timeline Timespan Birth Place Paris, France

Birth Place (110) 52 / 110

Paris, France	29 / 29
Versailles, France	7 / 7
Rouen, France	6 / 6
Nancy, France	5 / 5
Montpellier, France	5 / 5
Aix-en-Provence, France	5 / 5

Facet Filter Birth Place

Dimensions Birth Place

Count Number of Places

Clear

Figure 7. Table of Academies and People by Knowledge Network, Filtered by Paris as Birth Place

Tables can be filtered by categories, timespan, or timeline to dig deeper into the data. Let's look at filtering by categories, since that is the most flexible way of filtering. In this case, we already know who was associated with particular knowledge networks and of which academies they were members. If we want to know which of those people were Parisians, we can simply filter the data table to find only the people who were born in Paris, who died in Paris, or both (Figure 7); this is possible because the underlying data already contains that information. If we noticed interesting patterns in where individuals were born, we could reverse this process and sort the table according to the row dimension "Birth Place," and then add knowledge networks and academies as additional dimensions to see lists of the academies and knowledge networks associated with those places. Moving between tables and maps and graphs allows researchers to see the larger picture and dive deeper into the data without using multiple tools, yet the ability to look at subsets of the data is more limited than in tools like OpenRefine, or, indeed, Microsoft Excel.

## Galleries

The fourth kind of visualization which can be produced in Palladio is the "Gallery," or an array of thumbnails. Galleries are filterable and are particularly useful for large collections of images where the visual aspects of the image are important enough to make comparing thumbnail versions of the images productive. Each record must contain the URL of an image which is openly on the internet on sites like Wikimedia, Imgur, or Google Images. The links can be to images on multiple sites, but the images must be publicly hosted; it is not possible to link to private or paywalled repositories like Artstor. It is possible to designate a column as containing the title and subtitle for each image and another as containing the URL linking the image.

25

26

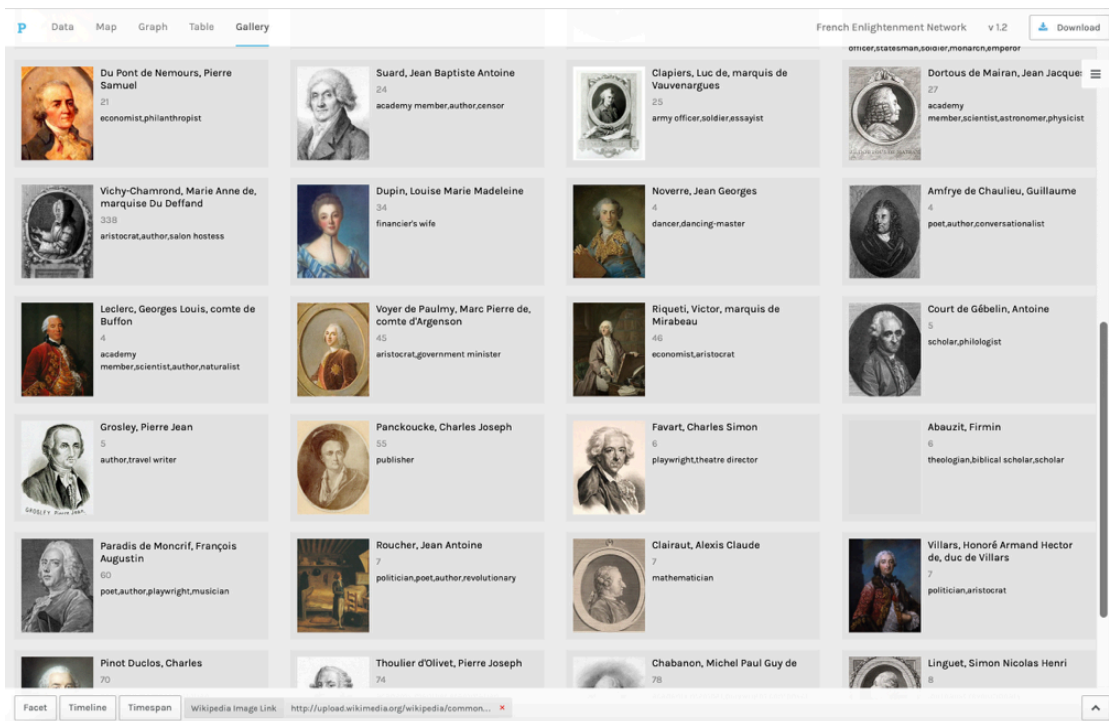


Figure 8. Gallery of Members of the French Enlightenment Network

In Figure 8, the image links are Wikimedia image URLs for portraits of historical individuals, the URLs are Wikipedia for biographies, the full name (reversed) is designated as the title, and the subtitle is the person's occupation from the Electronic Enlightenment data.

Galleries can be quickly filtered so that only the images associated with a specific value in another column will be shown; for instance, by gender or professional network. They can also be filtered by timeline or timespan.

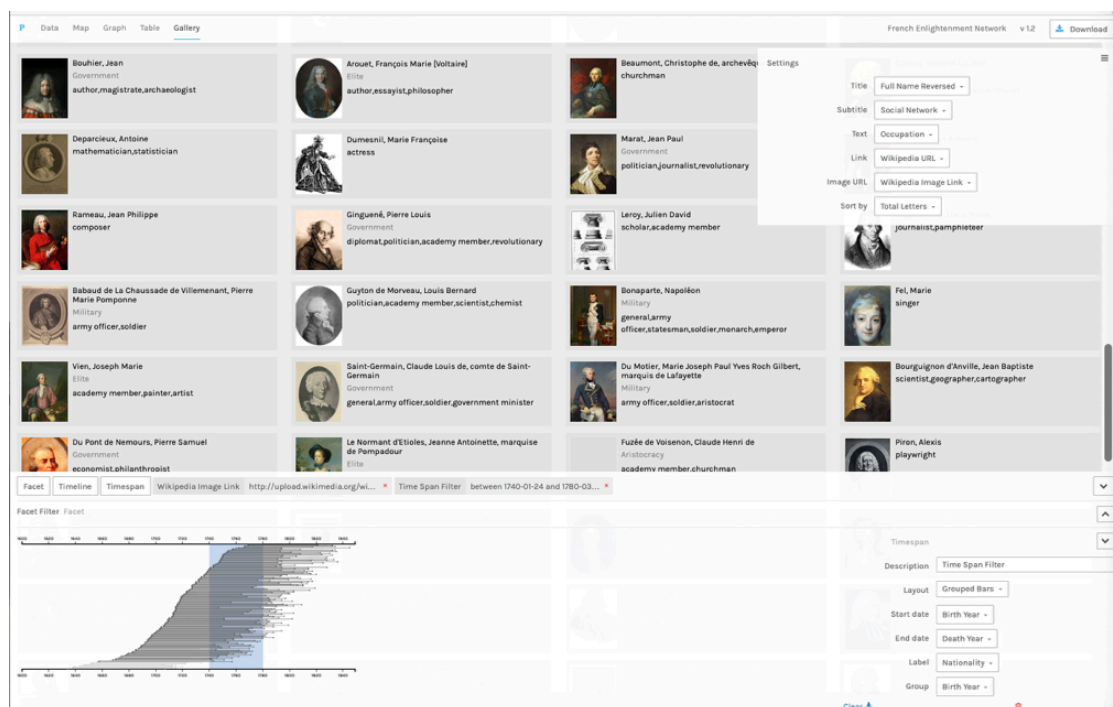


Figure 9. Gallery of Members of the French Enlightenment Network with Filtered Timespan

Figure 9 shows the same gallery with a timespan filter and social networks as the subtitle. The Timespan filter has three different layouts: bars, parallel, or grouped bars. Filtering by timespan requires start and end dates. It is also possible to choose a data column to group the bars and a tooltip label. The timespan can be filtered by clicking and holding to select a portion of the timespan, and only the entities whose timelines appear within that span will be displayed in the gallery. While the galleries are not very different from the tables insofar as they primarily show lists of entities which can be filtered, tables allow for easier reorganization of data and galleries foreground the visual element. Galleries do have additional uses in art history, architecture, film studies, and other disciplines where large numbers of images may be associated with dates or other time stamps and being able to filter those images by category or time could bring additional insight.

29

## Conclusions

As quintessential “middleware” for digital historians and literary/cultural historians, Palladio is ideal for producing static maps and network diagrams sequentially to explore data, especially when time and geography are important elements of the dataset. The ability in Palladio to toggle between different types of visualizations without re-importing the dataset is a benefit for prototyping diagrams and moving between the visualization and the data. The option to filter data and split multiple values means that many different data structures can be used, and the same dataset can produce many different types of diagrams. The static diagrams produced in Palladio can be used in publications, since high resolution screenshots can meet standards for publication. The SVG and TXT files can also be downloaded for further processing and incorporation into more elaborate graphics in programs like Adobe Illustrator. The same diagrams can be produced with different color and contrast settings, although the “land” and “streets” greyscale base maps do not have high enough contrast to be legible when projected; the full-color “Buildings and Areas,” “Terrain,” or “Satellite” maps are usually better for presentations. Similar issues may arise with diagrams produced in the other tools, since they are optimized for greyscale publication and the contrast may need to be increased or color introduced in order to make projected diagrams visible. This emphasis on maps and time is a strength when projects have a strong geospatial element but can be a weakness when geospatial patterns are less relevant to the matter at hand.

30

Finally, Palladio is useful in teaching because the data and formatting are easily shareable. It can also be used when teaching how to create visualizations and how to use visualization to explore data, as Joel Blecher has shown in his pedagogical article on using Palladio, along with RAW graphs, in group work in a class on the transmitters of early Islamic law [Blecher 2016]. The ability to download a formatted JSON file and share that with other researchers or students means that others can import pre-verified data — for example, a map which already has the coordinates selected and visualized or a gallery which already has the filters applied. Because the formatting is included in the JSON file, the person receiving the file, whether a student or a researcher, can open the file where the previous researcher left off and see what that person saw. Any changes to the formatting can be saved by the second person and sent back as a JSON file to the first person. This makes Palladio an ideal tool for experimentation by students for creating different diagrams, especially when there is not class time to create and verify an original dataset. Students can use the same dataset, or a selection of pre-verified datasets, and still save their work. A student who has created her own dataset can also share it with the class or instructor, and others can see both the visualizations and the underlying data.

31

While Palladio is a very flexible tool, it does have some inherent limitations, most of which come from the fact that it is highly useable. Data cannot be edited within Palladio. In practice, this often means creating a dataset, importing it into Palladio, visualizing it, and then discovering errors — such as typos which cause the value to appear twice in a network diagram or differing coordinates for the same place — only to have to restart the process to correct the data. This limitation means that Palladio is very useful for creating many diagrams quickly with a verified dataset — or, indeed, finding problems or outliers in a dataset — but Palladio is consequentially most useful at the exploratory phase. As one gets to know the dataset better and finds patterns that are worth visualizing, it may become apparent that a more complex visualization is necessary to show patterns that appear within filtered maps or network graphs. One way to show such patterns in publication is small multiples, or small diagrams with variations in what is presented, displayed side-by-side. If small multiples are insufficiently complicated, more sophisticated diagrams may be necessary. In order to create complex network diagrams or interactive maps, the researcher will have to use tools that are more

32

customizable and have more options for visualization and design than Palladio.

Palladio is most useful at the exploratory stages of a project, for teaching, and for collectively working through visualization problems, and less so in the latter stages of a complex project. The core assumption of the technology is that information visualization is primarily a process of designing visualizations that make historical arguments, rather than quantitative or scientific ones. The prioritization of moving between individual data points and their whole presumes enough familiarity with the underlying dataset that both the tabular information and the visualizations will make patterns apparent to the researcher rather than providing quantitative answers.

## Works Cited

- Bastian et al. 2009** Bastian, M., Heymann, S., & Jacomy, M. "Gephi: An Open Source Software for Exploring and Manipulating Networks," in *Third International AAAI Conference on Weblogs and Social Media* (2009), pp. 361-362. DOI: [https://doi.org/10.1007/978-1-4614-6170-8\\_299](https://doi.org/10.1007/978-1-4614-6170-8_299).
- Blecher 2016** Blecher, J. "Pedagogy and the Digital Humanities: Undergraduate Exploration into the Transmitters of Early Islamic Law." In E. Muhanna (ed.), *The Digital Humanities and Islamic & Middle East Studies*, Berlin: De Gruyter (2016), pp. 233-249.
- Braude 2014** Braude, M. "Palladio: Humanities thinking about data visualization," *Hestia* (October 6, 2014), <https://hestia.open.ac.uk/palladio-humanities-thinking-about-data-visualization/>
- Braude 2015** Braude, M. "Monte Carlo arrival" (2015), <https://vimeo.com/122883572>
- Ciuccarelli 2014** Ciuccarelli, P. "Mind the Graph: From Visualization to Collaborative Network Constructions," *Leonardo* 47.3 (2014): 268-269. DOI: [https://doi.org/10.1162/LEON\\_a\\_00772](https://doi.org/10.1162/LEON_a_00772)
- Comsa et al. 2014** Comsa, M.T., Conroy, M., Edmondson, C., Edelstein, D., Willan, C., Groupe d'Alembert, & Electronic Enlightenment Project. "French Correspondents of Major Enlightenment Figures," Stanford Digital Repository (2014), <http://purl.stanford.edu/bc436tm1194>
- Comsa et al. 2016** Comsa, M.T., Conroy, M., Edmondson, C., Edelstein, D., & Willan, C. "The French Enlightenment Network," *The Journal of Modern History* 88.3 (2016): 495-534. DOI: <https://doi.org/10.1086/687927>.
- Cytoscape 2019** "Cytoscape," [2019], <http://www.cytoscape.org/>
- DensityDesign Lab 2013** DensityDesign Lab. "RAWGraphs tool," RAWGraphs [2013], <http://app.rawgraphs.io>
- DensityDesign Lab 2019** DensityDesign Lab. "Research: RAWGraphs," DensityDesign Lab [2019], <https://densitydesign.org/research/raw/>
- Drucker and Svensson 2016** Drucker, J. & Svensson, P. "The Why and How of Middleware," *Digital Humanities Quarterly* 10.2 (2016), <http://digitalhumanities.org/dhq/vol/10/2/000248/000248.html>
- Düring 2015** Düring, M. "From Hermeneutics to Data to Networks: Data Extraction and Network Visualization of Historical Sources," *The Programming Historian* 4 (2015), <https://programminghistorian.org/en/lessons/creating-network-diagrams-from-historical-sources>
- Edelstein et al. 2017** Edelstein, D., Findlen, P., Ceserani, G., Winterer, C., and Coleman, N. "Historical Research in a Digital Age: Reflections from the Mapping the Republic of Letters Project," *The American Historical Review* 122.2 (2017): 400-424. DOI: <https://doi.org/10.1093/ahr/122.2.400>.
- Gephi 2019** "Gephi," [2019], <https://gephi.org/>
- Humanities + Design Lab 2014** Humanities + Design Lab. "Tutorials and FAQs," Palladio (2014), <https://hdlab.stanford.edu/palladio/help/>
- Humanities + Design Lab 2019** Humanities + Design Lab. "Mapping the Republic of Letters," Mapping the Republic of Letters [2019], <http://republicofletters.stanford.edu/>
- Jensen et al. 2014** Jensen, C., Sisk, K., and Braunstein, A. "Using Palladio to Visualize Ads," Digital History Methods (2014), <http://ricedh.github.io/01-palladio.html>
- Koivisto 2019** Koivisto, N. "New Data, New Methods? Sources on Ladies' Salon Orchestras in Europe, 1870–1918," *Музикологія / Musicology* 26 (2019): 41-60.

- Mauri et al. 2017** Mauri, M., Elli, T., Caviglia, G., Uboldi, G., and Azzi, M. "RAWGraphs: A Visualisation Platform to Create Open Outputs," in *Proceedings of the 12th Biannual Conference on Italian SIGCHI Chapter (CHIItaly '17)* (2017), article 28. DOI: <https://doi.org/10.1145/3125571.3125585>.
- MikeR 2019** MikeR (@nahamike01) "Still playing around with graphs...", Tweet (November 28, 2019), <https://twitter.com/nahamike01/status/1200179039090036736>
- Posner 2014** Posner, M. "Getting started with Palladio," Miriam Posner's Blog (2014), <https://miriamposner.com/blog/getting-started-with-palladio/>
- Shen 2018** Shen, Y. "Placing Graphic Design at the Intersection of Information Visualization Fields," *Digital Humanities Quarterly* 21.4 (2018), <http://digitalhumanities.org/dhq/vol/12/4/000406/000406.html>
- Tuominen et al. 2018** Tuominen, J., Mäkelä, E., Hyvönen, E., Bosse, A., Lewis, M., & Hotson, H. "Reassembling the Republic of Letters – A Linked Data Approach," in *DHN* (2018), pp. 76-88.
- Uboldi et al. 2013** Uboldi, G., Caviglia, G., Coleman, N., Heymann, S., Mantegari, G., and Ciuccarelli, P. "Knot: An Interface for the Study of Social Networks in the Humanities," in *Proceedings of the Biannual Conference of the Italian Chapter of SIGCHI (CHIItaly '13)* (2013), article 15. DOI: <https://doi.org/10.1145/2499149.2499174>.
- Valleriani et al. 2019** Valleriani, M., Kräutli, F., Zamani, M., Tejedor, A., Sander, C., Vogl, M., Betram, S., Funke, G., & Kantz, H. "The Emergence of Epistemic Communities in the 'Sphaera' Corpus: Mechanisms of Knowledge Evolution," *Journal of Historical Network Research* 3 (2019): 50-91. DOI: <https://doi.org/10.25517/jhnr.v3i1.63>.
- Zhang and Cho 2018** Zhang, S. & Cho, A. "Untapped Potential: Mining Register of Chinese Immigrants to Canada, 1886-1949 Using R and Palladio," OSF Preprints [2018], <https://osf.io/xg5nj>.