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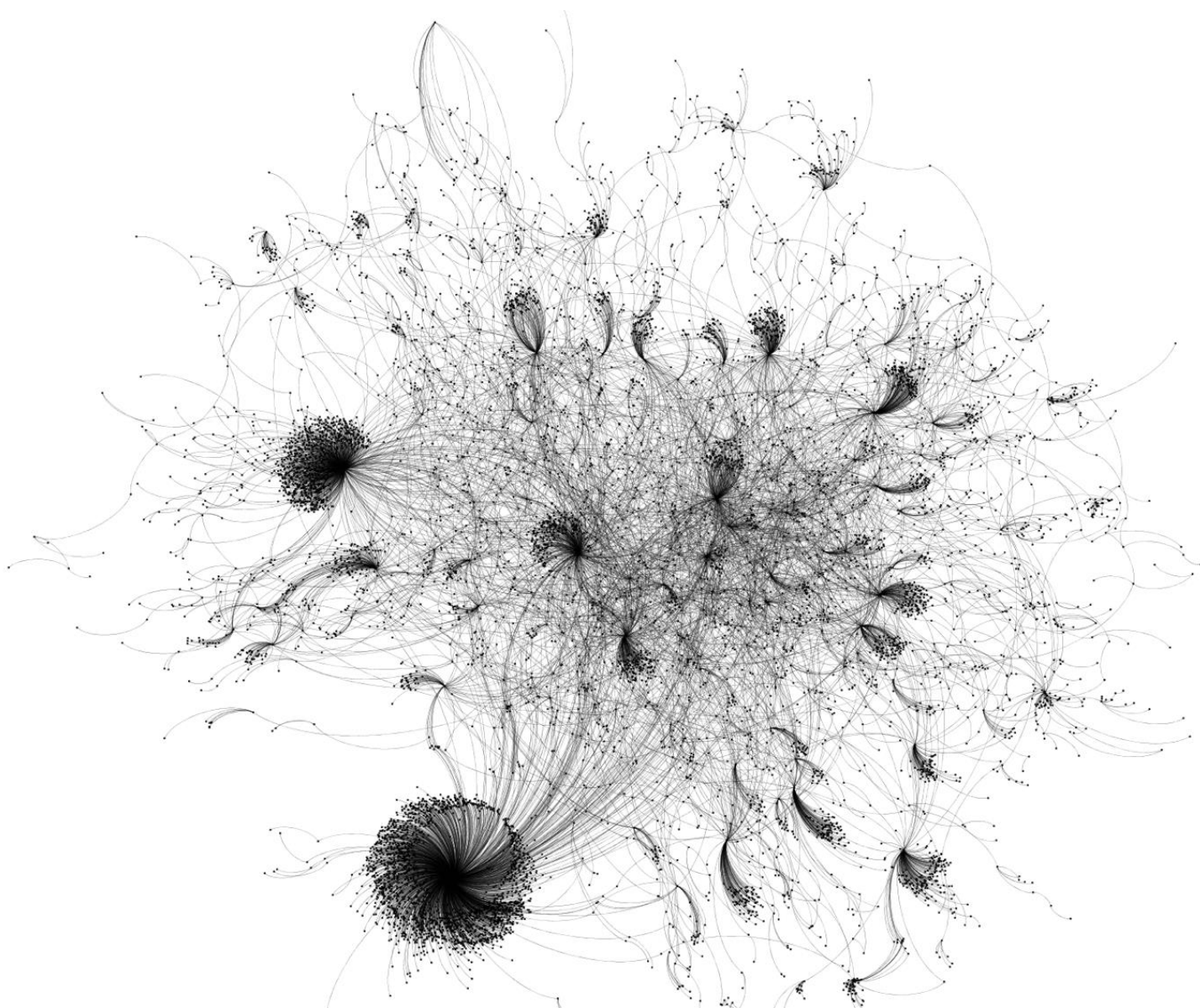
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The structure and dynamics of scholarly  
networks between the Dutch Republic and  
the Grand Duchy of Tuscany in the 17th  
century



Ingeborg van Vugt

# The structure and dynamics of scholarly networks between the Dutch Republic and the Grand Duchy of Tuscany in the 17th century

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ter verkrijging van de graad van doctor

aan de Universiteit van Amsterdam

op gezag van de Rector Magnificus

prof. dr. ir. K.I.J. Maex

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Dit proefschrift is tot stand gekomen binnen een samenwerkingsverband tussen de Universiteit van Amsterdam en de Scuola Normale Superiore met als doel het behalen van een gezamenlijk doctoraat. Het proefschrift is voorbereid in de Faculteit der Geesteswetenschappen van de Universiteit van Amsterdam en de Facoltà di Scienze Umane van de Scuola Normale Superiore.

This thesis was prepared within the partnership between the University of Amsterdam and the Scuola Normale Superiore with the purpose of obtaining a joint doctorate degree. The thesis was prepared in the Faculty of Humanities at the University of Amsterdam and in the Facoltà di Scienze Umane at the Scuola Normale Superiore.

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# Abbreviations

ASCH	Private Archives of the noble Dutch family Van Asch van Wijck, Prattenburg
ASF	Archivio di Stato di Firenze
BNCF	Biblioteca Nazionale Centrale di Firenze
BML	Biblioteca Medicea Laurenziana, Florence
BNF	Bibliothèque Nationale de France
CCF	Catalogo dei Carteggi - Firenze, Card Catalogue of the National Library of Florence
COR	Biblioteca Corsiniana, Rome
KB	Koninklijke Bibliotheek, National Library of the Netherlands
KNIR	Koninklijk Nederlands Instituut Rome
LMU	Ludwig Maximilian University Library, Munich
MdP	Mediceo del Principato, part of the Medici Archives in the State Archive of Florence
MM	Miscellanea Medicea, part of the Medici Archives in the State Archive of Florence
MOR	Biblioteca Moreniana, Florence
MPM	Museum Plantin-Moretus Archive, Antwerp
NA	National Archives of the Netherlands
NIKI	Nederlands Interuniversitair Kunsthistorisch Instituut, Florence
RIC	Biblioteca Riccardiana, Florence
UBA	Universiteitsbibliotheek Amsterdam
UBL	Universiteitsbibliotheek Leiden
UBU	Universiteitsbibliotheek Utrecht



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# Glossary of network analysis terms

This glossary is partly compiled in conjunction with the Early Modern Digital Agendas: Network Analysis institute in July 2017 at the Folger Institute in Washington DC, a research summit on the use of network analysis in the historical field. The glossary below aims to understand the terms used in the context of this study.<sup>1</sup>

## **Bipartite (also bimodal) network**

A network of two node types in which connections are only between nodes of different types. One can perform a projection on a bipartite network.

## **Centrality of a node**

A numerical measurement of importance of a node. Degree is a simple example. Four types of centrality: 1) Degree Centrality; 2) Closeness Centrality; 3) Betweenness Centrality; 4) Eigenvector Centrality.

### **Degree centrality – hubs**

Number of connections a node has. A node with a high degree centrality has many connections (edges): a hub.

### **Closeness centrality**

Closeness Centrality measures the proximity of a selected node to all other nodes within the graph.

### **Betweenness centrality - brokers**

The number of “shortest paths” in the network that flow through a node or edge. To what degree a node provides a bridge to other nodes. A node X has a high betweenness centrality if the shortest path from Y to Z is through X. Nodes with a high betweenness centrality can also be thought as brokers.

### **Eigenvector centrality**

Eigenvector centrality measures “the influence of a particular node by the connectedness of its closest neighbors. This can be thought of as the who you know type of centrality, wherein an individual node might not be thought of as important on its own, but its relationship to other highly connected nodes indicates a high level of influence. As Stephen Borgatti puts it: “the idea is that even if a node influences just one other node, who subsequently influences many other nodes (who themselves influence still more others), then the first node in that chain is highly influential” (Stephen P. Borgatti, ‘Centrality and Network Flow’, *Social Networks* 27 (2005), 61).

## **Cascade effect**

A cascade has the potential to occur when people make decisions sequentially, with later people watching the actions of earlier people and from these actions inferring something about what the earlier people know. A cascade thus develops when people abandon their own information in favor of inferences based on earlier people’s actions.

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<sup>1</sup> [https://folgerpedia.folger.edu/Glossary\\_of\\_network\\_analysis\\_terms](https://folgerpedia.folger.edu/Glossary_of_network_analysis_terms), last accessed 1 April 2019.

**Cliques**

Cliques (or clusters) represent segments of the networks that are more tightly knit in their connections to one another, and more limited in their connections to other components of the network.

**Clustering Coefficient**

The clustering coefficient is a measure of the degree to which nodes in a graph tend to cluster together. It is often used to indicate the presence of Triadic closure. Duncan J. Watts and Steven Strogatz introduced the measure in 1998 to determine whether a graph is a small-world network.

**Component**

A connected part of the network. Networks often consist of multiple disconnected components.

**CSV files**

Comma separated values files allow data to be saved in a table structured format. CSVs look like a garden-variety spreadsheet but with a .csv extension (Traditionally they take the form of a text file containing information separated by commas, hence the name).

**Degree (of a node)**

The number of edges connected to a node. Variants include in-degree/out-degree, which counts the number of ingoing and outgoing edges in a directed network. Sometimes indicated by the size of the sphere representing the node. Also called degree centrality.

**Density**

Density (or cohesion) is a measurement of the number of edges across the network, which relate to its stability and facilitation of information flow.

**Diameter (of a network)**

The largest shortest path length.

**Dyad**

Two nodes, usually connected by an edge.

**Edge**

Connections, link, or ties between nodes.

**Ego Network**

A network focused around one central node. A classic example is a correspondence network derived from the collected letters of a single individual.

**Homophily**

The tendency of nodes to become connected to other nodes that are similar under a certain definition of similarity.

**Multimodal network**

A network consisting of multiple types of nodes. Whereas the sociologist can work with complete unimodal or otherwise bimodal networks, the historian has to rely on the availability of the past. This

means that every piece of evidence that has come down to us needs to be included to interpret relations in the past: letters, books, persons, memberships, journals and so forth. This leads to a range of different kinds of nodes and links: the multimodal network emerges.

### **Node**

Sometimes called a “vector” because it marks the intersection of lines, and sometimes called an actor, nodes are the elements of a network that are being connected.

### **Projection (of a bimodal network)**

Transformation of a bimodal network into a weighted network of just one of the two original node types in which the weight of the connection is the number of shared neighbors in the bipartite network. When you project a bipartite network, in other words, you transform one of the node types into an edge: instead of two people nodes being connected to a place, they are connected to each other, and the place becomes the edge connecting them.

### **Power law or scale-free degree distribution**

Intuitively one might expect the degree distribution in a network to follow a bell curve, which is more formally described as a normal (or Gaussian) distribution: a large rounded peak tapering away rapidly on each side. A simple probability distribution that resembles a bell curve or normal distribution is the roll of two dice. The distribution is centered around the number 7 and the probability decreases as you move away from the center on either side. A power-law distribution, by contrast has no peak; instead it decreases continuously and rapidly for increasing degrees. In fact the distribution of the data points within a power-law distribution is so broad across several orders of magnitude that it is normally plotted on logarithmic axes. On these axes a power law distribution appears as a straight diagonal line, which means that the shape of the distribution is the same for high and low degrees, resulting in what is known as a scale-free degree distribution. Whether we look at the network as a whole, or at a specific region, due to the scale-free distribution we will always find a few relatively well-connected nodes or "hubs", and a much larger number of nodes with a relatively small number of connections compared to the hubs. A wide range of networks have been shown to exhibit this property, including power grids, social networks, and the world-wide web.

### **Shortest path**

The fewest number of steps between two nodes in the network.

### **Signed Graph**

A signed graph is a network in which every edge is designated to be either positive or negative. These edges are also called signed edges. This type of graph is essential in the structural balance theory.

### **Small-world**

The “small-world hypothesis”, first developed by Duncan J. Watts and Steven Strogatz, expresses the idea that every individual in a given population can reach every other via some “short” chain of intermediaries.

### **Structural balance theory**

The principles underlying structural balance are based on theories in social psychology dating back to the work of Heider in the 1940s and generalized and extended to the language of graphs beginning with the

work of Cartwright and Harary in the 1950s. Structural balance theory attends to a group's network of negative (-) and positive (+) sentiments and posits that this network alters over time toward particular structural forms of balance. Using the term "friend" to designate a positive sentiment and the term "enemy" to designate a negative sentiment, the classic balance model defines a sentiment network as follows: + + + (balanced); + + - (unbalanced); + - - (balanced); - - - (unbalanced/balanced).

### **Transitivity**

Transitivity of a relation means that when there is an edge from  $x$  to  $y$ , and also from  $y$  to  $z$  then there is also a tie from  $x$  to  $z$  (friends of my friends are friends) Transitivity depends thus on triads.

### **Triad**

Three nodes connected by an edge.

### **Triadic Closure**

Triadic closure is a measure of the tendency of edges in a graph to form triads. The basic principle of triadic closure is that if two people in a social network have a friend in common, then there is an increased likelihood that they will become friends themselves at some point in the future.

### **Unipartite or unimodal network**

A network of just one node type, in contrast to a bipartite network. Networks are typically unipartite. In a social network, such as the epistolary community of the Republic of Letters, correspondents are the nodes, and the relationships linking them are the edges.