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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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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Contents

Abbreviations .................................................................................................................. 6

Acknowledgements .......................................................................................................... 7

Glossary of network analysis terms .................................................................................. 9

INTRODUCTION ........................................................................................................... 13
  1. The digital Republic of Letters .................................................................................. 15
  2. The importance of disclose reading ........................................................................... 20

CHAPTER 1 Confidentiality and Secrecy in the Epistolary Network ............................... 23
  Introduction ................................................................................................................... 23
  1. Confidentiality in Early Modern Epistolography ....................................................... 23
  2. Secrecy: inclusion/exclusion .................................................................................... 27
  3. Practices of dissimulation ....................................................................................... 30
  4. Self-censorship in Early Modern Epistolography ....................................................... 33
  5. Digital secrecy and confidentiality ........................................................................... 38

CHAPTER 2 The Dutch roots of the Medici network under Cosimo III ............................. 41
  Introduction ................................................................................................................... 41
  1. Off to a good start: preparing the Grand Tour ........................................................ 44
  2. Two Florentine courtiers: Apollonio Bassetti and Giovanni Andrea Moniglia .......... 48
  3. The travel accounts of Bassetti and Moniglia ........................................................... 51
  4. The aftermath of the Grand Tour ............................................................................ 61
     4.1. Merchants as cultural agents of the Grand duke of Tuscany ................................. 65
     4.2. Spying for knowledge ........................................................................................ 67

CHAPTER 3 Dutch travelers in the Grand Duchy of Tuscany .......................................... 70
  Introduction ................................................................................................................... 70
  1. The rise of Antonio Magliabechi ............................................................................. 71
     1.1 Magliabechi: a brief biography ........................................................................... 72
  2. The 1640s: The founding fathers of the Dutch-Tuscan network .............................. 78
  3. The 1660s: Pieter Blaeu and the Tuscan atlas project .............................................. 82
  4. The 1670s: the rise of Dutch travelers to Tuscany ................................................... 84
     4.1. The travels of Jacob Gronovius (1645-1716) .................................................... 85
     4.2. The travels of Coenraad Ruysch (1650-1731) ................................................ 87
     4.3. The travels of Laurens Theodor Gronovius (1648-1724) ................................. 89
     4.4. The travels of Jacob Tollyus (1633-1696) ......................................................... 91
     4.5. The travels of Joannes Kool (1672-1712) ......................................................... 94
     4.6. The travels of Henrik Brenkman (1681-1736) ................................................ 97
  5. The Dangers of traveling to Florence: Religious Conversions .................................. 101
CHAPTER 6 Bound by Books. The use of multimodal network representations in historical research

Introduction ............................................................................................................. 200

1. Is the book forgotten in the digital Republic of Letters? .................................. 201

2. From a uni-modal network to a multimodal network ...................................... 203

3. The creation of a multimodal dataset ................................................................ 207
   3.1. The first layer: the epistolary network ......................................................... 208
   3.2. The second layer: letters content ................................................................. 209
   3.3. The third layer: metadata ........................................................................... 213

4. The use of book (co-)citations ......................................................................... 216

5. Power-laws and structure in book-citations ...................................................... 217
   5.1. Magliabechi’s bibliographical reports ....................................................... 218
   5.2. The threat of literary journals ................................................................... 221

6. Book hubs in the epistolary network ................................................................ 224
   6.1. Dedications and gifts as a social practice ................................................... 228
      6.1.1. Dedications and gifts in the context of creating relationships ............ 230
      6.1.2. Dedications and gifts in the context of maintaining long-standing relationships ...... 235
      6.1.3. Books in the context of expanding the network ................................. 239
   6.2. Books published out of revenge .................................................................. 241
   6.3. Prohibited books in the epistolary network ............................................... 250
      6.3.1. Limitations to scholarly openness ...................................................... 257

CONCLUSION .......................................................................................................... 262

SUMMARY/SOMMARIO/SAMENVATTING ................................................................ 265

Appendix 1 Correspondence Magliabechi - Dutch Republic ............................... 274

Appendix 2 Metrics CEN + CCF ........................................................................ 277

Appendix 3 Metrics 2nd degree network ............................................................. 279

Appendix 4 Dedications to Magliabechi ............................................................... 285

Bibliography .......................................................................................................... 287
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCH</td>
<td>Private Archives of the noble Dutch family Van Asch van Wijck, Prattenburg</td>
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<tr>
<td>ASF</td>
<td>Archivio di Stato di Firenze</td>
</tr>
<tr>
<td>BNCF</td>
<td>Biblioteca Nazionale Centrale di Firenze</td>
</tr>
<tr>
<td>BML</td>
<td>Biblioteca Medicea Laurenziana, Florence</td>
</tr>
<tr>
<td>BNF</td>
<td>Bibliothèque Nationale de France</td>
</tr>
<tr>
<td>CCF</td>
<td>Catalogo dei Carteggi - Firenze, Card Catalogue of the National Library of Florence</td>
</tr>
<tr>
<td>COR</td>
<td>Biblioteca Corsiniana, Rome</td>
</tr>
<tr>
<td>KB</td>
<td>Koninklijke Bibliotheek, National Library of the Netherlands</td>
</tr>
<tr>
<td>KNIR</td>
<td>Koninklijk Nederlands Instituut Rome</td>
</tr>
<tr>
<td>LMU</td>
<td>Ludwig Maximilian University Library, Munich</td>
</tr>
<tr>
<td>MdP</td>
<td>Mediceo del Principato, part of the Medici Archives in the State Archive of Florence</td>
</tr>
<tr>
<td>MM</td>
<td>Miscellanea Medicea, part of the Medici Archives in the State Archive of Florence</td>
</tr>
<tr>
<td>MOR</td>
<td>Biblioteca Moreniana, Florence</td>
</tr>
<tr>
<td>MPM</td>
<td>Museum Plantin-Moretus Archive, Antwerp</td>
</tr>
<tr>
<td>NA</td>
<td>National Archives of the Netherlands</td>
</tr>
<tr>
<td>NIKI</td>
<td>Nederlands Interuniversitair Kunsthistorisch Instituut, Florence</td>
</tr>
<tr>
<td>RIC</td>
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<td>UBA</td>
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<td>UBL</td>
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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.¹

**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.

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.