

Connecting York: a case study of the use of social network analysis on wills between 1520 and 1540, and the development of a new methodology for the inference of connections absent from the historical record



Figure 1: The most famous and fayre Citie YORKE described, John Speed, 1610.

Image source: University of Cambridge Digital Library, < <https://cudl.lib.cam.ac.uk/view/PR-ATLAS-00002-00061-00001/66>>, [Accessed: 13th December 2024].

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‘The historian...must gather what scraps of evidence he can and try to fit them together, as a worker in a mosaic fits together little coloured stones, to form a picture. But even so he must remember that among his coloured stones many are missing’.

J. R. H. Moorman, *The Medieval Parsonage and Its Occupants* [Lecture delivered at the John Ryland’s Library’]. (10th November 1943), p. 150.

Abstract

This dissertation begins with a Social Network Analysis (SNA) of a network constructed from testator-legatee connections in York wills for the period 1520-1540. It considers which institutions were important to testators, and which individuals held positions of structural significance within the network (and why). Acknowledging that legal restrictions around the making of wills disproportionately affected women, thus resulting in generally low network centrality scores for female nodes, it subsequently uses a close-reading of the wills to enhance the network through the use of implicit relational data, returning predominantly familial connections to it. The final chapter implements an original methodology based on the theory of transitivity, inferring connections which are missing from the historical record, and allowing for comparison of three network versions (base, implicit, and inferred). Key statistics show the network becoming gradually better connected, and the dissertation presents two core conclusions: firstly, that as a result of gaps in the data SNA conducted on historical networks can inflate the significance of some individuals whilst under-stating that of others; and secondly, that it is possible to create plausible, probabilistic historical networks using this new data-inference methodology, and that doing so can address some of these issues by suggesting who might have been credited with unwarranted significance, and who might have been overlooked (with a particular emphasis on non-elite women). This study points to new avenues for research into, for example, differences in bequeathing habits in urban and rural environments, and individual women who are now seen to be potentially influential in the network, having previously been statistically insignificant. It argues that whilst there is much that can be done with SNA on historical networks as they stand, there is merit in developing new techniques for use on such data because of the more representative understanding of past society that results.

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And last but by no means least, Thomas, who knows far more about triads and transitivity than any ten-year old should. Thank you for all the trips to York, for sometimes feigning interest in my research, and for politely informing me when my glossary definitions were more confusing than the words themselves.

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Abbreviations

A.Bp.Reg.	Archbishop's Rolls and Registers
B.I.	Borthwick Institute of Historical Research
D&C.Reg.	Probate Registers of the Dean and Chapter
Prob.Reg.	Probate Registers of the Exchequer and Prerogative Court of the Archbishop
The Belfrey	St. Michael le Belfrey
The Minster	The Cathedral and Metropolitan Church of St. Peter in York
TNA	The National Archives
Y.M.L.	York Minster Library

Note on Conventions

Spellings

Names in Latin have been given their English equivalent, and spellings have necessarily been standardised for use in Gephi. The standardised spellings are used throughout, but original spelling has been retained in footnote references to the wills for ease of locating the record.

Transcriptions

Contractions have been expanded without indication. Missing or illegible text is represented by square brackets, in-filled where the missing text can be determined through context.

Disambiguation and deduplication

In each instance in which a name appears in more than one person's will extensive efforts have been made to establish whether they indicate the same person, using information within the wills and additional sources. Such work has comprised a significant part of this study, given the difference errors might make to the analysis. Where multiple nodes share the same name and either definitively are not (or cannot reasonably be shown to be) the same person, a superscript number has been added to the end of their name (e.g. John Shaw¹). The superscript is used the first time a person is discussed in each chapter but not thereafter unless not to do so would lead to confusion.

Missing names

Names are often not provided in full and a consistent approach has had to be taken to such omissions. In the case of obviously under-age children, they have been assumed unmarried and therefore both male and female children have been given their father's surname. Where it has not

been possible to determine age and marital status sons have been given their father's surname, daughters have not. As it is often impossible to distinguish between, for example, 'brother' and 'brother-in-law', a surname has only been added to adult names where there is a reasonable degree of certainty. Where it has not been possible to determine a surname the notation *xf* has been used for female nodes and *xm* for males; the same notation has been used for missing first names (e.g. Cecily *xf*; *xm* Hogeson).

Analysis

All analysis has been conducted using Gephi, which has also been used to produce the network visualisations. Unless otherwise specified the **Force Atlas** algorithm has been applied to all visualisations. Betweenness scores are **normalised** throughout.

Terminology

In this dissertation the terms 'will' and 'testament' are used interchangeably, rather than abiding by the increasingly (by the late fifteenth century) obsolete distinction between the two as dealing with property and moveables respectively.¹

A glossary of key terms is provided in Appendix V. Words found in the glossary are shown in bold the first time they appear.

¹ For a discussion on this see Michael Zell, 'Fifteenth- and Sixteenth-Century Wills as Historical Sources', *Archives*, XIV(62) (1979), pp. 67-74, (p. 67).

Introduction

In May 1532 Elisabeth Shaw, resident of York, wrote her will; she must have died shortly afterwards, as it was proved in August of that year. In it she bequeathed ‘my beste gowne, one kerchif with my hatte’ to her ‘suster Rawson’.² No first name is given for Rawson (she is therefore given the notation xf), she appears in no other York wills of this period, and we know nothing of her other than that she and another sister (xf Bates) are Shaw’s siblings (biological, step, or in-law). Without this mention in her sister’s will Rawson, like so many others, might have been lost to history; she remains one of countless late-medieval women about whom little is known.

Shaw’s bequest to her sister forms part of a wealth of information within the York wills relating to the impact of the Reformation, the significance of different types of religious institution to testators, the nature of charitable giving, and material culture.³ W. K. Jordan’s argument that wills are ‘mirrors of men’s souls’ has given way to an understanding that they ‘probably do no more than reflect the general religious climate of an area’, historians cautioning that wills (described by Cullum and Goldberg as ‘optical illusions’) ‘may be an indifferent guide’ to charitable giving, ‘disclosing nothing about day-to-day piety’ and ‘seriously’ under-representing *post-obit* donation.⁴ Studies of charitable provision in York, however, demonstrate the value of wills as (at least) an indicator of charitable intention, and the importance of friaries to the people of York on the basis of testamentary evidence has been much discussed.⁵

Where the potential of these wills has not, to my knowledge, been utilised is in their ability to enable an overall understanding of the social structure of the city. Michael Zell points to the

² Elisabeth Shaw (1532), B.I., Prob.Reg.11, f.15v.

³ On Reformation-linked changes in the preambles of York wills, see Lorraine C. Attreed, ‘Preparation for Death in Sixteenth Century Northern England’, *The Sixteenth Century Journal*, 13(3) (1982), pp. 37-66, (pp. 41-45). For charitable intent see Patricia H. Cullum and Jeremy P. Goldberg, ‘Charitable Provision in Late-Medieval York’, *Northern History*, 29 (1993), pp. 24-39, (pp. 32, 39). On material culture see Lisa J. H. Liddy, *Domestic Objects in York c.1400-1600: Consumption, Neighbourhood, and Choice* (Unpublished PhD thesis, University of York, 2015), esp. chapters three and four. See also Swanson’s illuminating work on wills as a source for occupation-based studies: Heather C. Swanson, *Craftsmen and Industry in Late-Medieval York* (Unpublished DPhil thesis, University of York, 1980).

⁴ Wilbur K. Jordan, *Philanthropy in England, 1480-1660: A Study of the Changing Patterns of English Social Aspirations* (London: Allen and Unwin, 1959), p. 16. Claire Cross, ‘Northern Women in the Early Modern Period: the Female Testators of Hull and Leeds 1520-1650’, *The Yorkshire Archaeological Journal*, 59 (1987), pp. 83-94, (p. 91). Cullum and Goldberg, ‘Charitable provision’, pp. 32, 39. Clive Burgess, ‘“By Quick and by Dead”: Wills and Pious Provision in Late-Medieval Bristol’, *The English Historical Review*, 102(405) (1987), pp. 837-58, (p. 840).

⁵ Cullum and Goldberg, ‘Charitable provision’. Michael Robson, ‘The Grey Friars in York, c.1450-1530’, in *The Religious Orders in Pre-Reformation England*, ed. James G. Clark (Woodbridge: The Boydell Press, 2002), pp. 109-19.

potential for wills to trace ‘intimate ties of friendship’, and it is these **ties** (or connections) which will be used in this study.⁶ This dissertation will adopt an interdisciplinary approach to the study of these sources, using **Social Network Analysis** (SNA)’s capacity to enable an analysis of the ‘aggregate structure and shape’ of York’s social network.⁷ As Ahnert et al. discuss in their proposed ‘new normal’ of interdisciplinary collaboration in the study of networks, this process will not replace qualitative research, but rather combine the qualitative and quantitative to allow for a deeper understanding of a historical network.⁸ Historians are increasingly embracing the ‘network turn’, appreciating the capacity of SNA to direct us to new avenues of research and provide fresh insights into historical networks of all varieties, be that social, transport, or communication.⁹ Recent work in this field demonstrates the potential and pitfalls of applying quantitative methodologies to historical data and the findings of such studies have informed the approach adopted here.¹⁰

It might be supposed that working with ‘data’ removes the subjective nature of a historian’s work; this is emphatically not the case.¹¹ A number of subjective decisions will have been made in relation to the wills including: the law specifying who could (and could not) leave a will; which wills were proved (and therefore entered into the record) and which were lost; whether the scribe copied out the witness list in full or truncated it; which registers were retained or survived; who has been able to access the records over the intervening centuries, and what those people have chosen to do with them (for example, which wills have been deemed worthy of publication).¹²

⁶ Zell, ‘Fifteenth- and Sixteenth-Century Wills’, p. 67.

⁷ Robert M. Morrissey, ‘Archives of Connection: “Whole Network” Analysis and Social History’, *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 48(2) (2015), pp. 67-79, (p. 71).

⁸ Ahnert et al., *The Network Turn: Changing Perspectives in the Humanities* (Cambridge: Cambridge University Press, 2020), p. 73.

⁹ On the idea of a network turn, see Ahnert et al., *Network Turn*.

¹⁰ For examples of the application of SNA to historical data, see in particular the seminal work of John F. Padgett and Christopher K. Ansell, ‘Robust Action and the Rise of the Medici’, *The American Journal of Sociology*, 98(6) (1993), pp. 1259-1319; Ruth Ahnert and Sebastian E. Ahnert, *Tudor Networks of Power* (Oxford: Oxford University Press, 2023); Christopher N. Warren et al., ‘Six Degrees of Francis Bacon: A Statistical Method for Reconstructing Large Historical Social Networks’, *Digital Humanities Quarterly*, 10(3) (2016); Ruth Ahnert and Sebastian E. Ahnert, ‘Protestant Letter Networks in the Reign of Mary I: A Quantitative Approach’, *ELH*, 82(1) (2015), pp. 1-33.

¹¹ For the discussion around the very word ‘data’, its misleading connotations, and the argument that humanists would be better served by using ‘capta’, implying information that is ‘constructed, *taken*, not simply given as a natural representation of pre-existing fact’, see Johanna Drucker, ‘Humanities Approaches to Graphical Display’, *Digital Humanities Quarterly*, 5(1) (2011), pp. 1-52, (p. 3).

¹² On the reasons for a significant difference between the number of wills being written and proved, see David M. Smith, ‘The exercise of the Probate Jurisdiction of the Medieval Archbishops of York’, in *Life and Thought in the Northern Church c.1100-c.1700: Essays in Honour of Claire Cross*, ed. Diana Wood (Woodbridge: The Boydell Press, 1999), pp. 123-44, (p. 143); and for an estimate of what the difference might have been for York wills see Will Coster, ‘Community, Piety, and Family in Yorkshire Wills between the Reformation and the Restoration’, in *Life and Thought in the Northern Church c.1100-c.1700: Essays in Honour of Claire Cross*, ed. Diana Wood (Woodbridge: The Boydell Press, 1999), pp. 511-31, (pp. 515-16).

This chain of decisions does not stop when the wills are used as a source for SNA. Decisions abound over: which wills to include; which data to extract; how to deal with missing information; spelling standardisation, deduplication, and disambiguation (particularly important when considering connections between people); and non-specific data, for example whether a person is a brother or brother-in-law.¹³ Such decisions make the process of extracting data from the wills and formatting it for analysis inherently subjective; these issues will be discussed throughout this dissertation, as the process of selecting, cleaning, and presenting the data permeates every aspect of it.¹⁴

This dissertation will consist of layers of analysis, building a series of datasets in an attempt to increase the completeness of the network. Chapter one provides an overview of the network and introduces key metrics, whilst discussing the structural position of both institutions and certain individuals. It uses SNA to create a network of social connections in late-medieval York, and to study the structure of that network with a view to learning which institutions, individuals, and occupational groups might have been significant within it. Chapter two uses qualitative research to add **implicit** connections, and compares the two versions of the network to demonstrate how effective the addition of data derived from a close reading of the sources can be in providing a fuller picture. Chapter three goes further in enhancing the network, following the powerful call of Ahnert and Ahnert for new methods ‘to draw out the threads of women’s lives, however few, so their histories can be reconstructed’.¹⁵ Through the design of an original methodology it will hypothetically resituate data missing from the historical record. Using **inferred** data to increase the representation of connections between women in the network will allow for a better understanding of their potential significance within it, potentially redrawing the social map.

What this work will not be able to do is fully represent the social network of early sixteenth-century York. While suggesting that historians consider new methodologies which push the

¹³ A number of sources have been used to identify and disambiguate nodes, including: Claire Cross and Noreen Vickers, *Monks, Friars and Nuns in Sixteenth Century Yorkshire* (Huddersfield: The Yorkshire Archaeological Society, 1995); Francis Collins ed., *Register of the Freeman of the City of York: Vol. 1, 1272-1558* (Durham, 1897); Claire Cross, ‘York Clergy Ordinations 1500-1509’, *Borthwick List and Index 30* (University of York, 2001); Claire Cross, ‘York Clergy Ordinations 1510-1519’, *Borthwick List and Index 31* (University of York, 2002); Claire Cross, ‘York Clergy ordinations 1520-1559’, *Borthwick List and Index 32* (University of York, 2002); Cause Papers in the Diocesan Courts of the Archbishopric of York, 1300-1858 (University of York, 2010-2012), <<https://www.dhi.ac.uk/causepapers>>; York Archbishop’s Registers, 1245-1650 (University of York, 2016), <<https://archbishopsregisters.ac.uk>>.

¹⁴ On the critical importance, but time-consuming nature, of deduplication and disambiguation (often referred to as ‘data cleaning’) and the argument that it should be seen as ‘curatorial labour’, not only a ‘prerequisite for network analysis’ but ‘a scholarly object in its own right’, see Ahnert et al., *Network Turn*, pp. 4, 55.

¹⁵ Ahnert and Ahnert, *Tudor Networks*, pp. 34, 142.

boundaries of historical data, Christopher Warren et al. discuss the ‘infinitesimal sliver of the rich and varied kinds of relationships between people’ that SNA based on historical data is able to provide, and the missing coloured stones of J. R. H. Moorman’s historical mosaic remain a limiting factor.¹⁶ Studies of this kind can never fully represent the past; instead of reconstruction what will be achieved is the *construction* of a partial and potential version of a historical community. Nevertheless, this research will produce new network versions which go further than before in attempting to include a greater proportion of historical relationships. In doing so it will challenge the dichotomy between close and distant reading to look at women in the network at both macro and micro scale, to tell an aggregate story about their position in society and, where possible, to enhance what we know about individual women such as x Rawson.¹⁷ It aims to demonstrate that adopting an interdisciplinary approach towards wills can allow for a deeper understanding of late-medieval society, and that new methodologies can help in constructing more representative networks.

¹⁶ Warren et al., ‘Six Degrees’, p. 1. Moorman, *Medieval Parsonage*, p. 150.

¹⁷ For an introduction to distant reading, see Franco Moretti, *Distant Reading* (London: Verso, 2013).

Chapter One: Making Connections

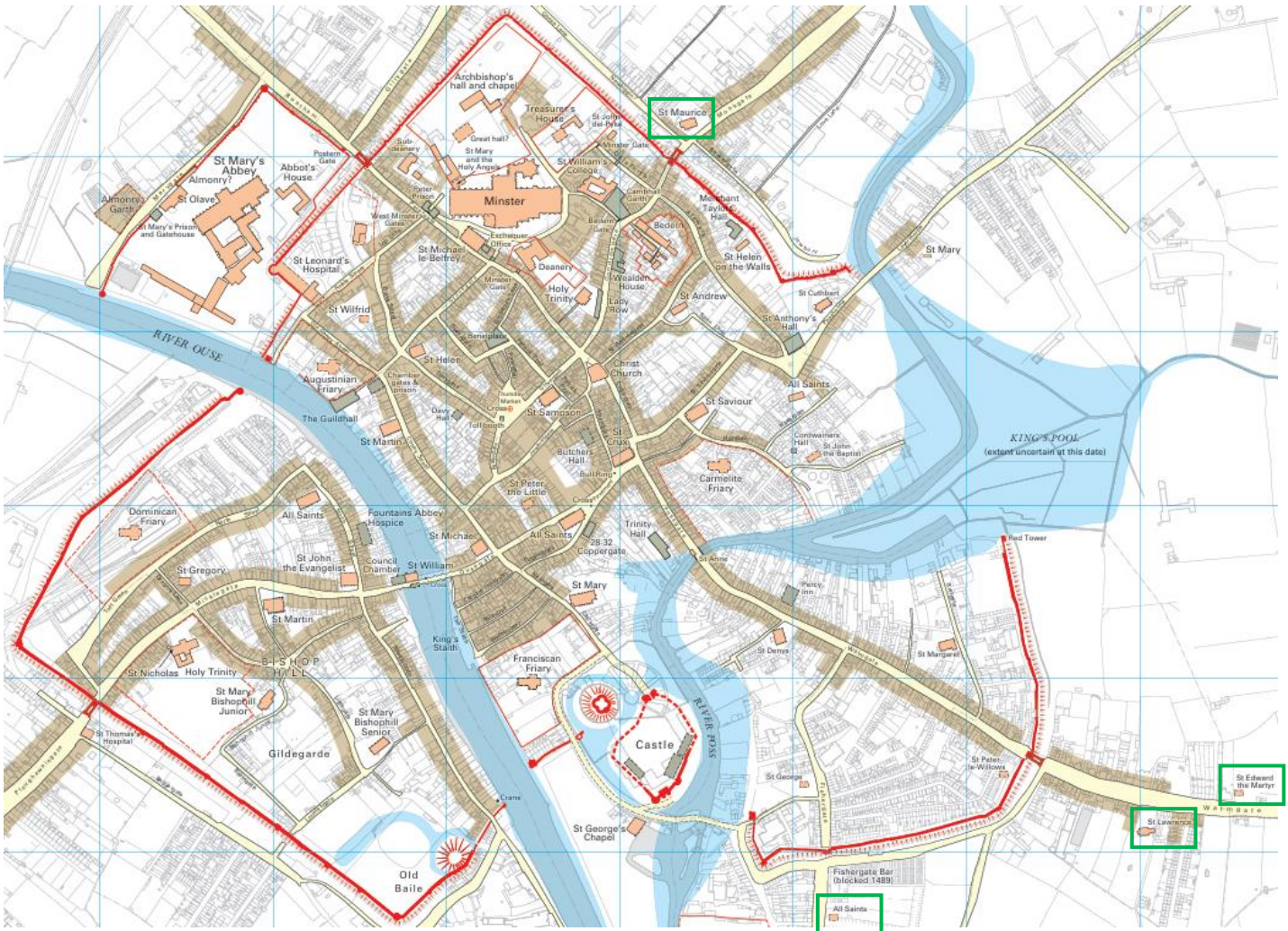


Figure 2: York c.1500. The general geographical boundary for this study is the city wall (shown in red), including the St. Mary's Abbey precinct boundary and St. Olave's (also red); where parishioners of extra-mural churches have been included as testators these are shown in green rectangles.

Image source: by kind permission of the Historic Towns Trust, from the *British Historic Towns Atlas, Volume V, York*, ed. Peter Addyman (2015).

Before building the networks studied here it was first necessary to define geographical and temporal boundaries. All three hundred and thirty-seven wills written or proved by a York **resident** between 1520 and 1540 are included.¹⁸ A resident has generally been defined as a person

¹⁸ The majority of the wills included in this study are registered copies: York, Borthwick Institute of Historical Research (B.I.), Probate Registers of the Exchequer and Prerogative Court of the Archbishop (Prob.Reg.), vols. 9, 10 and 11; B.I., Archbishop's Rolls and Registers (A.Bp.Reg.), vols. 27 and 28; York Minster Library (Y.M.L.) Probate Registers of the Dean and Chapter (D&C.Reg.), vol. 2. One will is found in the Prerogative Court of Canterbury and related Probate Jurisdictions: Will Registers (Brian Higden, ref. TNA, PROB 11/26/317).

living within an intra-mural parish, unless the area is ‘detached’ (see Figure 1 for extra-mural exceptions).¹⁹

The majority of this study takes a whole network, **sociocentric** approach.²⁰ This means that instead of taking a sample of the wills or focussing on those belonging or connected to certain individuals (**egocentric**), as far as possible all available wills meeting the criteria have been included.²¹ Previous quantitative work has not always taken this approach, instead using only published wills selected by editors on the subjective basis that they are more interesting than others. Lorraine Attreed, for example, justifies her exclusion of unpublished material on the basis that there is ‘no reason to believe that the published wills are not representative of the whole’, but David Palliser discusses the ‘bias inherent’ in published editions and correctly judges that the collection as a whole represents a ‘larger cross-section of society’ than those which have been printed, quantitative analysis requiring ‘the enumeration of many more ordinary wills’.²² For the purposes of SNA it is the nature of the whole which is of interest rather than the individual, no one will being essentially more worthy of study than any other. Because a majority of wills have been omitted in published editions, this research has returned to the manuscripts, transcribing all three hundred and thirty-seven wills.²³

¹⁹ Detached areas are those belonging to a York parish but removed from the city itself. As residents of these outlying villages are less likely to have had connections within York, the inclusion of their wills in the analysis would have impacted key measures; eleven wills have been excluded on this basis. For an explanation of such parishes see ‘The boundaries of the city’, in *A History of the County of York: the City of York*, ed. P. M. Tillott (London, 1961), pp. 311-321. For a list of the parishes included in this study and the number of surviving wills for 1520-1540, see Table 1, Appendix II.

²⁰ For a discussion of the requirement for whole network analysis over sampling, see Morrissey, ‘Archives of Connection’, p. 72.

²¹ It should be noted that even this approach of using all wills does not meet Wetherell’s requirement that whole network analysis requires the collection from ‘all available sources all possible instances of social interaction’, as broadly this study is limited to data taken from wills, rather than being supplemented with other sources such as guild records: Charles Wetherell, ‘Historical Social Network Analysis’, *International Review of Social History*, 43 (1998), pp. 125-44, (p. 129).

²² Attreed, ‘Preparation for Death’, p. 38. David M. Palliser, *Tudor York* (Oxford: Oxford University Press, 1979), p. 252. David M. Palliser, *The Reformation in York 1534-1553* (York: St Anthony’s Press, 1972), p. 19. These decisions around which wills would be published and therefore more easily/often studied is mirrored in curatorial decisions today around which historical sources to digitise: Adam Crymble, ‘The Archival Revisionism of Mass Digitisation’, in *Transformations in the Digital Age*, ed. Adam Crymble (University of Illinois Press, 2021), pp. 46-78, (p. 48).

²³ The exception to this is twenty-nine of the York clergy wills for which Claire Cross’ excellent transcriptions have been used, but compared against the manuscripts: Claire Cross, *York Clergy Wills I: Minster Clergy* (York, University of York, 1984); Claire Cross, *York Clergy Wills II: City Clergy* (York: University of York, 1989). On the ‘extensive omissions’ in the published transcriptions, see Attreed, ‘Preparation for Death’, p. 38.

Despite using all extant wills, one must remain aware of the deliberately collated nature of the archive and the proportion of people who will never have been reflected in it.²⁴ The law relating to the making of wills has been well-summarised by Wray and Cossar, although the extent of its impact on the representativeness of the York wills is disputed.²⁵ Will Coster calculates that for St. Margaret's parish (albeit a relatively poor area) only 40.9 wills were made for every 1,000 parishioners (for the period 1500-1560). However, he counters the old argument that wills were only made by a very limited social class, arguing that wills for Yorkshire provide a 'diversity of information for almost all social groups', with only the very poor excluded.²⁶

Bipartite Analysis

The data contained within the wills includes the names of both people (testators and those they name in their wills) and places (institutions such as parish churches, guilds, religious houses, and charitable organisations). SNA enables the investigation of social networks through a focus on a structure built out of the connections between entities of one kind or another. In this case it means we are interested in the connections between testators and legatees rather than the details of the bequests left, and an **edge** in the network represents a link between two people who knew each other.²⁷ 3,499 people and 181 places become **nodes** in the network, and for this first chapter only explicitly specified connections (i.e. those between a testator and a person named in his/her will) are included. The data is given no weighting, meaning that all edges have equal significance within the network.²⁸

²⁴ For some of the ways in which network analysis can be used to 'shed light on the biases of the archive', see Ahnert and Ahnert, *Tudor Networks*, p. 49.

²⁵ Shona R. Wray and Roisin Cossar, 'Wills as Primary Sources', in *Understanding Medieval Primary Sources: Using Historical Sources to Discover Medieval Europe*, ed. Joel T. Rosenthal (London: Routledge, 2012), pp. 59-71, (pp. 62-64). For a good summary of the ways in which women might have been able to circumvent these laws, see Susan E. James, *Women's Voices in Tudor Wills, 1485-1603: Authority, Influence and Material Culture* (London & New York: Routledge, 2015), p.7.

²⁶ Coster, 'Community, Piety, and Family', p. 511. Coster's argument is supported by Zell who argues for wills being written by men and women of 'almost all social levels': Zell, 'Fifteenth- and Sixteenth-Century Wills', p. 68.

²⁷ The wills contain much more information than this, data which has also been extracted and includes key details pertaining to the will and testator, as well as a myriad of information on the bequests themselves. Such information has not been used in this study to help in determining relationship strength, as bequests can too easily be dependent upon the health or wealth of an executor and therefore have the potential to skew the data. Ideally the spreadsheet containing this information, and indeed all the data involved in this work, would be made available, but preparing the volume of data (with the production of accompanying notes) proved to be outside the scope of this dissertation. For an extract from the dataset illustrating the categories of information it contains, see Appendix IV: Dataset Extract.

²⁸ Where therefore a testator has left multiple bequests to the same person, or a particularly large bequest, the edge between them is given no greater significance than any other. This approach is undoubtedly reductive, but was deemed most suitable for the purposes of this study.

Whilst most of this study will discuss networks of individuals and therefore use **one-mode** data (i.e. the nodes in the network are all of the same type, in this case people), this initial analysis includes all mentions within the wills and is therefore a **two-mode** or **bipartite** network (i.e. there are nodes of two types, people and places). To create the bipartite version, edges between individuals have been removed, leaving only those between a person and a place. Figure 3 provides a visualisation of the bipartite network, comprising 507 nodes and 1,389 edges.

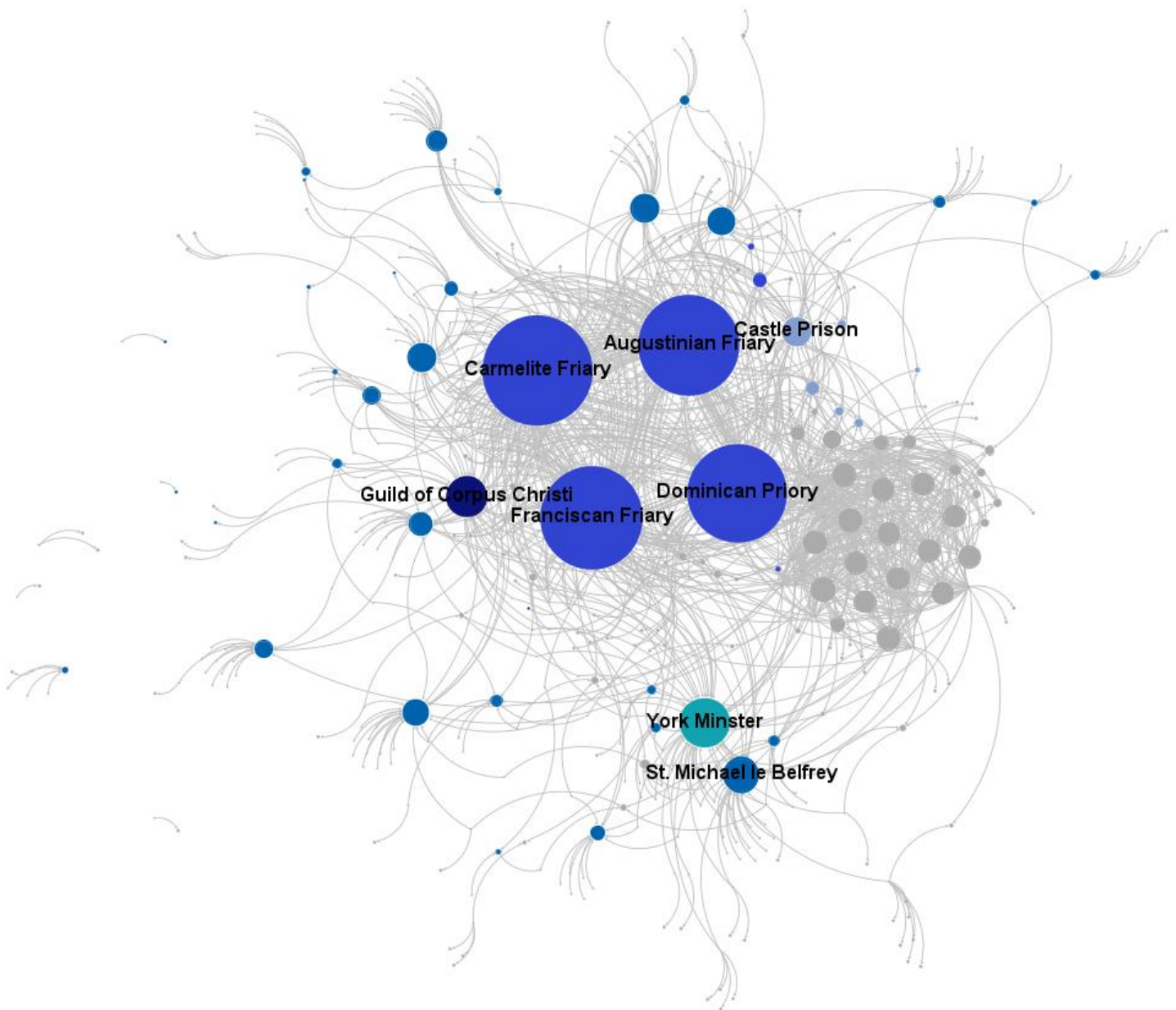


Figure 3: Curved-line visualisation of bipartite **base network** with nodes sized by in-degree; the higher the score the larger the node appears. Key categories of institution are differentiated by colour.²⁹

²⁹ Note that proximity in network visualisations does not generally represent geographical proximity, but is instead an artificial organisation which depends upon the layout algorithm being used. The visualisations presented here use Force Atlas to position nodes with higher centrality closer together and in the centre, and those with lower

When considering this bipartite network we will look only at the simplest measure of centrality, that of **degree**, in order to compare the prominence of different types of institution in the York wills. **Network centrality** is determined by a series of measures which calculate how central each node is within a network. Knowing this allows us to consider why a node holds such a position and what impact it has on the network (for example, whether someone might be able to exploit their centrality to exert influence or control). The measurement of **in-degree** considered here simply means the number of wills in which a particular person or place features. We can calculate in-degree because the data is **directional**, i.e. a bequest (represented by an edge) goes *from* the testator *to* the institution, rather than it necessarily being a record of a **reciprocal** relationship. The majority, although not all, of the references to institutions in these wills signify a bequest, and therefore we can generalise that a high in-degree score equates to a high number of bequests being made to that institution.³⁰

The visible prominence of the friaries echoes existing scholarship. Attreed's calculation of a third of testators leaving bequests to the friaries includes those made to other religious houses (such as St. Mary's Abbey and Clementhorpe Nunnery), and is therefore slightly higher than the result for friaries alone here (99 of 337 wills include one or more bequests to a York friary).³¹ Both reflect the significance of the mendicant orders to the city's residents, however, and Michael Robson's conclusion that in the early sixteenth century friaries remained 'at the heart of the life of the city' would appear to be supported by the results of network analysis, the qualitative corroborated by the quantitative and vice versa.³² That said, the relatively small number of wills (eight) requesting burial within a friary's church or grounds suggests that while their prayers, masses, and attendance at burial were felt to be efficacious, they were not the places with which

centrality further apart and further from the centre. It is also important to be aware that even with an impossibly 'flawless' and objective dataset, the very process of deciding how to analyse and present that data can lead to significant differences in outcome and conclusion. A detailed discussion of this is impossible here, but for the convincing argument that the same data can be used to prove opposing points depending upon the visualisations used, see Caitlin Burge, *Letters, Networks of Power, and the Fall of Thomas Cromwell, 1523-1547* (Unpublished PhD thesis, Queen Mary University of London, 2022), p. 116. For the data behind Figure 3 see Table 2, Appendix II.

³⁰ Exceptions would be the mention of a place as a testator's parish or burial location without a bequest, but these are rare.

³¹ Attreed, 'Preparation for Death', p. 48.

³² Robson, 'Grey Friars', pp. 110-12, 119. Robson makes the point that in the case of the Grey Friars this included physical integration in the form of a friary designed to accommodate the local community at open-air sermons within its grounds, a deliberate invitation to lay people which contrasts with the relative isolation of St. Mary's Abbey. On the idea that quantitative methods both corroborate and are corroborated by earlier qualitative work, see Ahnert and Ahnert, *Tudor Networks*, p. xxv.

people's primary religious allegiance lay.³³ For most testators (where a place is given) it was their parish church to which they looked for burial (and where they more usually left bequests for church works or of a liturgical nature).³⁴

Following the friaries in node-size (or in-degree) is the cathedral church of York (the Minster), mentioned often in the wills of clergy as their place of burial and/or employment and by some non-clerical testators, but not drawing the same volume of bequests as did the friaries.³⁵ The prominence of the Corpus Christi Guild in York is reflected in its high-scoring position for in-degree and, as is to be expected, other city-wide institutions popular amongst testators such as *maisonsdieus* and almshouses begin to feature (several of these make up the cluster of larger grey nodes on the right of Figure 3). The reasons behind bequests to guilds and charitable institutions, often made irrespective of parish, are likely to have been different, despite their scoring relatively similarly for in-degree. As York's most prestigious guild, Corpus Christi regularly received bequests requesting its keepers and lights at burial processions and funerals, a visible demonstration of the testator's status as a member of the guild. Gifts to *maisonsdieus*, almshouses, and hospitals, on the other hand, are likely to have been more exclusively charitable in their intent, motivated by a desire to do good (albeit often also to be seen to do good), and to secure the prayers of the poor, considered to be particularly beneficial. Testators such as Alexander Foster were able to leave a bequest to 'every howse of the masyndewes', or even more generously to allocate an amount (in the case of William Cokkes a halfpenny) to 'every persone, men or women, in them'. Others either chose or were forced to be more discerning, Cristiane Beke singling out the Hospital of St. Thomas to receive 'one almes bede one mattres one pare of shettes and one Coverlet', but leaving nothing to any other specific charitable institution.³⁶

In bequests to prisons a contrast with Attreed's findings for the north as a whole is found. She concludes that 'gifts to prisoners received little attention' from testators, finding bequests to prisons comprising only 2.8% of total gifts between 1525 and 1540.³⁷ This contrasts with the result here of 7.4% for York for the period 1520-1540, reflected in the position of the prisons when

³³ On primary loyalty being to parish churches, see Barrie Dobson, *Church and Society in the Medieval North of England* (London: The Hambledon Press, 1996), p. 272.

³⁴ The category of 'liturgical' bequest has been defined as including: wax (where not specified as directly related to a burial or funeral service); fabrics (e.g. altarcloths, vestments); contributions to a variety of lights within a church; silverware; and books explicitly given to parish churches.

³⁵ Of the forty-four bequests to the Minster thirty came from a testator requesting burial there.

³⁶ Alexander Foster (1520), B.I., Prob.Reg.9, f.271r; William Cokkes (1524), B.I., Prob.Reg.9, f.373r-v; Christiane Beke (1538), B.I., Prob.Reg.11, f.312r.

³⁷ Attreed, 'Preparation for Death', pp. 46-47.

ranked by in-degree: 8th (Castle prison); 39th (Archbishop's prison); =50th (Kidcote unspecified, where a testator has not specified whether the bequest should go to the Kidcote for men or women); =50th (men's Kidcote); =50th (women's Kidcote); and 70th (Bidcote).³⁸ Every prison features in the top eighty nodes by in-degree, and whilst it is unsurprising that a city-wide institution would score well, this does suggest that for the people of York there was merit in giving to a category of the needy which was perhaps not always considered to be as worthy as those inhabiting almshouses or *maisonndieus*.³⁹ It may be that this difference in the proportion of testators leaving bequests to prisons is reflective of differing attitudes towards prisons and prisoners in rural and urban environments. Testators in the city of York were perhaps more likely to be personally acquainted with prisoners held in the city (and the conditions of those prisoners) than residents in small villages who might know no-one in a York prison, or who would potentially be unaware of their need for charity.

The significance of parish churches to testators, touched on earlier in relation to burial requests, is reflected in six featuring in the top fifteen scoring nodes. Whilst some mentions of churches related only to obligatory tithes or mortuary dues, in many wills additional sums of money were left for burial, funeral expenses, masses, and/or prayers. Property was bequeathed (sometimes delayed until after the death of a spouse) to pay for obits and anniversaries, and wills make clear the depth of connection between parishioners and their churches in additional bequests for church works, maintenance of various lights and torches, and physical items to be used during services. No doubt such bequests were in part intended to secure the prayers of parishioners and, as Justin Colson argues, to allow the deceased to be involved in the continuing life of the parish, but in leaving 'a silver sponne to be occupied when the blissed sacrament is mynistred to seke folke', £4 4d. for 'the bouke that is in makynge [to] my parish kirke to make it a holl buke', and 'a pece of tymber', John Barnes, Margaret Speight, and Agnes Bell exhibit a concern for and interest in improving both the fabric and liturgy of their churches.⁴⁰ This close relationship between

³⁸ Removing pre-1525 bequests to prisons to provide a direct comparison with Attreed's figures reduces the difference somewhat, but still results in 5.3% of testators donating to prisons. The score for the male and female Kidcotes is artificially low as a result of a lack of specificity in some wills; 'Kidcote (unspecified)' has a separate position in the network, but in reality its degree score would be added to either one/both of the male and female kidcotes if this detail were provided. For a discussion of York's late medieval prisons, see P. M. Tillott, 'Prisons and Gallows', in *A History of the County of York: the City of York*, ed. P. M. Tillott (London, 1961), pp. 491-98.

³⁹ On prisons and prisoners being considered less worthy than other groups, see Cullum and Goldberg, 'Charitable provision', p. 34.

⁴⁰ Justin Colson has written interestingly on the idea that at least some of the provision in wills was intended to maintain an 'active relationship between the dead and those whom they had known in life': Justin R. Colson, *Local Communities in Fifteenth Century London: Craft, Parish and Neighbourhood* (Unpublished PhD thesis, University of London, 2011, p. 217). John Barnes (1540), B.I., Prob.Reg.11, f.452r-v; Margret Spегhe (1532), B.I., Prob.Reg.11, f.37r-v; Agnes Bell (1530), B.I., Prob.Reg.10, f.16r. For the convincing argument that such

parishioner and church differs from that seen with the Minster, bequests to which (unless from its own employees) are generally a small amount of money for church works. In stark contrast to the friaries, the wealthy Benedictine abbey of St. Mary's also receives dramatically fewer bequests, only three across all three hundred and thirty-seven wills (Robert Asbe left 3s. 4d. for the 'gilding' of the high altar, John Rasing requested obits for his 20s., and Robert Fons bequeathed 12d. 'for my breif sending with their brevitour to their howses of religion as Brother of thair Chapitour').⁴¹ In addition to the abbey itself, the office of abbot appears four times, in one case as **supervisor** and once as a debtor (Sir Thomas Forne requested that £20 be given to the rebuilding of St. Michael le Belfrey (the Belfrey) 'if it may be gettyn of th'abbott of Sanct Maries without Bowthome which he doith aw unto me').⁴²

This brief survey has served to establish the relative prominence of different types of institution in the York wills. It also demonstrates that SNA can both produce similar results to existing research (for example, the significance of friaries), and suggest avenues for further research (what might be learnt about differences in charitable giving to prisons in urban and rural environments). The next part of this dissertation will discuss one-mode networks (modified to exclude institutions unless stated otherwise) in order to focus on the connections between people and the structural position of individuals within the network.⁴³

One-mode Analysis

Removing all institutions results in a network of 3,491 individuals with 4,462 edges between them.⁴⁴ Figure 2 plots the number of nodes for each degree score and shows that a large number of nodes have a low degree score and a very small number a high degree; this is known as a **scale-free** network and is a distribution found in the majority of real-world networks.

bequests were partly left with a view to supporting or enhancing liturgical provision, see Burgess, 'By Quick and by Dead', p. 844.

⁴¹ Roberte Asby, B.I., Prob.Reg.9, f.129r; John Rasyng, B.I., Prob.Reg.9, f.383r; Robert Fons, Y.M.L., D&C.Reg.2, f.174v-175v. Here Fons was asking for notice of his death to be carried by a breviator (messenger) to other monastic communities and religious houses in the form of a mortuary brief, presumably to secure their prayers. Palliser cautions against reading too much into the paucity of bequests to religious houses other than friaries, arguing that it may reflect 'a feeling that the religious houses were already adequately provided for through...endowments': Palliser, *Tudor York*, p. 227.

⁴² John Metcalf, B.I., Prob.Reg.10, f.20r-v; Thomas Forne, Y.M.L., D&C.Reg.2, f.167r-168v.

⁴³ Aside from those institutions already discussed, groups of people such as the brothers of St. William's College, the brothers of the Bedern (residence of the Minster's Vicars Choral) and the 24 (a part of York's governing council) have also been excluded.

⁴⁴ For a visualisation of this network see Figure 1: Appendix III.

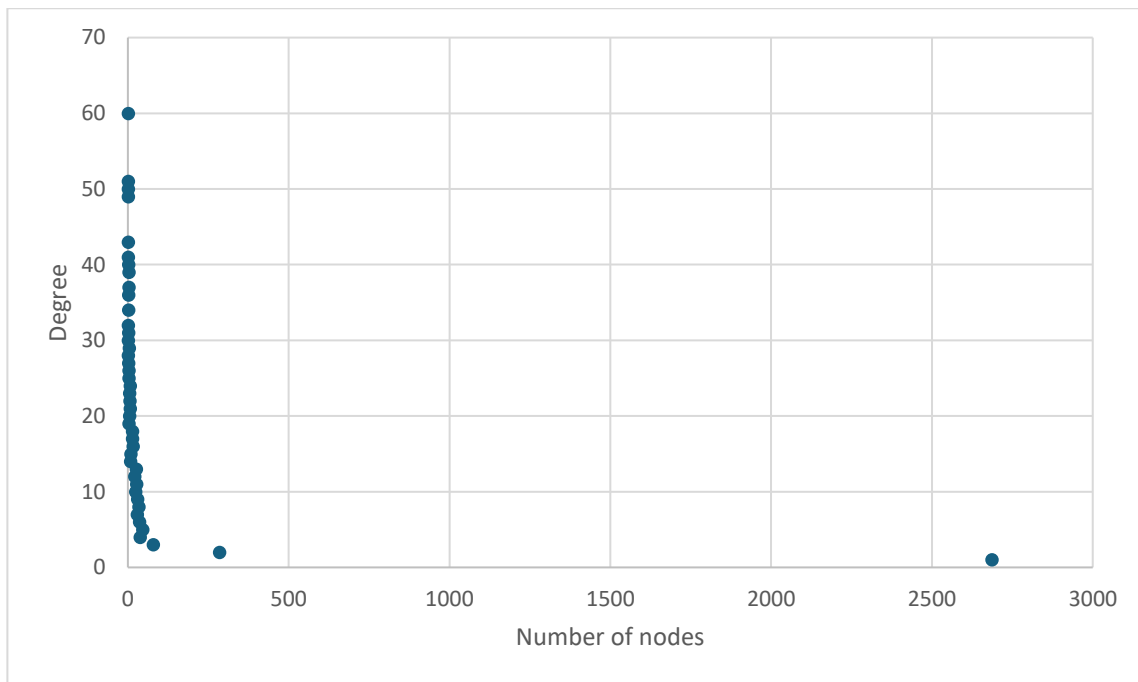


Figure 4: Degree distribution for base network, showing a high number of nodes with very low degree (far right) and a low number of nodes with high degree (left).

Of the top twenty in-degree scores twelve are city (as opposed to Minster) clergy.⁴⁵ Whilst a proportion of these priests will have received formulaic bequests such as forgotten tithes, many were given additional sums or items and/or acted as witnesses to the wills.⁴⁶ Present at key life events such as christenings, marriages, and often deaths (as well as parish events and church services) it would have been unusual if such priests had not come to know their parishioners well, if, as R. B. Dobson argues, there had not existed ‘fundamental...personal ties’ binding together priest and citizen.⁴⁷ The same was not generally true for the Minster clergy, who tended to operate at more of a distance from the majority of York’s populace, although Doctor Edward Kellett (prebendary in the Minster from 1524 and precentor from 1538) is in twentieth place with an in-degree score of eight, five of his edges coming from York citizens rather than his Minster colleagues.⁴⁸

So far we have looked at in-degree, a measure of how many times a node features in the wills. Its opposite, **out-degree**, is of less interest in isolation given its propensity to favour longer wills

⁴⁵ See Table 3, Appendix II for a table showing these scores and the parish(es) to which each priest was attached.

⁴⁶ It is sometimes impossible to know whether a priest appears as a witness solely by virtue of their role as scribe for a will, or whether he has been chosen for a more personal reason; often it may be both.

⁴⁷ Dobson, *Church and Society*, p. 264. See also Cross’ argument that York city clergy were ‘overwhelmingly’ recruited locally, a possible contributing factor to close relationships between clergy and laity: Cross, *City Clergy*, p. vi.

⁴⁸ Kellett’s will is lost, but Francis Drake recorded his tombstone as giving 5th September 1539 as the date of his death: Cross, *Minster Clergy*, p.38.

and/or the wealth of the testator. Combining in- and out-degree gives an overall measurement, and it is this overall degree score that is used when we analyse an **undirected** network. In an undirected network, directionality of the edges is removed. Although this network is inherently directional (in the sense that a testator names a person in their will and the edge therefore originates from one side), in order for A to know B, B must know A, and the relationship can therefore be considered reciprocal (i.e. travelling in both directions).⁴⁹ Whilst the absence of separate scores for in- and out-degree means that we cannot use this version of the network to determine which nodes featured in the highest number of wills or which nodes named the highest number of people, using undirected data reflects the reciprocal nature of real-world relationships and allows for a greater range of analysis. The loss of individual in- and out-degree scores is not overly problematic, given that in terms of understanding a node's structural position degree alone can be of limited use (a high degree score does not necessarily equate to a central position within a network). It should be noted, however, that choosing to remove the directionality inherent in the wills is only one of many decisions which impact conclusions drawn from the network.⁵⁰

Considering other centrality measures will demonstrate how and why significance within a network is not necessarily determined by degree, and the first new measure we will look at is **betweenness centrality**. Betweenness centrality is a measure of how often each node in a network appears on a **geodesic** (or **shortest**) **path**, in other words how many times a node sits on the shortest route between two other nodes. For each pair of nodes in a network (such as A and E in the 'toy' diagram below) there is a shortest path along the edges between them; the more times a particular node sits on a shortest path the higher will be its betweenness score. In Figure 5, A can reach E in two ways, either A-B-D-E or A-C-E; in this case the shortest path is through C.

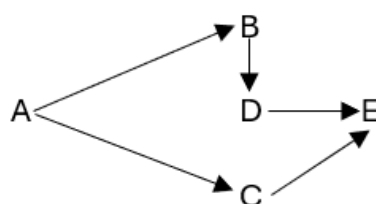


Figure 5: 'Toy' diagram (i.e. not real data) illustrating shortest path concept.

⁴⁹ There are a small number of exceptions to this rule, for example when a testator leaves money for prayers for the soul of a deceased city dignitary and may not have personally known that dignitary, but these are few and far between; even where a testator does not specify the name of a parish priest they are almost certain to have known him.

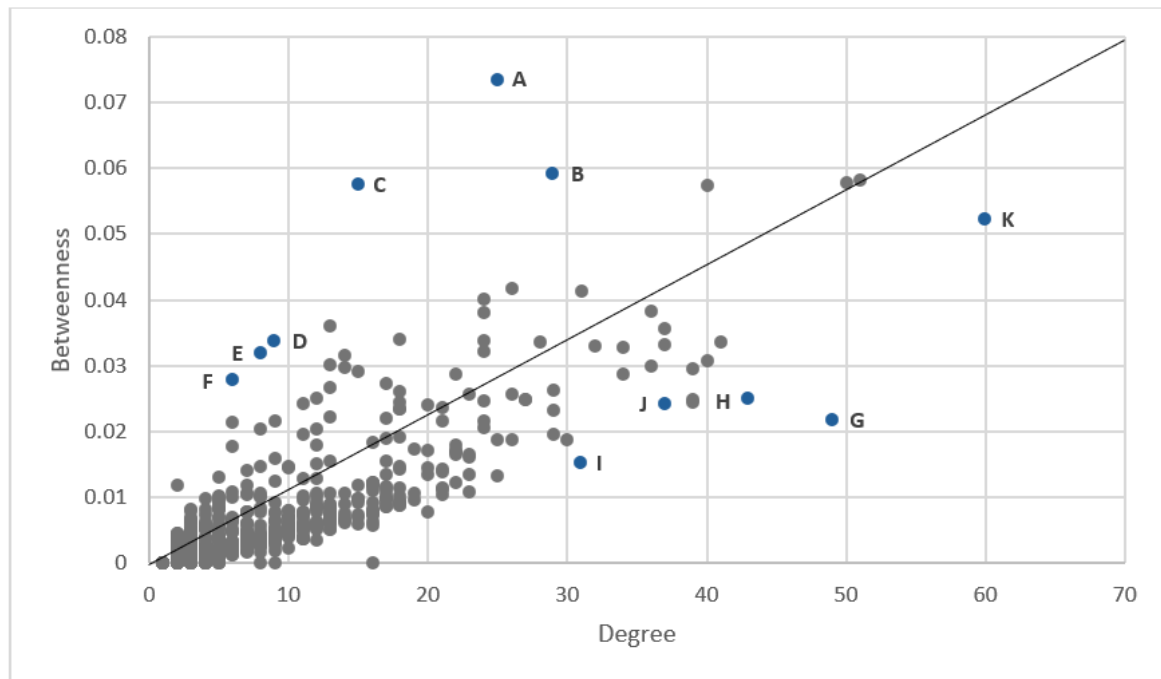
⁵⁰ For a discussion of the issues surrounding 'abstraction', 'the deliberate reduction of the amount of available information' so often necessary to make SNA work with historical data, see Ahnert et al., *Network Turn*, pp. 75-79.

A node's betweenness score can be interesting to us for a number of reasons, not least because of that node's potential to act as a **bridge** between different areas of the network, or to hold it together. This potential is just that: it does not tell us that a particular node definitively was structurally significant, rather that it sits in a position within the network which gives it the *potential* to be so. Rather than making assumptions about the importance of a particular node, historians must take this potential for centrality and then, as Borgatti points out, attempt to form 'hypotheses about the potential consequences of [that] centrality'.⁵¹

A high betweenness score can suggest a node has the ability to control the flow of information through the network, conferring an advantage upon that person.⁵² However, this measure can be influenced by how many paths a node is able to sit on as a result of their degree (a higher degree means more paths, which might lead to higher betweenness). In a network for which we had all the connections of each node, degree would be a more reliable measure of centrality, but here it is too easily influenced by who did and did not leave wills. We must therefore find other ways of detecting potentially significant nodes, and plotting betweenness against degree is one such method. Figure 6 allows us to see who stands out as scoring higher or lower for betweenness than the norm for their degree score, those people who score highly for betweenness despite a low degree or, conversely, do not perform as well for betweenness despite a high degree.

⁵¹ Stephen P. Borgatti, Martin G. Everett, and Jeffrey C. Johnson, *Analysing Social Networks* (London: Sage Publications Ltd, 2013), p. 164.

⁵² Bonnie H. Erickson, 'Social Networks and History: A Review Essay', *Historical Methods*, 30 (1997), pp. 147-57, (p. 152).



A Sir Laurence Hall; **B** John Rasing; **C** Sir John Stapleton; **D** Christopher Conyers; **E** William Wright²; **F** John Tod; **G** Elisabeth Shaw; **H** Maude Shaw; **I** Sir John Rayner; **J** Sir Gregory Woodall; **K** Sir John Sheffield.

Figure 6: Betweenness scores plotted against degree for all individuals within the network; those scoring disproportionately higher for betweenness than degree are seen above the trend line, those scoring disproportionately lower for betweenness than degree are seen below the trend line.

This comparison immediately demonstrates that, as discussed, a high degree score does not always equate to a high betweenness score. The clustering of nodes in the bottom left of the graph indicates that a majority of nodes have both low degree and low betweenness, and the trend line shows that (generally) as degree increases so too does betweenness; this is reflected in the top twenty betweenness scores including nine nodes who also fall in the top twenty degree scorers.⁵³ There are, however, nodes featuring in the top twenty for betweenness who score as low as 228th for degree (Christopher Conyers), and high-degree nodes (Elisabeth Shaw at 4th, Maude Shaw at 10th) who do not appear in the top twenty (their respective ranks for betweenness are 58th and 45th). Considering why these nodes score either better or worse than the norm for betweenness can tell us a great deal about the network, and by extension the society on which it is based.

The highest scoring node for betweenness, and a clear outlier in Figure 6, is Sir Laurence Hall, parochial chaplain of the Belfrey from at least 1522-1547/8.⁵⁴ Despite ranking 33rd for degree, Hall scores higher for betweenness than the first, second, and third highest degree score holders

⁵³ See Table 4, Appendix II for the top twenty betweenness scorers and their degree ranking.

⁵⁴ Cross puts Hall in the Belfrey in 1522, but places him in York (as keeper of the Corpus Christi Guild) in 1521 and suggests he may have been a priest before 1522: Cross, *City Clergy*, p. 44.

(Sir John Sheffield, John Shaw¹, and Sir William Merton).⁵⁵ In order to explain this we will compare the ego networks of four clergymen: Sir Laurence Hall and Sir John Stapleton who score highly for betweenness but lower for degree, and Sir Gregory Woodall and Sir John Rayner who score higher for degree than Hall and Stapleton but lower for betweenness.

Node	Betweenness rank	Degree rank	Degree score	Nodes in two-depth ego network
Sir Laurence Hall	1 st	33 rd	25	311
Sir John Stapleton	5 th	113 th	15	293
Sir Gregory Woodall	49 th	12 th =	37	96
Sir John Rayner	87 th	21 st	31	41

Table 1: Betweenness rank compared with degree rank and score for Sir Laurence Hall, Sir John Stapleton, Sir Gregory Woodall, and Sir John Rayner.

Neither Hall nor Stapleton left wills in this period and their degree scores are therefore composed solely of mentions in other people's wills.⁵⁶ In contrast, Woodall and Rayner did leave wills; their networks are made up of the people they name in those wills, exclusively in Rayner's case, with one exception in Woodall's.⁵⁷ There will no doubt be a number of factors influencing why some clergymen feature in the wills more than others, but one such factor is their particular role.⁵⁸ As parochial chaplain of the Belfrey and rector of Holy Trinity, King's Court respectively, Hall and Stapleton would be more likely to have been embedded in their parish communities, interacting daily with a wide range of people.⁵⁹ Some of these people would go on to leave them a bequest (often a sum of money for prayers but sometimes of a more personal nature, such as the 'silver sponne with a garleke hed of the ende' left to her curate, Hall, in Alice Wattirton's will of

⁵⁵ Sheffield was Minster prebendary in the chapel of St. Mary and the Holy Angels from some time after 1501 until his death in November 1534: Cross, *Minster Clergy*, p. 32. He is noticeable in Figure 6 for his low betweenness compared to degree score, probably explained by the majority of his bequests going to family members (who do not otherwise appear in the wills) and religious houses.

⁵⁶ Hall wrote his will in February 1548 and it was proved in June of the same year: Lawrence Hall (1548), Y.M.L., D&C.Reg.3, f.20r-v). Hall's *in-degree* is particularly high (at twenty-five he would feature in the top ten nodes even with institutions included), no doubt influenced by the length of his tenure and the relatively high number of extant wills for his parish. Stapleton's will has not survived, but he was dead by 3rd April 1550 (B.I., A.Bp.Reg.29, f.33v). He became rector of Holy Trinity in 1535; prior to that he may have been at either St. John's, Ouse Bridge End or St. Michael's, Spurriergate, and was certainly a cantarist in St. William's Chapel on Ouse Bridge and both keeper (1520) and master (1544) of the Corpus Christi Guild: Cross, *City Clergy*, p.10; Christopher C. Webb, 'A Census of York Clergy?', in *Life and Thought in the Northern Church, c.1100-1700: Essays in Honour of Claire Cross*, ed. Diana Wood (Woodbridge: Boydell Press, 1999), pp. 257-93, (p. 289).

⁵⁷ The only reference to Woodall in a will other than his own is in that of Bettresse Lee (1538), B.I., Prob.Reg.11, f.323r; Lee names Woodall as her son and appoints him executor.

⁵⁸ On the difference in the way clergymen were treated in wills, and in particular variation in the roles in which they are found (e.g. witness, executor, supervisor), see Colson, *Local Communities*, p. 193.

⁵⁹ As rector Stapleton's residence within the parish would not have been required, but there is no indication that he lived elsewhere: Alexander H. Thompson, *The English Clergy and their Organization in the Later Middle Ages* (Oxford: The Clarendon Press, 1947), pp. 122-23, (p. 102).

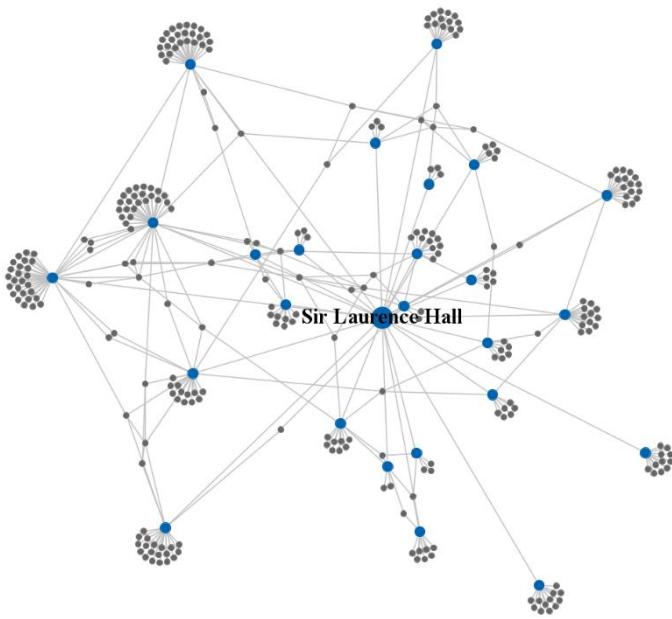
1528), or who might request their assistance as either scribe of or witness to their will.⁶⁰ Woodall and Rayner, on the other hand, were chantry priests, Woodall in St. John's, Ouse Bridge End and Rayner in St. Christopher's Guild in the Minster (appointed 1538).⁶¹ Their involvement with the people of York, particularly in Rayner's case, may have been more limited, and perhaps their absence in the wills of those people reflects this.⁶²

The difference in these clergymen's ego networks (Figure 7) illustrates how the nature of their connections affects their overall structural position. The ego networks are shown at a depth of two (i.e. those people immediately connected to the testator (**alters**) and anyone immediately connected to each of those alters). There is a clear difference in both the size and structure of the networks. Those of Woodall and Rayner are smaller despite their higher degree scores, a total of 96 and 41 nodes respectively, as opposed to those of Hall and Stapleton which contain a total of 311 and 293 nodes (see Table 1). The networks of both Woodall and Rayner contain a large number of **pendants**. A pendant is a node connected to only one person (in this case a testator) and, contrasted with Hall, it becomes clear that having more pendants might result in a lower betweenness score. Because Hall's connections are derived from the wills of other people, his network contains no pendants; every one of his alters has an edge to the other people named in each will, thus extending Hall's reach within the network and increasing the number of paths he sits on (and therefore his potential to sit on shortest paths). The people named in Woodall and Rayner's wills (those who appear here as pendants) would have had their own connections, but because they did not leave wills (at least in this period and possibly at all), those connections are absent from the network and thus Woodall and Rayner appear less well-connected within it.

⁶⁰ Alice Wattirton, Y.M.L., D&C.Reg.2, f.148r&v.

⁶¹ Cross, *Minster Clergy*, p. 47; Cross, *City Clergy*, pp. 17-18.

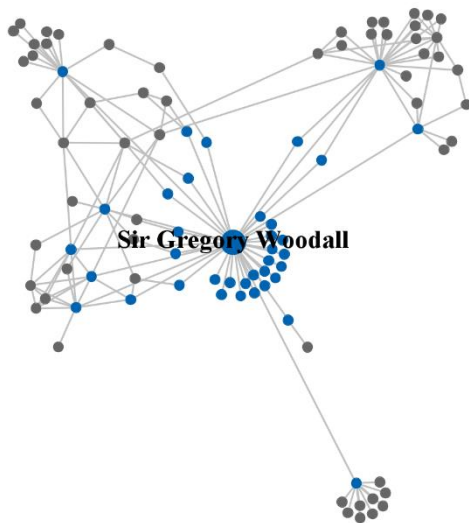
⁶² A caveat to this is that cantarists *could* be closely involved with the laity in their parishes: Palliser, *Reformation*, p. 23.



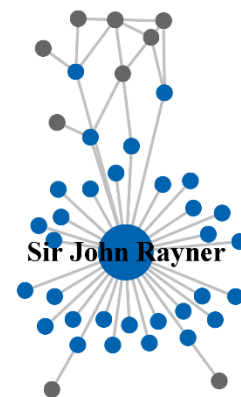
a.



b.



c.



d.

Figure 7: Ego networks to two-depth for a) Sir Laurence Hall, b) Sir John Stapleton, c) Sir Gregory Woodall, and d) Sir John Rayner; egos and alters are in blue.

In addition to this key difference in the make-up of their networks, the non-pendant nodes in Woodall and Rayner's networks are more interconnected than those in Hall and Stapleton's (at least in some cases). Unlike Hall and Stapleton's visually central position (reflective of their location on paths between the different **hubs** in their networks), Woodall and Rayner sit on the

periphery of an area of interconnected nodes, a majority of which have shorter paths between them than with Woodall or Rayner included; they therefore do not sit on as high a number of short paths as Hall and Stapleton, and as a consequence score less well for betweenness. In Rayner's case the interconnected nature of the people he names in his will is explained by a significant proportion of them being fellows of St. William's College, most probably Rayner's own place of residence.⁶³ The depth of his connection to the college is reflected in his bequests to its butler and cook, but living here and working in the Minster may have reduced his interactions with people outside the Minster Precinct.⁶⁴ Those people closest to Rayner were clearly not York's laity, and this is most probably fairly reflected in his relatively peripheral position within the network.⁶⁵ Woodall, however, names several lay people who appear occasionally in other wills or sources. His position as a chantry priest in a city parish rather than the Minster, whilst not as integrated as Hall or Stapleton, does appear to have resulted in more links with the city than Rayner has, but as many of these are pendants they do not increase his potential for betweenness.⁶⁶ It is therefore not so clear that Woodall's centrality score is reflective of his real-world position. This leads us to an issue at the heart of this dissertation, the incompleteness of historical data and the difficulty in relying on centrality measures derived from a network of this nature.⁶⁷

As briefly discussed earlier in relation to degree, if we were looking at a complete dataset the networks above would tell us that Woodall's alters were less well-connected than Hall's and we could rely upon the centrality scores. Such a network would contain the alters of each node included (in practical terms this would mean that any person mentioned in a will would have left their own will). For Woodall, the absence of this information on the possible connections of pendants in his network leads to a lower betweenness score. Whilst the fact that a pendant is not mentioned in more than one will does suggest that these nodes were not very highly connected, having additional information on them might change Woodall's centrality scores. The occupation-

⁶³ St. William's College was the residence of the Minster cantarists, a group Cross describes as sharing a 'common loyalty': Cross, *Minster Clergy*, p. ix. Whilst Thompson points to chantry colleges set up for parish cantarists, testamentary evidence does not suggest the same loyalty, parish cantarists more often focusing on bequests to their immediate colleagues rather than a place of collective residence: Thompson, *English Clergy*, p. 158.

⁶⁴ Rayner left 6d. to the butler and 4d. to the cook, in addition to a number of bequests including money and 'a gallon of wyn emongges them' to all those of the college's brethren who attended his funeral: John Rayner (1540/1), Y. M. L., D&C.Reg 2, f.190v-191r.

⁶⁵ Peripherality used here is the opposite of centrality. It does not necessarily mean that a node is isolated, but that it is 'poorly integrated' and 'likely to have little influence': John Scott, *What is Social Network Analysis?* (London: Bloomsbury Academic, 2012), p. 42.

⁶⁶ Another contributing factor to Woodall's city links may be that he was local to York – the record of his ordination gives him as 'de Ebor', B.I., A.Bp.Reg 27, f. 214r.

⁶⁷ For a conceptual discussion of historical SNA see Kate Davison, 'Early Modern Social Networks: Antecedents, Opportunities, and Challenges', *The American Historical Review*, 124(2) (2019), pp. 456-82.

based reasoning suggested here for these clergymen's differing betweenness scores is plausible, but comes with the caveat that the centrality scores are potentially impacted by missing data.

Figure 6 also highlights lay people, such as Christopher Conyers, who are noticeable for their high betweenness. Conyers, a merchant, scores 17th for betweenness but 228th for degree, for which he scores only nine (all mentions in other people's wills).⁶⁸ Considered alongside Hall and Stapleton, Conyers adds to a pattern of those nodes scoring highly for betweenness relative to degree often being those who did not themselves leave wills. Whilst this is not always the case (we shall shortly discuss John Rasing, a merchant and alderman who did leave a will and yet scores significantly higher for betweenness than for degree), it remains noticeable that being named in the wills of other people tends to be more helpful for increasing a node's betweenness score than leaving a will of their own, given the likelihood of pendants and the negative impact such alters can have on betweenness. Conyers has a lower degree score than any of his alters, but several of those alters themselves score highly for degree, resulting in his network at two-depth consisting of two hundred and thirty nodes. His ego network shows a similar structure to those of Hall and Stapleton; no pendants and a series of hubs around those testators who named him.

Figure 8 depicts Conyers in the centre of a network in which for many of the peripheral nodes their shortest path to most other nodes in the network is via Conyers himself (as seen in the highlighted example paths). Any path not going through Conyers would increase the distance (i.e. the number of edges) between them.

⁶⁸ Conyers' own will survives and we know his occupation from the will of Agnes Norman: Christopher Conyers (1557), B.I., Prob.Reg.15, f.364v; Agnes Norman (1533), B.I., Prob.Reg.11, f.68r.

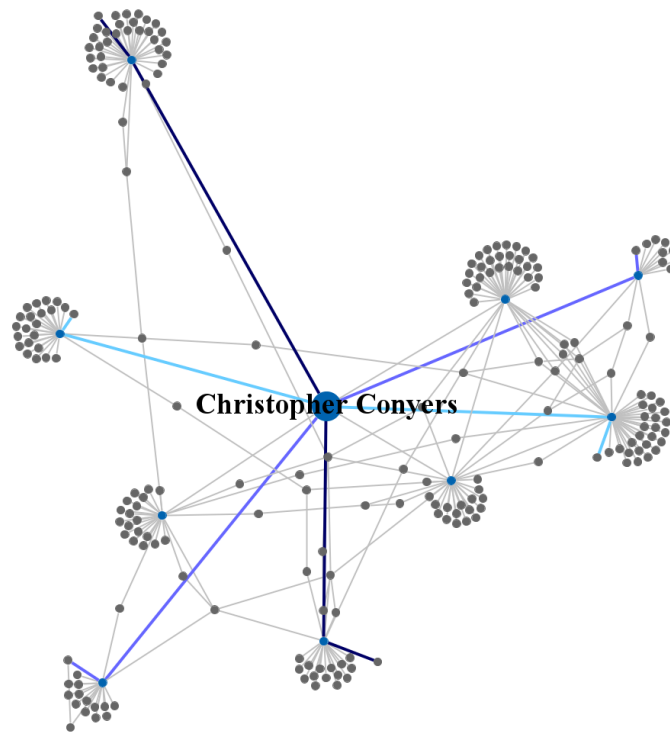


Figure 8: Conyers' ego network at two-depth with example shortest paths passing through him highlighted; Conyers and his alters are in blue.

Like Conyers, his fellow merchant John Rasing scores more highly for betweenness than might be expected given his degree. This begins to suggest that being a member of (particularly parish-based) clergy was not the only occupation which might result in a higher betweenness score and a more central role within the network. A key factor for merchants is their greater potential for a wider geographical spread in their connections. Whilst they were more likely to be members of city-wide guilds which formed *gesellschaften*, or 'communities of interest', through which they might have formed additional social relationships, the city-wide nature of their role in maintaining trade links also made them literal 'go-betweens'.⁶⁹ Figure 9 shows Conyers' location in his parish of All Saints, Pavement with the parishes of his alters marked.⁷⁰

⁶⁹ Italics my own. For go-betweens see Davison, 'Early Modern Social Networks', p. 466. On the significance of membership of the Corpus Christi Guild (particularly in terms of social climbing), see Mervyn James, 'Ritual, Drama and Social Body in the Mediaeval English Town', *Past & Present*, 98 (1983), pp. 3-29, (p. 25, n. 81). This point is not universally accepted; for a more recent counter-argument see Haigh's suggestion that guilds 'offered few social...advantages': Christopher Haigh, *English Reformations: Religion, Politics, and Society Under the Tudors* (Oxford: Oxford University Press, 1993), p. 36. On communities of interest see Colson, *Local Communities*, p. 21.

⁷⁰ The parishes of the majority of Conyers' alters are specified in their wills. William Cure and John Chapman¹, whose parishes are not specified, are assumed (on the basis of content within their wills) to belong to the Belfrey.



A: All Saints, Pavement (Christopher Conyers; William Robinson; Agnes Norman); **B:** Holy Trinity Micklegate (William Nelson¹); **C:** St. Mary's, Castlegate (John Marshall¹); **D:** St. Crux (Henry Holme); **E:** St. Sampson's (John Rasing); **F:** Holy Trinity, King's Court (Nicholas Malland); **G:** St. Michael le Belfrey (John Chapman¹; William Cure).

Figure 9: Map showing the parish locations of Christopher Conyers and his alters.

Image source: by kind permission of the Historic Towns Trust, from the *British Historic Towns Atlas, Volume V, York*, ed. Peter Addyman (2015).

A network of connections in multiple parishes is fairly atypical in this dataset; a useful comparison is seen in Thomas Clerk², whose in-degree of seven is similar to that of Conyers but who ranks 129th for betweenness. Comparing the physical geography of their connections allows us to see the difference the increased distribution of Conyers' alters may be making to his potential for betweenness. Clerk's own parish and occupation are unknown, but at least four of his seven alters are known to have been parishioners of All Saints North Street, with only one confirmed to be based elsewhere in the city.⁷¹ The increased geographical distribution of Conyers' alters opens his network to a wider range of people who may not already be connected to one another (as nodes who share the same parish are more likely to have been). This feature, a merchant with relatively

⁷¹ Thomas Clerk² may be the person referred to in Paul Gillour's will as 'gentilman' but this is unclear: Paule Gillour, B.I., Prob.Reg.9, f. 283v-284v.

low degree but high betweenness, is also found elsewhere. In their work on early-modern correspondence networks Ahnert and Ahnert argue that, as here, merchants ‘do not necessarily need many links to put them on a shortest path across the network;...their high betweenness derive[s] from the ways they span different communities or geographical spaces’.⁷² Conyers is a useful illustration of (where the data is available) how effective geo-based methods of analysis and visualisation can be in enhancing our interpretation of networks.⁷³

The higher-than-normal betweenness scores of two other nodes who stand out in Figure 6 (William Wright² and John Tod) can also be in part attributed to their occupations and office-holding status. Like Rasing, Wright was both merchant and alderman and, somewhat unusually, also a notary (as was Tod).⁷⁴ The need to have someone literate to write a will increases the probability of notaries being found as witness in a diverse range of wills.⁷⁵ Interestingly both of the notaries discussed here, whilst scoring higher for betweenness compared to degree than the norm, exhibit less of a difference between these scores than the two merchants. It is impossible to draw conclusions on the basis of only four nodes, but further research might look at whether there is generally an increased likelihood that a merchant scores highly for betweenness compared to, for example, a notary.

What can be understood from the results discussed so far is that there is a distinct correlation between certain types of occupation and betweenness. Members of the clergy and mercantile classes score disproportionately highly for betweenness and can therefore be understood as being important to the network’s connectivity, but they perform slightly different functions within it. Clergymen such as Sir Laurence Hall tend to be highly-connected within a particular parish and therefore integral to the connectivity of that local network. Merchants like Conyers, however, seem to cross parish boundaries with greater regularity, giving them the potential to connect disparate parts of the network. This suggests that the consequence of a high betweenness score

⁷² Ahnert and Ahnert, *Tudor Networks*, p. 55.

⁷³ For a particularly useful example see Justin R. Colson ‘Reinterpreting Space: Mapping People and Relationships in Late-Medieval and Early-Modern English Cities using GIS’, *Urban History*, 47 (2020), pp. 384-400.

⁷⁴ Wright is recorded as alderman from 1514 until his death in 1543, and also sheriff (1511-12), MP (1515), and twice lord mayor (1518-19, 1535-36). His betweenness score might also be reflecting the fact that he is known to have moved parishes three times in his adult life. His will, which falls outside the period covered here, can be found in B.I., Prob.Reg.11, f. 680v. For more on Wright see David M. Palliser, ‘Wright, William (by 1482-1543), of York’, in *The History of Parliament: the House of Commons 1509-1558*, ed. Stanley T. Bindoff (London: Secker & Warburg, 1982), p. 663. John Tod is named as notary and proctor in the will of Richard Turnor (1531), B.I., Prob.Reg.11, f.104v, and he is found acting as a defence proctor in the York Cause Papers, B.I. GB 193, CP.G.3567. The fact that four of his six mentions in wills were as a witness is likely at least in part to be attributable to his role as notary, and is a key contributor to his betweenness score.

⁷⁵ Colson found that in his fifteenth-century London wills ‘scribes, sciveners and notaries’ form more than 10% of witnesses: Colson, *Local Communities*, p. 274.

differs depending upon the way in which that score is achieved. Hall's power within his parish is likely to have been significant, sitting as he does in a position of trust and control (both in an occupational and network centrality sense). He may not, however, have had much control over the wider network, his authority being restricted to the Belfrey parish. Conyers, on the other hand, wields a different type of control. His betweenness score reflects his geographically-disparate connections and he therefore has the potential to control the flow of information (such as news), political ideas, and possibly also goods (given his occupation) on a city-wide scale.⁷⁶

So far we have discussed why clergymen might score higher or lower for betweenness, and the impact other occupations might have on such scores. The final factor we will consider for betweenness in this chapter is sex, and how for women their betweenness scores can be particularly negatively impacted by the nature of the will-based data, as a result of restrictions around who could and could not leave wills (the wills disproportionately represent men, by a ratio of 291:46, with women featuring largely as widows).⁷⁷ Studies of urban families in the medieval period have found women to play 'critical roles in the formation and descent of urban properties and businesses', controlling key economic resources and affecting 'intra-familial relationships amongst town residents'.⁷⁸ Despite Jeremy Goldberg's finding that there is likely to have been a reduction in labour opportunities for women in York as a result of economic recession in the mid-fifteenth century, evidence in the wills does point to women running businesses and training apprentices.⁷⁹ Alice Blakay describes herself as 'cappier' in her will of 1525, and leaves substantial 'workyng gere' including 'sheres' to her two apprentices. She is also seen to have links to other cappers in the city, naming 'Henry Moyses, and William Bukshaw cappers' as **executors**.⁸⁰ Blakay's position as the highest scoring woman for betweenness in this network is probably in part a reflection of her trade, and she is evidence that, whilst family connections can be important

⁷⁶ On the advantages to merchants in trading ports (they discuss London but it equally applies to medieval York, a major trading port) in terms of their ability to gather and control the release of news, see Ahnert and Ahnert, *Tudor Networks*, p. 67.

⁷⁷ Only two women, Jenet Sparke (1533), B.I., Prob.Reg.11, f.85r and Agnes Bell (1530), B.I., Prob.Reg.10, f.16r, neither declare themselves to be a widow nor provide information in their wills which might enable this to be determined. The under-representation of early-modern women in the archive is by no means unique to probate collections. Within letters in the Tudor State Papers archive, correspondence by women constitutes only approximately 4% of the collection: Ruth Ahnert et al., 'Introduction: From Archive to Network', *Huntington Library Quarterly*, 86(2) (2023), pp. 195-226, (p. 217).

⁷⁸ Maryanne Kowaleski, 'The History of Urban Families in Medieval England', *Journal of Medieval History*, 14 (1988), pp. 47-63, (pp. 49-50). See also Cross on women playing 'an active part in the commercial and manufacturing life of their communities': Cross, 'Northern Women', p. 90, and Kumin on women in minor parochial offices: Beat Kumin, *The Shaping of a Community: The Rise and Reformation of the English Parish c. 1400-1560* (Aldershot: Scolar Press, 1996), p. 40.

⁷⁹ Jeremy P. Goldberg, 'Female Labour, Service, and Marriage in the Late Medieval Urban North', *Northern History*, 22(1) (1986), pp. 18-38, (pp. 35-36).

⁸⁰ Alicie Blakay (1525), B.I., Prob.Reg.9, f.355r-v.

in determining a woman's centrality (as will be seen for the Shaw women), family is not the only means by which a woman might be central to the network.⁸¹ Blakay cannot, however, have been unique amongst the women of late-medieval York in conducting a business, and such women would potentially be significant within a social network. In this network, however, certainly for betweenness, women do not generally score well, a consequence of their peripherality and the fact that 'methods designed to look for statistical significance will repeatedly overlook already marginalised constituencies'.⁸²

Table 2 lists the top ten scoring women for betweenness with their ranking (their position in the network for betweenness relative to all other nodes). Note that xf Rawson, discussed earlier as Elisabeth Shaw's sister, does not appear in this list; in fact she scores zero for betweenness.

Node	Betweenness Rank	Betweenness Score
Alice Blakey ¹	32	0.028773
Isabel Whitfield	33	0.028679
Maude Shaw	45	0.024756
Elisabeth Shaw	58	0.021761
Bishophill Anchoress	62	0.02131
Agnes Norman	63	0.020677
Isabel Baseborn	66	0.019601
Agnes Hardsong	75	0.017856
Margaret Speight	78	0.01711
Janet Spark	80	0.01689

Table 2: Top ten female betweenness scores with network ranking positions.

Without additional biographical information it is difficult to know whether the betweenness scores of other women in this list are also partly a reflection of a trade or occupation, but there are hints in the wills of their involvement in business outside their homes. Isabel Whitfield, for example, releases Christopher Clerke 'of dett that is specified in on of the obligacions soo moche as perteyneth and belongeth unto my part' and asks her children to 'be good unto' him in relation to the other part of the debt.⁸³ We do not know what the relationship between the two was, whether Whitfield had lent Clerke money as a business transaction or perhaps because he was a friend who needed assistance (he acts as witness to her will), but Stephanie Appleton argues convincingly that

⁸¹ Blakay may have inherited a deceased husband's business, but it is just possible she was unmarried as her extensive will makes no mention of a husband or children (nor does she detail any other relations). She does not appear in the Freeman's Register.

⁸² Ahnert and Ahnert, *Tudor Networks*, p. 143.

⁸³ Isabell Whitfeld (1534), B.I., Prob.Reg.11, f.105r.

female involvement in money-lending brought the benefit of ‘facilitating the creation, expansion, and maintenance of social networks’.⁸⁴

Two other women who feature in Table 2 were mentioned earlier as scoring highly for degree, these being Elisabeth and Maude Shaw. Members of the same family (Maude is Elisabeth’s aunt), it is partly this family connection which impacts their betweenness score which, although comparing well with that of most women in the network, sees their betweenness rank significantly lower than their position for degree (Table 3).

Node	Betweenness rank	Degree rank
Maude Shaw	45 th	10 th
Elisabeth Shaw	58 th	4 th

Table 3: Betweenness and degree ranks for Maude and Elisabeth Shaw.

The Shaws were an influential, well-connected family for which several wills survive. Leonard and John Shaw¹ (Elisabeth’s sons and Maude’s great-nephews) were both merchants, and Thomas Shaw¹ was master of the Trinities hospital (1512-19). Sir William Merton (whom we will encounter in any discussion of the Shaws) was not a member of the family but closely connected to it, and rector of St. Crux from 1516 until his death in 1540.⁸⁵ As we have seen, merchants and clergymen tended to score highly for betweenness, and here the two Shaw women are connected to several of them. Where in another situation they might have been the only route from one part of the network to another, here there are other nodes who share the same connections and take on this role, thus reducing the Shaw women’s potential for betweenness. This circumstance can also impact the betweenness scores of male nodes: John Shaw, for example, scores highly for degree but falls below Sir Laurence Hall for betweenness partly because his familial connections provide alternative short paths through the network. Whilst the densely interconnected nature of his ego-network reduces Shaw’s betweenness score, the fact that his neighbouring nodes are so well-connected boosts his performance by other centrality measures such as **eigenvector centrality** (for which he ranks highest). Eigenvector centrality will be considered in more depth later in the chapter, but serves here to demonstrate the importance of considering centrality measures together

⁸⁴ Stephanie J. Appleton, *Women and Wills in Early-Modern England: The Community of Stratford-Upon-Avon, 1537-1649* (Unpublished PhD thesis, University of Birmingham, 2016). Clerke’s appearance as both debtor and witness is a caution that the terms and/or wording of a will might be influenced by those present at the time of writing. On this see Wray and Cossar, ‘Wills’, p. 64.

⁸⁵ Leonard Shawe (1532), B.I., Prob.Reg.11, f.10v; John Shawe (1537), B.I., Prob.Reg.11, f.276r; Thomas Shawe (1516), B.I., A.Bp.Reg.27, f.151v; William Merton (1540), B.I., A.Bp.Reg.28, f.182r-v.

rather than in isolation from one another – no one centrality measure will tell the whole story of a node’s structural position.⁸⁶

When we look at ego networks at two-depth for the two Shaw women a familiar structure of hubs (nodes, in this case predominantly testators, which have a markedly higher than average degree) surrounded by pendants emerges.

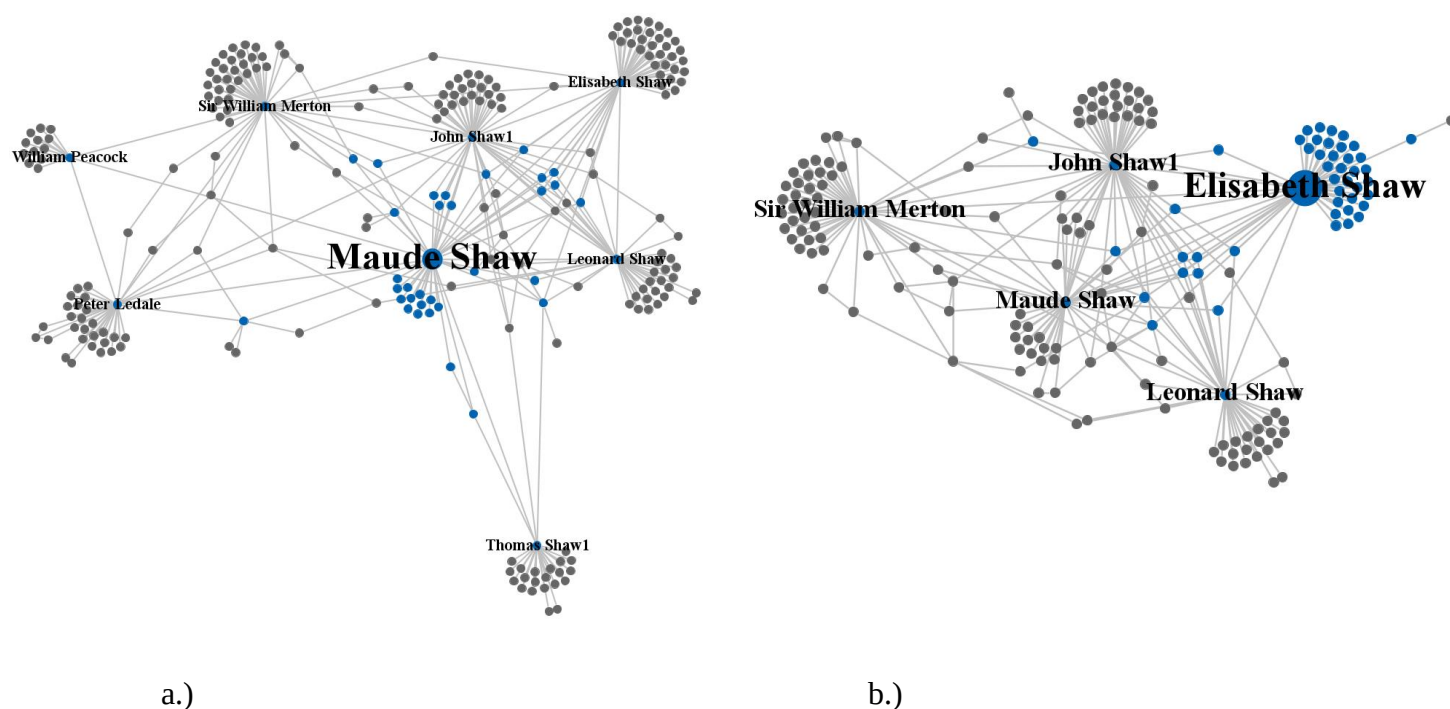


Figure 10: Ego networks at two-depth for a) Maude and b) Elisabeth Shaw; ego and alters are shown in blue.

In Elisabeth’s case three of the larger hubs seen here are members of her own family (her sons Leonard and John, and her aunt Maude), with the fourth being Sir William Merton who also forms the centre of a hub in Maude’s network. Maude’s hubs include the same family members plus Elisabeth and another relative, Thomas Shaw¹ (her son-in-law), as well as two other men (Peter Ledale, baker and sheriff of York in 1537, and William Peacock, ‘fyscher’).⁸⁷

Looking at Figure 11, ego networks including only their alters, we see more clearly a high number of pendants and the interconnected nature of the other nodes making up the networks.

⁸⁶ See Ahnert & Ahnert’s argument that ‘a single metric is rarely a good proxy for the specific cultural attributes or phenomena a scholar is interested in’: Ahnert and Ahnert, *Tudor Networks*, p. 72; and for their work on centrality profiles (a combined overview of up to eight separate measures), see Ruth Ahnert and Sebastian E. Ahnert, ‘Metadata, Surveillance, and the Tudor State’, *History Workshop Journal*, 87 (2019), pp. 27-51, (p. 42).

⁸⁷ For York sheriffs and their dates see Geni, *Sheriff of York*, 2025, <<https://www.geni.com/projects/Sheriff-of-York/4815>>, [Accessed: 28th November 2024].

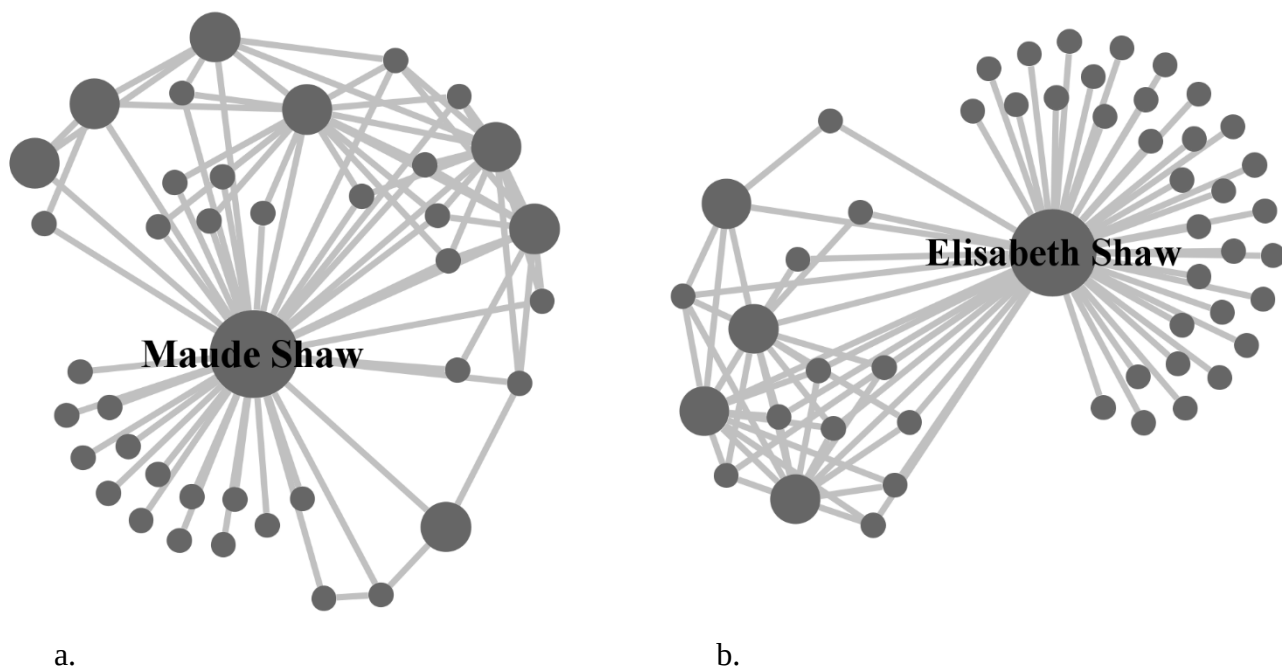


Figure 11: Ego networks for a) Maude and b) Elisabeth Shaw, showing only their alters (i.e. at one-depth); the hub-forming nodes labelled in Figure 10 are shown here as the larger nodes.

Both of these women left their own wills naming multiple other York residents, but the other women they name did not leave wills, and their connections are therefore not visible in this network. The proportion of male-female edges in their wills is 20:15 and 23:23 respectively, whereas nodes such as Leonard and John Shaw have male-female ratios of 24:13 and 33:14.⁸⁸ The reduced number of women leaving wills increases the likelihood that those appearing in the network will be pendants, and this disproportionately affects the networks of female nodes because of the higher proportion of women who tend to feature in their wills.⁸⁹ The result of this is that the number of paths the Shaw women are able to sit on is reduced because of a lack of data. Their lower betweenness scores may therefore be more reflective of issues with the data than of their actual position in society. Across the network as a whole the under-representation of women in the archive is reflected in the centrality measures derived from analysis of that archive.⁹⁰ It is hoped that in versions of the network to be discussed in following chapters some of these pendants

⁸⁸ In all cases nodes for which sex could not be determined (for example, unnamed servants) have been excluded from the calculation.

⁸⁹ On the tendency of female testators to give 'preference' to female relatives in their bequests, see Amy L. Erickson, *Women and Property in Early Modern England* (London & New York: Routledge, 1995), p. 19.

⁹⁰ On the notion of 'structural bias' being reinscribed when data from archival collections is analysed in this way (e.g. women's will-making rights were restricted and they therefore appear peripheral in the archives, as a result of which they appear peripheral in late-medieval networks), see Ahnert et al., *Network Turn*, p. 53 (although they generally prefer the term 'perspective' to 'bias').

(such as xf Rawson) will become better connected, and that this will make a difference to female centrality scores.

Where the highly-connected nature of the Shaw women's family connections works to reduce their betweenness score (because of the alternative, shorter paths such family provide) it can, however, have a positive impact on other centrality measures such as eigenvector. While betweenness is generally associated with a capacity for control, eigenvector centrality measures the *influence* of a node by looking not only at how many nodes it is connected to but how central those nodes themselves are.⁹¹ It is considered to be a measure of influence on the basis 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'.⁹²

Table 4 lists the top fifteen nodes by eigenvector score, and it is immediately clear that whilst many of the same names feature, the results do differ (particularly in relation to female nodes).

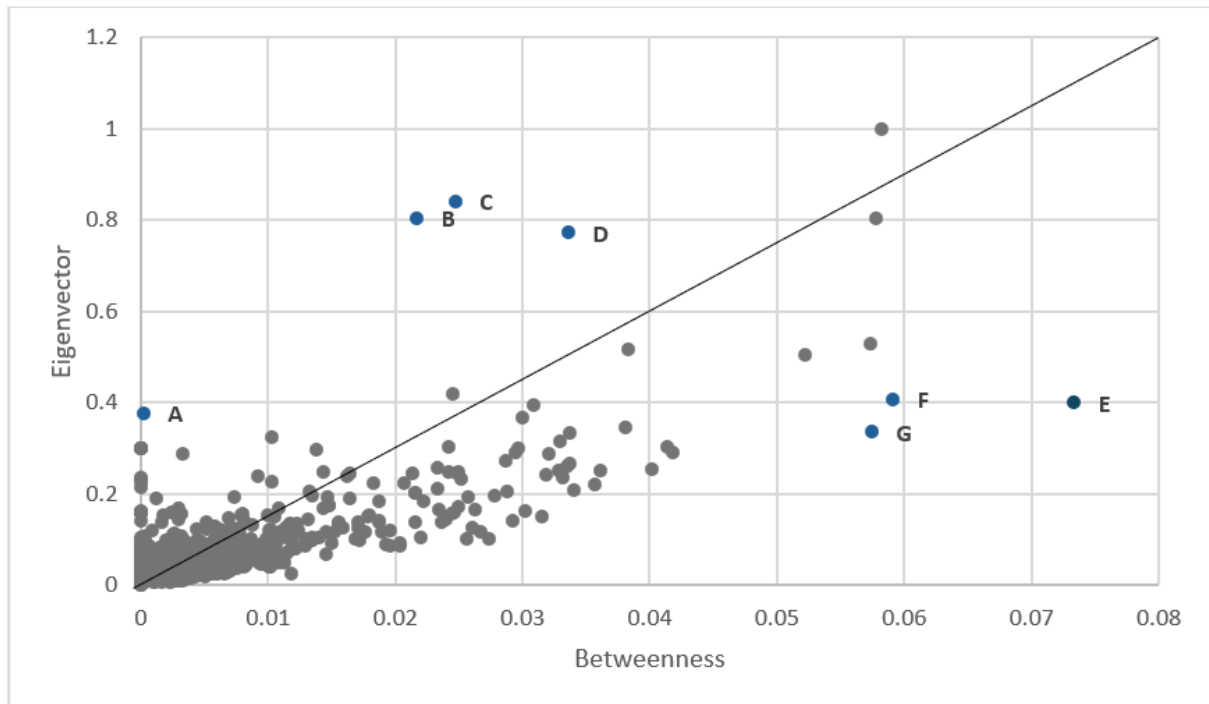
Node	Eigenvector rank	Betweenness rank
John Shaw ¹	1	3
Maude Shaw	2	45
Sir William Merton	3	4
Elisabeth Shaw	4	58
Leonard Shaw	5	18
John Chapman ¹	6	6
Peter Ledale	7	11
Sir John Sheffield	8	7
William Cure	9	47
John Rasing	10	2
Sir Laurence Hall	11	1
Dean Brian Higden	12	26
Sir William Pinder	13	651
Sir Thomas Forne	14	28
John Thornton ¹	15	12

Table 4: Top fifteen nodes in the base network ranked by eigenvector score, with their betweenness ranks for comparison.

⁹¹ Gephi has been used to calculate eigenvector, and it does so by using a node's degree score. This measure can therefore be influenced by those nodes who left wills containing a high number of names, as well as those named in a high number of wills, but it remains a reasonable measure of potential for influence.

⁹² Stephen P. Borgatti, 'Centrality and Network Flow', *Social Networks*, 27 (2005), pp. 55-71, (p. 61).

Unlike for betweenness, here the connections of the two Shaw women to their influential family members works in their favour, increasing their eigenvector scores.⁹³ No other women feature in this list, however; whether the eigenvector centrality of women changes in alternative versions of the network will be explored in later chapters. Figure 12 plots betweenness against eigenvector, and shows that whilst a majority of nodes are clustered in the bottom left indicating both low betweenness and eigenvector, certain nodes stand out as being either high or low for one or the other.



A Sir William Pinder; **B** Elisabeth Shaw; **C** Maude Shaw; **D** Leonard Shaw; **E** Sir Laurence Hall; **F** John Rasing; **G** Sir John Stapleton.

Figure 12: Betweenness plotted against eigenvector for the base network.

Eigenvector can be helpful in highlighting nodes who might not score well for degree or betweenness but who, because of their specific edges, can bring influence to bear on the network. Sir William Pinder, chantry priest in the Shaw's parish church of St. Crux and master of the Corpus

⁹³ The cluster of nodes sitting directly below Sir William Pinder in Figure 12 consists of others whose connections within the Shaw family boost their eigenvector score, but who score zero for betweenness (in large part because of the interconnected nature of the family network). These are Agnes Shaw², Matthew Oglethorpe¹, Peter Shaw, and William Shaw².

Christi Guild (1537), scores 13th for eigenvector, despite having a degree score of only five and ranking 651st for betweenness.⁹⁴ Pinder's ego network (Figure 13) shows his small number of highly influential alters; his five edges are to the five nodes scoring highest in the network for eigenvector. His own ability to exert influence through those five people is therefore reflected in his high eigenvector score compared with either his degree or betweenness scores. Differences in performance by each of these measures reinforce the need to consider a range of centrality measures in order to arrive at an accurate understanding of a node's structural position.

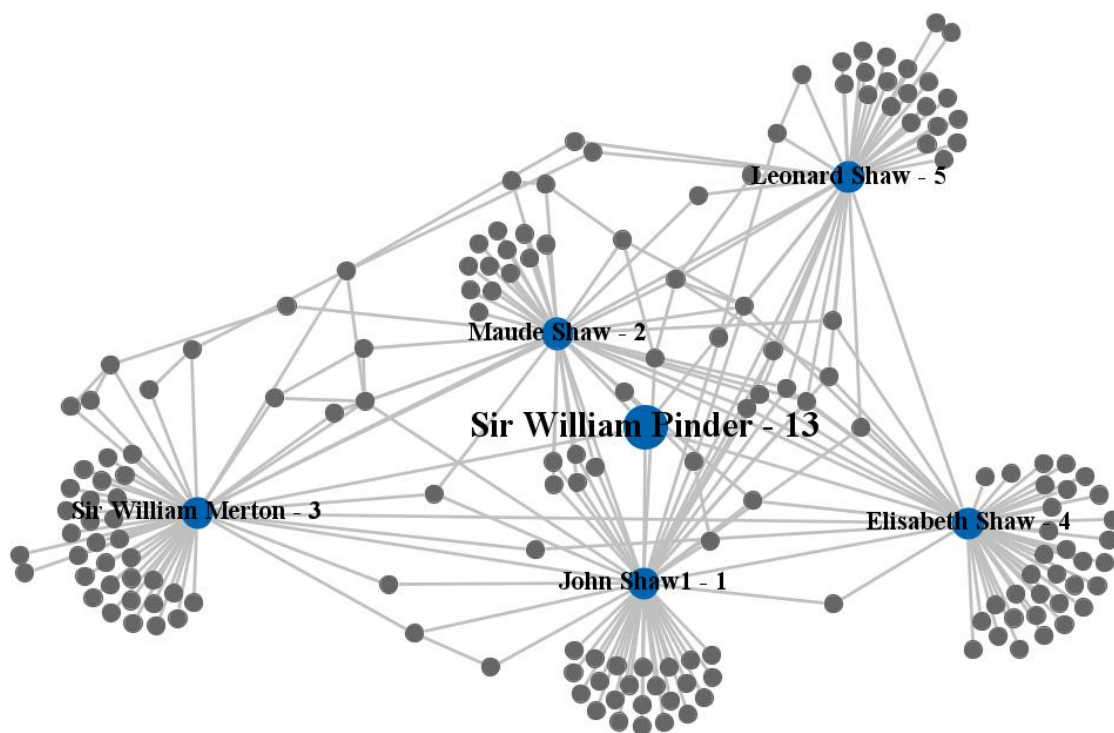


Figure 13: Ego network at two-depth for Sir William Pinder; his alters are in blue with their eigenvector rankings shown.

It is not the case that Pinder's situation applies to all clergymen. Sir Laurence Hall and Sir John Stapleton, who we discussed earlier as performing well for betweenness, have significantly lower eigenvector scores. Whilst they score well relative to the majority, their eigenvector cannot match their betweenness. Hall (top for betweenness), for example, appears in 11th position because the nodes with which he has edges are less influential (only two of his alters, John Chapman¹ and William Cure, feature in this top fifteen). As a result of this the influence Hall himself is calculated to be able to exert is reduced.

⁹⁴ Pinder served as a chantry priest in St. John's, Hungate at the same time as in St. Crux: Cross, *City Clergy*, p. 78.

In this chapter we have seen both the potential and the limitations of the dataset as it stands in its ability to represent a real-world social network. There is much we can read from it in terms of the significance of both institutions and the clergy to testators, and some conclusions can be drawn about links between centrality and both sex and occupation. The network is partial, however, and centrality results derived from it are potentially affected by the fact that we have wills for some nodes and not others. A person named in a will by only one testator, who did not themselves leave a will, is likely to always appear peripheral to the network structure. In many cases this will be a fair reflection of their position in society, but not always. Even amongst those individuals who did leave wills there are those who are likely to have been influential within the city who do not appear so in the network (see for example Thomas Drawswerd, a stone-carver of national renown who served as junior chamberlain (1501-02), sheriff (1505-06), alderman (1508-29), MP (1512-15), and lord mayor (1515-16, 1523-24) but who does not perform well by either betweenness or eigenvector).⁹⁵ In some cases there is no remedy for this. Even with the addition of alternative historical sources such as parish records (almost none of which have survived for York in this period) it would be impossible to achieve a full representation of the societal structure of the late-medieval city. The central question of this study is to what extent these partial data can be enhanced to build as full a network as possible, and what impact that work has on the results of centrality measures, because the more closely the network resembles the historic past, the more useful will be the centrality measures derived from it. The next chapter will focus on a qualitative approach to enhancing the network, through a close-reading of the wills and the extraction of additional relationship data.

⁹⁵ Thomas Drawswerde (1528), B.I., Prob.Reg.9, f. 448r. David M. Palliser, 'Thomas Drawswerd, by 1476-1529, of York', in *The History of Parliament: the House of Commons 1509-1558*, ed. Stanley T. Bindoff (London: Secker & Warburg, 1982), pp. 54-55.

Chapter Two: Joining the Dots

Thus far the network has been analysed in its most basic form, each edge representing an explicit connection between a testator and legatee. Whilst this has the merit of being the least open to error of the networks discussed, it does not follow that it is the most representative. This chapter will look at how the network changes when implicit relational data is added, connections between people which can be derived through a close-reading of the wills. Figure 14 shows that where an explicit approach includes only edges between John Asbe and his wife (Elisabeth) and daughter (Anne), an understanding of the implicit relational data within his will allows an edge to be added between his wife and daughter, representing their mother-daughter relationship.⁹⁶

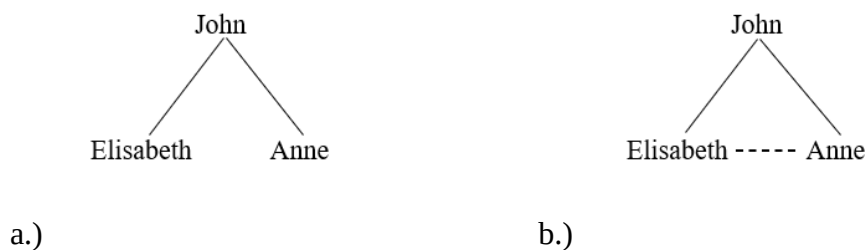


Figure 14: Edges between John Asbe, his wife, and daughter in a) base and b) implicit networks; the new (implicit) edge is shown as a dashed line.

By looking beyond only testator-legatee edges we will receive a better picture of the testator's own significance as well as a clearer understanding of the position of those people who appear as legatees but did not themselves leave wills, and whose potential importance can be obscured.

Despite familial relationships involving varying degrees of complexity in their interpretation, these edges can be added to the network with a high degree of certainty (the flexible use of 'cousin' as a descriptor and loose conventions regarding the distinction between 'step' and 'in-law' can be complicating factors in determining the precise nature of a relationship, but it is sufficient for these purposes to know that there was one).⁹⁷ The wills also contain another layer of relational data, found in instances where two or more people have been appointed as executor, supervisor, or witness. Witnesses are known to have been co-present at the signing of a will (sufficient to form an edge in this network), and the likelihood of co-executors and co-supervisors being required to co-operate and therefore come into contact with one another has been considered high enough to

⁹⁶ John Asbe (1530), B.I., Prob.Reg.10, f.49v.

⁹⁷ On the imprecision and inconsistency of relational-term usage, see David Cressy, 'Kinship and Kin Interaction in Early Modern England', *Past and Present*, 113 (1986), pp. 38-69, (p. 66). For a comprehensive list of the types of implicit connection added (both familial and non-familial) see Table 5, Appendix II.

justify an edge being added between them.⁹⁸ Further, it has been assumed that wives of male testators would have shared the same parish church and priest, and therefore corresponding edges have been added. The qualitative work involved in this process is significant, and some degree of error may have been introduced either by missing an implicit connection or adding one where it did not exist within this period (where a person has died for instance), but we can be confident that a substantial majority of the implicit edges represent genuine relationships.⁹⁹ The new network generated through the addition of these edges will be referred to as the **implicit network**, and Table 5 compares its key statistics with those of the base network.

Network measure	Base	Implicit
Edges	4,451	9,407
Density	0.001	0.001
Av. path length	6.013	5.198
Diameter	12	11
Av. clustering co-efficient	0.147	0.767

Table 5: Key network measures for the base and implicit networks.

An increase in the number of edges from 4,451 to 9,407 results in no noticeable increase in the network's **density** (the proportion of all possible edges that are present), but a reduction in **average path length**. Average path length takes the average of all shortest paths in the network and, coupled with a decrease in the overall **network diameter**, it suggests that the network is slightly better connected. The **average clustering co-efficient** measures the tendency of nodes to be clustered (i.e. for the nodes around an ego to be themselves highly connected), and is therefore an indicator of inter-connectedness. It has also increased such that the network now meets one of the standard criteria for a **small-world network**, a network-type commonly found in social networks (although the average path length remains longer than expected).¹⁰⁰

The addition of edges means that the degree score of some nodes has increased.¹⁰¹ Clergymen often see an increase in their degree as a result of edges being added between wives and their

⁹⁸ A cautious approach has been taken in not adding edges between the supervisors and executors of a will, although such edges would be plausible given the likelihood of the two encountering one another during the performance of their duties.

⁹⁹ For an attempt to quantify the impact of erroneous edge addition on centrality measures and the conclusion that it is acceptable to use such measures on imperfect data, see Stephen P. Borgatti, Kathleen M. Carley, and David Krackhardt, 'On the robustness of centrality measures under conditions of imperfect data', *Social Networks*, 28 (2006), pp. 124-36.

¹⁰⁰ On small-world networks see Duncan J. Watts and Steven H. Strogatz, 'Collective Dynamics of 'Small-World' Networks', *Nature*, 393 (1998), pp. 440-42 (p. 442).

¹⁰¹ For the degree scores of the top fifty scoring nodes in the implicit network (and the increase in their scores) see Table 6, Appendix II.

husbands' parish priests, whilst an increase in the degree of a layperson is more likely to be a consequence of their being named in a will containing a large amount of relational data, and thus gaining edges with several other individuals named in that will. Such increases in degree often do not translate into increased scores for other centrality measures, because the new edges add no new nodes and duplicate existing links within the network. Degree therefore will again be discounted as being too easily influenced by factors such as the length of a will, and the focus here will instead be on betweenness and eigenvector.

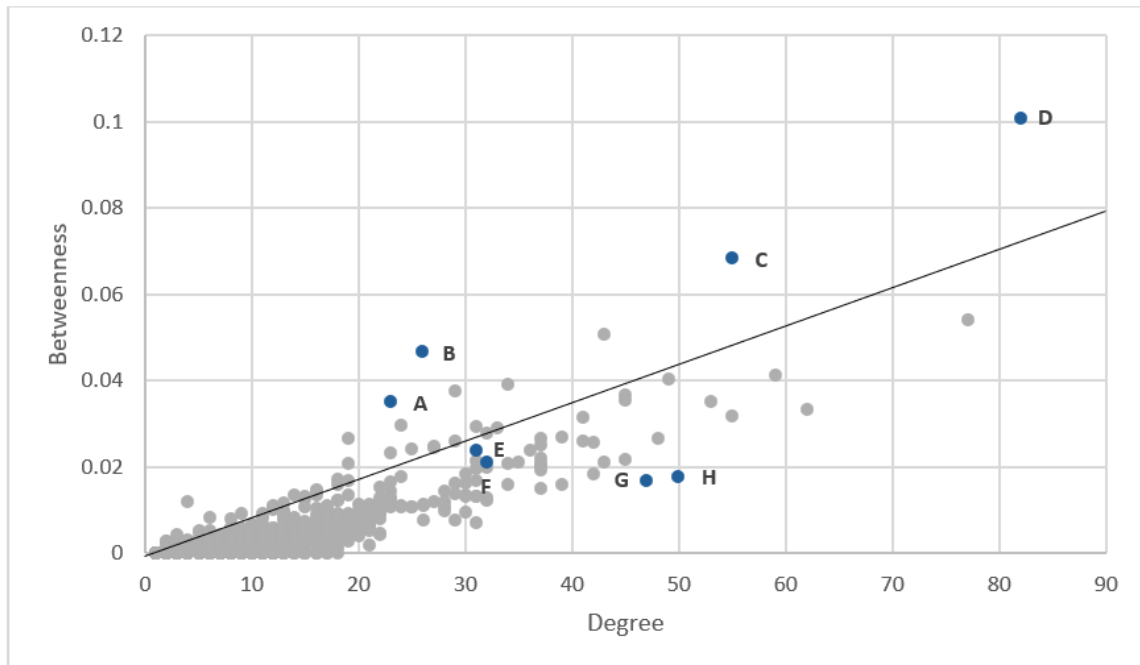
Table 6 gives the top twenty betweenness scorers in the implicit network alongside the change in their betweenness rank.

Betweenness rank	Node	Ranking change
1	Sir Laurence Hall	-
2	Sir John Stapleton	↑ ₃
3	Sir William Merton	↑ ₁
4	William Bachelor	↑ ₂₅
5	William Wright ²	↑ ₁₉
6	John Shaw ¹	↓ ₃
7	William Harrington	↑ ₂
8	Sir George Richardson	↑ ₅
9	Thomas Water	↑ ₁
10	John Barnes ¹	↑ ₄
11	John Chapman ¹	↓ ₅
12	Sir Thomas Ovington	↑ ₃
13	John Tod	↑ ₂₁
14	Sir John Sheffield	↓ ₇
15	Peter Ledale	↓ ₄
16	Sir Richard Wilkinson	↑ ₅₁
17	Thomas Mason ³	↑ ₁₄
18	William Holme	↑ ₄₂
19	Sir Henry Gelstrop	↑ ₂₉
20	Sir John Simpson ¹	↑ ₇

Table 6: Top twenty scorers for betweenness in the implicit network; numbered arrows indicate how many places up or down by ranking each person has moved.

Sir Laurence Hall remains the highest scorer for betweenness, and all clergymen included in the top twenty for betweenness in the base network remain there in the implicit version (although there is movement in their individual positions). The same cannot be said for lay people (John Rasing, for example, sees his ranking fall from 2nd to 40th) and, as in the base network, no female nodes feature in the top twenty.

Looking at betweenness plotted against degree in the implicit network (Figure 15) draws attention to similarities with the base network (in the positions of Hall and the Shaw women for instance), but also some key differences.



A: John Tod; **B:** William Wright²; **C:** Sir John Stapleton; **D:** Sir Laurence Hall; **E:** Christopher Conyers; **F:** John Rasing; **G:** Maude Shaw; **H:** Elisabeth Shaw.

Figure 15: Betweenness plotted against degree for all nodes in the implicit network; the trendline is set in the same position as in the base network graph (Figure 6) in order to be able to more usefully compare the two.

Generally, as degree scores increase with the addition of implicit edges, the contrast between betweenness and degree is reduced. Those nodes who gain a high number of degree points, such as Sir John Stapleton (an increase from fifteen to fifty-five), see a slight reduction in their distance from the trendline, and some (such as John Rasing) drop below the trendline, their score decreasing sufficiently to result in their now having a lower than average betweenness score for their degree. The two Shaw women still perform poorly for betweenness compared to their degree, and both have lower betweenness scores than in the base network. Elisabeth's ego network at one-depth illustrates why a node's betweenness score might decrease (from 0.021761 to 0.017658 in her case).

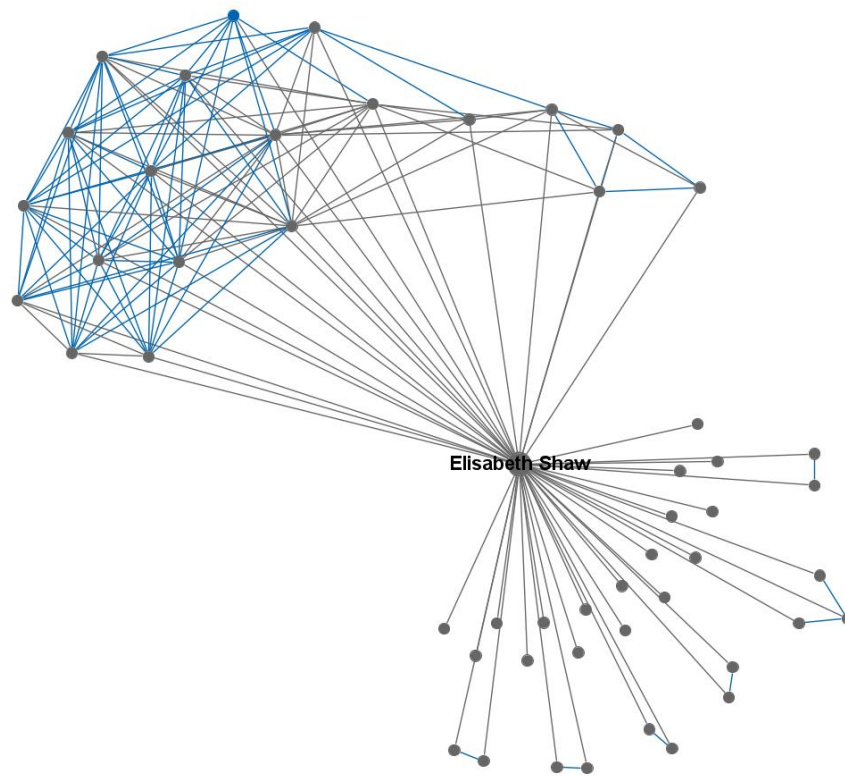


Figure 16: Elisabeth Shaw's ego network (implicit) at one-depth; new nodes and edges are shown in blue.

The blue edges highlight the increased interconnectivity between Elisabeth's alters, the densely connected upper left of the sociogram representing the Shaw family and its close connections amongst York clergymen and merchants. Whilst these edges will have contributed to her reduced betweenness score, they are predominantly between family members who already shared multiple connections, and their impact will therefore be less significant than might be expected given their number. The edges principally responsible for her decreased score are amongst nodes which used to be pendants and therefore relied upon Shaw for their connection to the rest of the network (and each other); here, in the lower right, there are now seven new edges. Whilst they do not increase the connectivity of any of the nodes involved to the network as a whole, these edges mean that some of the pendants connect directly to one another without needing to pass through Shaw in order to do so; in other words, the shortest paths between them no longer include Shaw. This explains the reduction in her betweenness score, but how do we account for the increase in her betweenness *rank* (from 61st to 51st)?¹⁰² As seen in Shaw's network, new edges have varying impacts on betweenness scores; where the number of new edges is low or they are between already connected family members the change to betweenness (both in terms of increase and decrease) is lessened. Whilst Shaw's new edges reduce her betweenness score they do so less dramatically

¹⁰² In contrast, Maude Shaw's change in her betweenness rank correlates with the decrease in her score, falling from 45th to 56th.

than in the ego-networks of (some) other nodes, and therefore her ranking relative to them improves.

Two such individuals whose rank decreases, Christopher Conyers and John Rasing, are amongst those who scored highly for betweenness in the base network but in the implicit version fall out of the top twenty (note the visible difference in their positions in Figures 6 and 15, illustrated here in Figure 17).

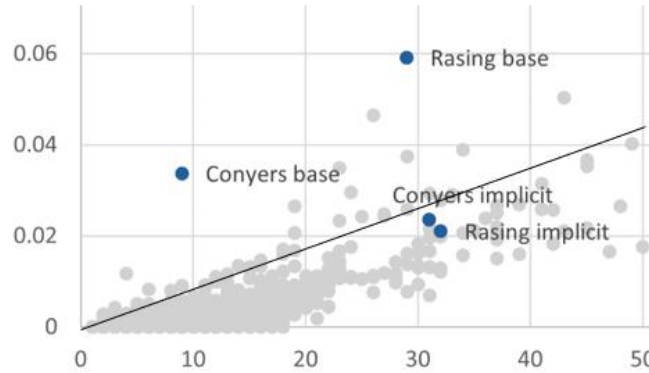


Figure 17: Section of Figure 15 comparing the base and implicit betweenness (vertical) and degree (horizontal) of Conyers and Rasing.

Re-examining Conyers demonstrates that for some nodes the nature of their edges means that not only do their betweenness scores decrease (from 0.033741 to 0.023609 in Conyers' case), but that when ranked alongside nodes who see little change in their score or whose new edges increase their betweenness scores, they fall down the rankings (from 17th to 33rd for Conyers, and 2nd to 40th for Rasing).

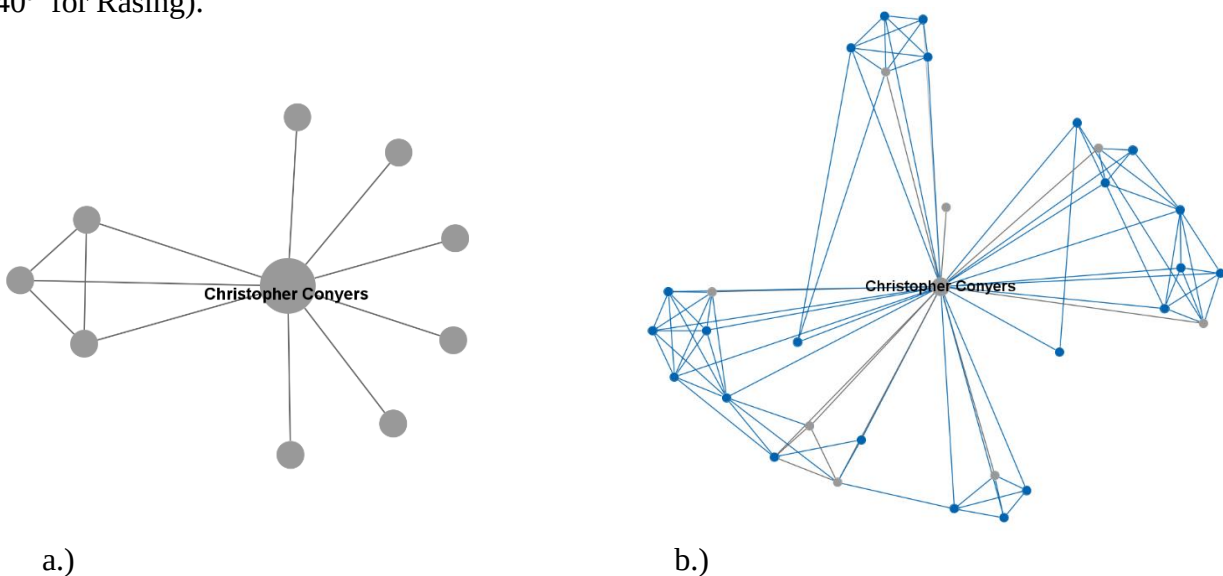


Figure 18: Christopher Conyers' a) base and b) implicit ego networks at one-depth; new edges and nodes are shown in blue.

The number of new nodes and edges in Conyers' network is considerable, and the nature of his base network alters is key to this. Named in nine wills, Conyers appears three times as a witness and once as supervisor. In each instance edges with his jointly-appointed witnesses and supervisor have been assumed. These co-mentions increase the size of Conyers' network (adding twenty-three nodes), but reduce the number of shortest paths on which he sits by providing many more opportunities for paths of a reduced length to exist between his original alters. Nodes who were pendants (only one of which remains) now have direct paths to others they could previously only reach via Conyers. Consequently, his betweenness score decreases more significantly than average and he ranks lower relative to other people in the network. Whilst Rasing's network size does not increase to the same extent as Conyers' (from thirty to thirty-three nodes) a similar effect occurs. Of the nineteen pendants in his base ego network only one remains in the implicit version, the eight witnesses Rasing names resulting in the addition of a particularly high number of witness-based edges. Five of these witnesses were originally pendants, but with the addition of implicit edges they each become connected to other witnesses (and their alters) and therefore the shortest path between many of them no longer includes Rasing, thus leading to a reduction in his betweenness score.¹⁰³ For both Conyers and Rasing the high number of non-familial edges added results in a more significant decrease in betweenness than that experienced by Elisabeth Shaw; her *rank* therefore increases as theirs decreases, despite all three having a lower score. The behaviour of nodes such as Conyers and Rasing provides the first indication that the missing edges in historical networks can result in the significance of certain nodes being exaggerated; when additional edges are added, the centrality of such nodes reduces such that one might question assumptions about their importance derived from the base network alone.¹⁰⁴

If co-mentions in wills are such a significant factor in how nodes respond to the addition of implicit edges, how then does this impact women? Only one woman is named as a witness in this dataset and only two as supervisor.¹⁰⁵ Female family members, most often spouses, are commonly named as executor but this tends to be alone (and therefore giving rise to no co-mentions) or with another family member (in which case an edge already exists between them, and the additional edge, in an **unweighted** network, has no effect). There are, however, women for whom these implicit edges have had a positive impact on either their betweenness or eigenvector scores.

¹⁰³ For visualisations of Rasing's ego-networks see Figure 2, Appendix III.

¹⁰⁴ This idea will be discussed further in chapter three.

¹⁰⁵ Janet Hall is listed as a witness to Sir John Pulley's will (1530), B.I., Prob.Reg.10, f.94v; Agnes Thornton as supervisor of her son Thomas Thornton's (1531), B.I., Prob.Reg.11, f.65r); and the Prioress of Wilberfoss, Elisabeth Lorde, supervisor of her brother Brian Lorde's (1526), B.I., Prob.Reg.9, f.368v.

Clearly this does not generally apply to the top ten female scorers for betweenness, listed in Table 7. The downward trajectory of most of these women demonstrates that the new edges have resulted in a reduction in their betweenness scores (and for the majority their rank too).¹⁰⁶

Node	Betweenness Rank	Betweenness Score
Elisabeth Shaw	51 ↑ 7	0.017658 ↓
Maude Shaw	56 ↓ 11	0.016603 ↓
Alice Blakey ¹	61 ↓ 29	0.015791 ↓
Janet Spark	62 ↑ 18	0.015223 ↓
Isabel Baseborn	68 ↓ 2	0.013735 ↓
Agnes Norman	76 ↓ 13	0.013084 ↓
Margaret Barker	98 ↑ 1	0.011071 ↓
Agnes Hardsong	100 ↓ 25	0.010849 ↓
Isabel Whitfield	109 ↓ 76	0.010302 ↓
Margaret Speight	116 ↓ 38	0.009611 ↑

Table 7: Top ten female betweenness scores in the implicit network with their rank; arrows indicate whether the score and rank have increased or decreased, and in the case of rank by how many places.

Janet Spark is one of three nodes (including Elisabeth Shaw) whose betweenness rank increases despite decreases in their score. Spark's will of 1533 names four witnesses and two executors (all of whom appear to be non-familial), and her will differs from that of many women in featuring a higher proportion of male to female names (12:10).¹⁰⁷ Each man named is less likely to be a pendant than women who either have no other known connections or who we are unable to reconcile with an existing name in the dataset because we are not given their full names. Of the ten implicit edges added to Spark's network, seven are between men who are not family members (markedly different from the implicit edges of the Shaw women). Consequently, her network behaves more like that of some male nodes, with an increased number of nodes resulting in her sitting on a higher number of paths than in the base network. Whilst this increased potential for betweenness is not realised, and Spark's betweenness score decreases in the implicit network, it is by a smaller amount than the decrease seen by other nodes (both male and female), and her rank therefore improves.

It is clear therefore that for betweenness the nature of the additional relational data is key. Where the implicit edges are predominantly familial or female a node's betweenness score may

¹⁰⁶ The average rank of the top ten scoring women for betweenness falls from 59th in the base network to 80th in the implicit network (averages are rounded to the nearest whole number unless specified otherwise). For betweenness calculations any node scoring zero in both versions of the network has also been excluded.

¹⁰⁷ Jenet Sparke, B.I., Prob.Reg.11, f.84r.

not change or may decrease. Where the additional edges derive from co-mentions they are more likely (but not certain) to have a positive impact on betweenness; this favours male nodes as they are more likely to be found in the types of position which result in such co-mentions. In either case the change to a node's betweenness *ranking* will depend upon its performance relative to all other nodes in the network, and therefore a node with an increased betweenness score may see its ranking by betweenness decrease (and vice versa). As a result of the greater opportunity for men to benefit from non-familial edges, because of the nature of the data in their wills, women are generally more likely to see their ranking position fall (by an average of eighty-four places, against twenty-six for men). That said, a noticeable proportion of the women who score zero for betweenness in the base network gain a score in the implicit network (see Figure 19); this may not be an accurate reflection of female betweenness centrality in late-medieval York, but it is a small step towards it.

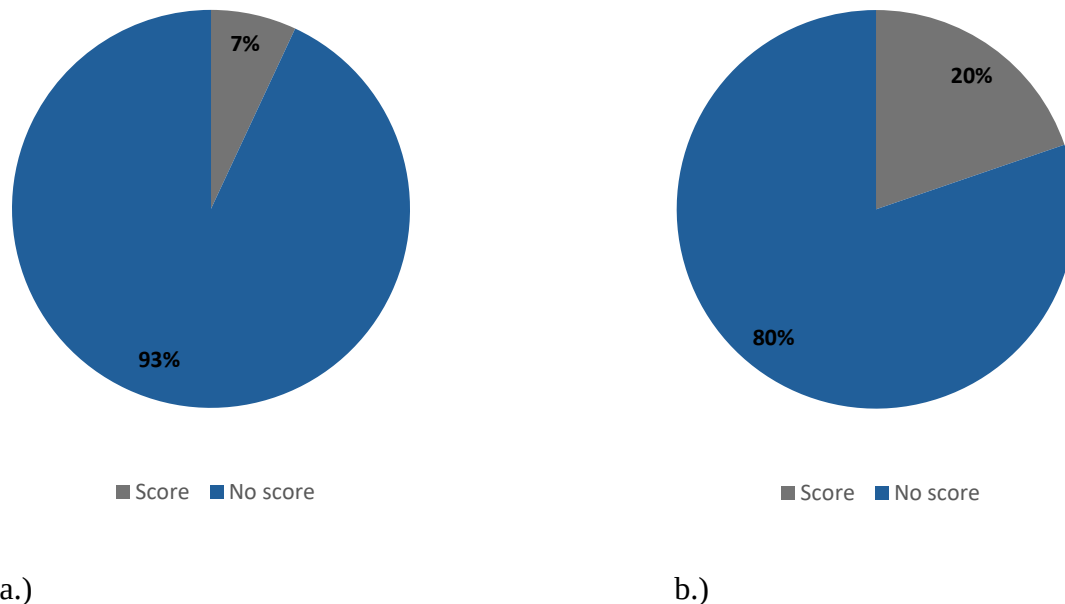


Figure 19: Proportion of female nodes who score for betweenness in the a) base and b) implicit networks.

In respect to eigenvector, however, there is a marked difference in the way in which some female nodes perform. Table 8 below gives the top fifteen female eigenvector scores in the implicit network.¹⁰⁸

¹⁰⁸ The inclusion of Elisabeth Oglesthorpe in this list is misleading as she is deceased for at least part of the period. Leonard Shaw names her in his will of 1532 as 'my suster Elisabeth late wif of Mathew Oglesthorpe' when he leaves money to her children (his nieces and nephews): Leonard Shawe (1532), B.I., Prob.Reg.11, f.10v & 11r. Elisabeth is an example of one of the potential issues with a static network such as this, which is that it takes people mentioned in the wills and assumes that they are alive and connected at the same moment in time rather than accounting for the fact that the wills cover a period of twenty years in which people will have died or moved. Other historians working with SNA discuss a similar problem: see Marten During, 'How Reliable are Centrality Measures for Data Collected from Fragmentary and Heterogeneous Historical Sources? A Case Study', in *The*

Name	Eigenvector rank	Eigenvector score
<i>Maude Shaw</i>	6 ↓4	0.764894 ↓
<i>Elisabeth Shaw</i>	9 ↓5	0.640869 ↓
<i>Agnes Shaw</i> ²	16 ↑6	0.433841 ↑
<i>Agnes Shaw</i> ¹	31 ↑20	0.389871 ↑
Agnes Thornton	39 ↑13	0.370671 ↑
<i>xf Shaw</i> ²	41 ↑48	0.365159 ↑
<i>xf Rawson</i>	57 ↑267	0.313254 ↑
<i>xf Bates</i>	59 ↑265	0.311813 ↑
<i>Elisabeth Oglethorpe</i> ¹	82 ↑288	0.27589 ↑
Agnes Norman	89 ↓34	0.272143 ↓
<i>Agnes Shaw</i> ⁴	90 ↑16	0.270916 ↑
Isabel Whitfield	91 ↓59	0.270214 ↓
Margaret Jackson ³	124 ↑24	0.225362 ↑
Agnes Harbottle	128 ↓79	0.216517 ↓
Agnes Ledale	132 ↑435	0.21396 ↑

Table 8: Top fifteen female eigenvector scores in the implicit network, with members of the Shaw family in italics; arrows indicate whether the score and rank has increased or decreased, and in the case of rank by how many places.

Here only a third of the women experience a decrease in their eigenvector ranking, and instead of one increased betweenness score, two thirds experience an increase in eigenvector. There is a much clearer correlation between an increase in eigenvector score and rank than there is for betweenness, with all women whose score increases also being ranked higher in the network. Amongst some very significant increases is Elisabeth Shaw's sister, xf Rawson; the addition of implicit edges led to no increase in her betweenness score, but for eigenvector, resituated in the centre of an important family, she is rightly accorded greater potential influence. In fact, a majority of these higher-scoring women are members of the Shaw family, demonstrating not only the prominence of the Shaws in York but also the impact on a late-medieval network of having multiple wills for a single family.

The woman who experiences the largest increase in eigenvector rank of those listed in Table 8 is Agnes Ledale, (an increase of 435 places). Agnes is named once in the will of her husband (Peter Ledale, a baker who also served as sheriff (1537) and chamberlain), and therefore her ego network at one-depth in the base network consists of only one edge.¹⁰⁹ In the implicit network, however, the same ego network consists of seventeen nodes and eighty-four edges. Peter Ledale is significant within both versions of the network (ranking 7th for eigenvector in the base and 4th in the implicit), but as a pendant connection in his base network Agnes is connected only to him.

Connected Past: Challenges to Network Studies in Archaeology and History, eds. Tom Brughmans, Anna Collar, Fiona Coward (Oxford: Oxford University Press, 2016), pp. 85-101, (pp. 90-1).

¹⁰⁹ Peter Ledale (1540), B.I., Prob.Reg.11, f.774v & 776r.

Once implicit data is added she gains edges to several other nodes, principally other members of the Ledale family. This increases her eigenvector score sufficiently to also increase her rank (although given her very low eigenvector ranking in the base network it is not surprising that it increases given the number of new edges). Whilst this increase in eigenvector score and ranking demonstrates that for eigenvector (unlike for betweenness) familial connections can have a positive effect on a node's performance, the increase is not representative of the performance of women in the network overall. The average male node sees an increase in eigenvector of 0.021437, whereas female nodes on average increase by only 0.008272; the consequence of this is that male nodes tend to move up the rankings (by an average of fifty-two places) whilst female nodes move down (by an average of eighty-six places).

Women tend to see an increase in their eigenvector score through familial connections with men who have a high eigenvector score, but changes in the scores of male nodes can also be driven (as for betweenness) by the roles to which they are appointed in wills. Table 9 lists the top twenty scorers in the implicit network (both male and female).

Name	Eigenvector rank		Eigenvector score	
Sir William Merton	1	↑2	1	↑
John Shaw ¹	2	↓1	0.926283	↓
Sir Laurence Hall	3	↑8	0.915878	↑
Peter Ledale	4	↑3	0.833434	↑
Sir John Stapleton	5	↑11	0.788032	↑
Maude Shaw	6	↓4	0.764894	↓
William Bachelor	7	↑19	0.753993	↑
Leonard Shaw	8	↓3	0.675292	↓
Elisabeth Shaw	9	↓4	0.640869	↓
William Harrington	10	↑11	0.600165	↑
Ralph Harbottle	11	↑19	0.517328	↑
John Thornton ¹	12	↑3	0.496198	↑
Peter Jackson ¹	13	↑4	0.485658	↑
Ralph Langley	14	↑4	0.482122	↑
John Chapman ¹	15	↓9	0.474246	↓
Agnes Shaw ²	=16	↑6	0.433841	↑
William Shaw ²	=16	↑9	0.433841	↑
Thomas Thornton	18	↑50	0.430517	↑
John Rasing	19	↓9	0.424703	↓
James Thorn	20	↑74	0.424013	↑

Table 9: Top twenty eigenvector scores in the implicit network; arrows indicate whether the score and ranking has increased or decreased, and in the case of rank by how many places.

A majority of these individuals also appear within the top twenty eigenvector scorers in the base network, or just outside it. James Thorn, however, has moved from 94th to 20th position, and his score has increased markedly, from 0.154268 to 0.424013.¹¹⁰ No will exists for Thorn but he receives four mentions in those of other men, in each case as a witness. This means that when implicit edges between witnesses are added into the dataset his ego-network gains a significant number of edges (an increase from four to sixty-three).¹¹¹ Witnesses were chosen for a variety of reasons, from close friendship to expediency, but social status also sometimes influenced the decision, a testator choosing someone who they felt could be trusted but who potentially also demonstrated their own status.¹¹² In Thorn's case the men he is chosen to witness alongside are either important in their own right (John Shaw¹ for instance) or are themselves chosen to witness or supervise other wills, meaning that Thorn receives edges with several of the most influential men in the network (such as Sir William Merton and Peter Ledale). In fact, in the implicit network Thorn has edges with six of the top twenty eigenvector scorers and consequently his own eigenvector score increases significantly. The change in his structural position is another reminder that network analysis of historical data is not a simple undertaking. A network-visualisation of testator-legatee connections (the base network) does not make clear the potential influence wielded by Thorn, a man about whom little is known. His presence as a witness in four wills might have suggested that he was a trusted member of society, but not necessarily that he was potentially influential in late-medieval York. This reinforces the fact that as much data as possible must be extracted from the sources, and is a powerful argument in favour of doing all we can to enhance these networks.

Combined with the findings for betweenness, it is clear that enhancing the network through the addition of implicit edges has led to mixed results and variation in the impact on centrality. For both men and women betweenness scores have on average decreased in the implicit network (a consequence of there being a higher number of edges amongst a similar number of nodes), but increased for eigenvector (see Figure 20). The average decrease in betweenness for men is slightly higher than that for women, but this is predominantly a consequence of there being a larger number

¹¹⁰ This may be the Jacobus Thorn, merchant, listed in the Freeman's Register in 1511-12, but it is impossible to be certain as the wills do not detail his occupation: Collins, *Freemen's Register*.

¹¹¹ For an illustration of James Thorn's ego-networks in the base and implicit networks, see Figure 3, Appendix III.

¹¹² On the selection of witnesses on the basis of their status, see Appleton, *Women and Wills*, pp. 103-04. For the interesting notion that witnesses were not always carefully selected but may sometimes have simply been people 'hauled in off the street when the need was urgent', see Colson, 'Reinterpreting space', pp. 394-95.

of women who scored zero for betweenness in the base network and who now receive a small score in the implicit. The greater eigenvector increase for men is more noticeable.

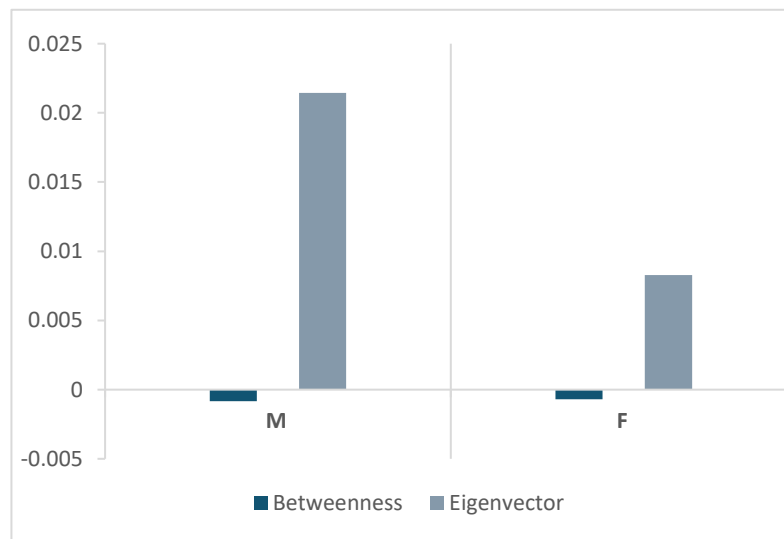


Figure 20: Male (M) and female (F) betweenness and eigenvector average score changes from the base to implicit network.

In terms of the performance of female nodes, there are certainly some women whose prominence has increased as a result of new edges (including xf Rawson), but we have not seen widespread increases in either betweenness or eigenvector. The lack of consistently positive changes to the centrality scores of women does not mean that the addition of implicit edges has been unsuccessful. The implicit network remains male-dominated, our ability to understand the position of women restricted by a lack of information about their relationships, and it would be unreasonable to expect that the new edges would result in a radical re-ordering of the network. Seeing an increase in the centrality of any women (where this can be justified as plausible through qualitative research) allows for a better understanding of their role within the network and suggests new female candidates for research, women who might previously have been overlooked (Ahnert and Ahnert's 'infrastructural figures').¹¹³ What is also reinforced through this work is the need for the quantitative and qualitative to work hand-in-hand with one another; without an understanding of the historical context within which the nodes in a network sit no interpretation of why centrality scores change would be useful.¹¹⁴ The next chapter will focus on an attempt to enhance the network further, inferring the connections of and between women in order to investigate what difference this might make to our interpretation of the network.

¹¹³ Ahnert and Ahnert, 'Protestant Letter Networks', p. 17.

¹¹⁴ Morrissey, 'Archives of Connection', p. 73.

Chapter Three: Re-connecting York

Chapter two demonstrated that the addition of implicit data has to some extent changed the structural position of nodes within the network, drawing our attention to individuals whose significance is obscured in the base version because of the nature of historical data. This chapter represents an experiment in going further, designing a new methodology for inferring data where it is absent from the historical record (what Warren et al. term ‘probabilistic network inference’).¹¹⁵ It might be argued that a hypothetical network moves us further from an ‘actual’ past, but as Hayden White and other leading postmodernists argue, the inherent subjectivity of historiography renders it a collection of narratives which suggest potential pasts rather than representing a single true version.¹¹⁶ Acknowledging this subjectivity does not render attempts at reconstruction ‘intrinsically flawed’, nor does it ‘imply the need for silence’; much can be learnt through the modelling of alternative histories, considering the *possible* in order to come closer to the *real*.¹¹⁷ This chapter is an attempt to create and interrogate an inferred network, adding another dimension to the story of late-medieval York, and to some small extent changing the social map. It will also allow for further consideration of SNA’s propensity to inflate the significance of some nodes when applied to historical data, whilst understating that of others.

The testators of two churches, the Belfrey and St. Crux, were chosen to form a subset, selected to allow for continuing discussion of some of the individuals introduced in earlier chapters and because a good number of wills are present for each parish (twenty-six for the Belfrey and nineteen for St. Crux).¹¹⁸ The institutions which were removed for analysis of both base and implicit networks were temporarily returned to the network to allow for the addition of edges on the basis of co-membership, before being removed prior to analysis. In order to reduce the risk of erroneous edge addition, edges have only been added where two people shared the same parish within ten years of each other (the same restriction has been applied to guild membership).¹¹⁹

¹¹⁵ Warren et al., ‘Six Degrees’, p. 9.

¹¹⁶ For a brief summary of post-modernist theory and its key proponents, see Jerome de Groot, *The Historical Novel* (Abingdon: Routledge, 2010), pp. 109-12).

¹¹⁷ Stephanie Decker, ‘The Silence of the Archives: Business History, Post-Colonialism, and Archival Ethnography’, *Management & Organisational History*, 8(2) (2013), pp. 155-73, (p. 160); Beverley Southgate, *History, What and Why?: Ancient, Modern and Postmodern Perspectives* (London: Routledge, 1996), p.124. For White’s ‘truth-reality distinction’ and the argument that in order to come closer to the ‘real’ historiography must accept the ‘possible’, see Hayden White, ‘Introduction: Historical Fiction, Fictional History, and Historical Reality’, *Rethinking History*, 9(2-3) (2005), pp. 147-57, (pp. 147-49).

¹¹⁸ Given the scope of this dissertation working with the whole network would have been impossible. Unless explicitly stated otherwise all analysis and discussion in this chapter will be based on the subset.

¹¹⁹ For details of the very few edges generated through co-membership of guilds, see Table 7, Appendix II. Although co-membership of a parish is not considered to be a strong enough relationship to have resulted in inferred edges,

For the analysis thus far it has been sufficient (indeed helpful) to work with unweighted data, i.e. a network in which all edges are considered to be of the same significance. For this stage, however, it was necessary to weight the data, to give each edge a value to represent the strength of the relationship.¹²⁰ In some cases determining the strength of a relationship is more straightforward than in others. Mark Granovetter's argument that 'mutual choice indicates a strong tie' can be applied to any reciprocal connection, i.e. instances in which two testators have each named the other in their will.¹²¹ Other types of connection for which there is a clear basis for assuming strength or weakness include, to take two extremes, the link between a parent and child as opposed to that between a landlord and tenant. In order to define edge-weights consistently (albeit with generalisation) the various types of relationship found in the wills were grouped together according to a judgement as to the likely strength of each; each group was then allocated an edge-weight.¹²² In a small number of cases this approach is rendered inappropriate by geographical distance. This is because where a node scores highly for strength of relationship to the testator they should not be given an edge with another York resident where such a connection would be unlikely (e.g. Isabel Whitfield's son Alexander lived in Hull and would therefore be less likely to know other people in York).¹²³ In such cases alternative ('**variant**') edge-weights have been allocated, enabling a nuanced approach to be taken (Alexander is still likely to have a stronger connection to other York residents than a tenant farmer based in Hull).¹²⁴

this approach would benefit from further work given the potential importance of such relationships, Palliser arguing that churches may have been instrumental in maintaining friendships between 'families that otherwise moved in different social spheres': David M. Palliser, *Medieval York* (Oxford: Oxford University Press, 2014), p. 154.

¹²⁰ It is important to note that featuring in a person's will in most cases represents a significant relationship, given the small proportion of people known to a testator who will be included in their will. On this see Joe Chick, 'Urban Oligarchy and Dissolutioned Voters: The End of Monastic Rule in Reading, 1350-1600', *Cultural and Social History*, 16(4) (2019), pp. 387-411, (p. 389).

¹²¹ Mark S. Granovetter, 'The Strength of Weak Ties', *American Journal of Sociology*, 78(6) (1973), pp. 1360-80, (p. 1364). The base network contains only one reciprocal tie and therefore mutuality of connection is not generally of significance in this study.

¹²² The conventional weighting scale of 0-9 was used; the stronger a connection the higher the edge-weight will be: Scott, *What is SNA*, p. 36. Generalised judgements have had to be made (e.g. that **consanguineal** relationships are likely to be stronger than **affinal**, with the exception of spouse-spouse). In each case the highest single point value has been used, rather than cumulatively adding for each group (e.g. a spouse (9) will be in the same parish (1), but he/she would receive the higher of the two possible edge-weights - nine rather than either one, or nine plus one). The category-defining approach owes much to the work of Martin During: During, 'Centrality Measures', p. 88.

¹²³ Isabell Whitfeld (1534), B.I., Prob.Reg.11, f. 105r.

¹²⁴ Relatively few geographically distant nodes appear in the dataset and therefore the variant points are not much used. Some of these scenarios are also not likely to occur (e.g. a spouse living outside York while their partner is resident in the city) but are included in the interests of producing a method which is applicable to a wider range of sources than only wills. In the case of witnesses an exception has been made, because despite their given location being specified as other than York they would have been physically present in the city for the witnessing. The categories of relationship included in each edge-weight grouping, with geographical variants, can be found in Table 8, Appendix II.

This newly **weighted** data allows us to consider the edge-strengths of each **triad** in the network and, where a triad is **intransitive**, to calculate where a relationship might have existed and infer an edge (thus closing the triad). Granovetter argues that where A is strongly connected to both B and C, and there is no existing relationship between B and C, their ‘common strong ties to A will probably bring them into interaction and generate one’.¹²⁵

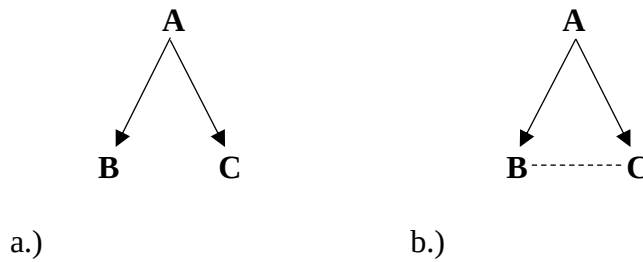


Figure 21: a) an intransitive triad with no edge between B and C; b) a closed, or transitive triad, with an inferred edge (shown as a dashed line) between B and C.

Although others, particularly Ronald Burt, have argued that there are significant exceptions to this rule (for example in competitive markets), it is sufficiently accepted to form the basis for the inference method designed and implemented here.¹²⁶ It is not, however, reasonable to assume that in all situations where a testator names two individuals and there is no known relationship between them an inferred connection can be added; not all intransitive triads should become **transitive**.¹²⁷ Granovetter argues that **transitivity** (B choosing C, or in this case simply *knowing* C) is ‘most likely when both ties – A-B and A-C – are strong, least likely when both are weak, and of intermediate probability if one is strong and one weak’.¹²⁸ In order consistently to determine whether a particular combination of edges should result in an inferred edge, the edge-weights were grouped and categorised as either weak (0-2), intermediate or ‘mid’ (3-5), or strong (6-9).¹²⁹ The edge-weighting process enables a judgement to be made as to whether the strength of relationship

¹²⁵ Granovetter, ‘Strength of Weak Ties’, p. 1362.

¹²⁶ A detailed discussion of Granovetter’s theory, the psychology behind it, and the counter-arguments, is impossible here, but see in general: Granovetter, ‘Strength of Weak Ties’; and Ronald S. Burt, ‘From Structural Holes: The Social Structure of Competition’, in *The New Economic Sociology: A Reader*, ed. Frank Dobbin (Princeton, N. J: Princeton University Press, 2004), pp. 325-48.

¹²⁷ See for example Giovanni Ruffini’s work on the social networks of Byzantine Egypt and the problems (and solutions) he found when assuming that any people or places mentioned in an individual papyrus were connected to one another: Giovanni Ruffini, *Social Networks in Byzantine Egypt* (Cambridge: Cambridge University Press, 2008), pp. 203-11.

¹²⁸ Granovetter, ‘Strength of Weak Ties’, p. 1377. **Homophily**, the tendency for people to form relationships with those who are similar to them (either in terms of status or values), would also contribute to the likelihood of transitivity operating, but has not generally been considered here.

¹²⁹ See Table 8, Appendix II.

between A-B and A-C is sufficient that transitivity is likely to have operated and resulted in an edge between B and C; Figure 22 shows possible triadic combinations.

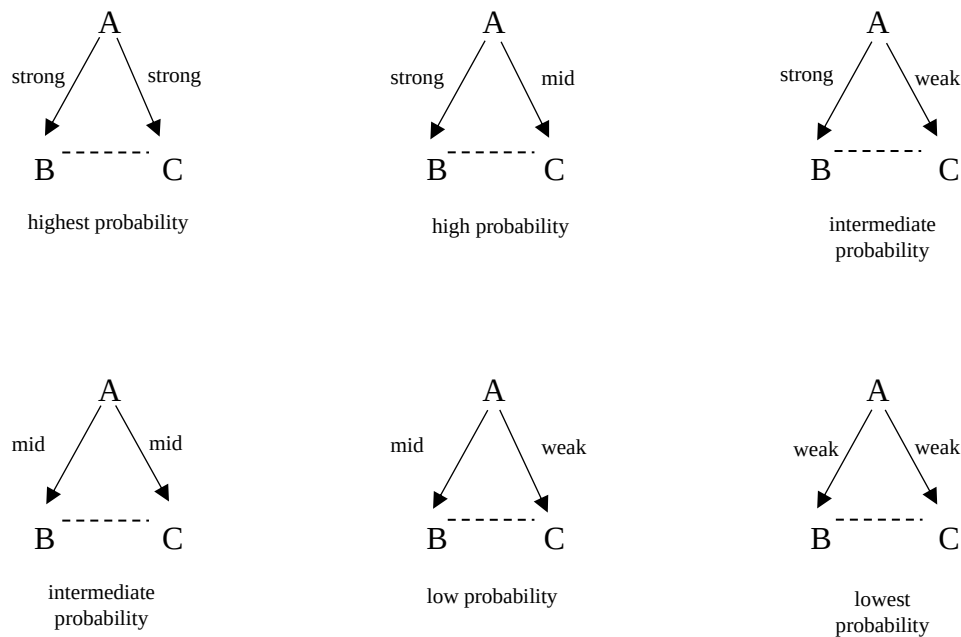


Figure 22: Possible combinations of edge strengths showing the resultant probability of an inferred connection between B and C; dashed lines represent inferred edges.

For this study only edges involving a testator were used, resulting in 7,124 potential triads for St. Crux and 2,228 for the Belfrey.¹³⁰ The higher number of possible combinations for St. Crux, despite the parish having fewer surviving wills, reflects the (on average) higher number of names in the wills of that parish (an average of twenty-two per will as opposed to thirteen in those of the Belfrey), and the greater volume of relational data in those wills (which enabled a larger proportion of relationships to be determined and thus given a higher edge-weighting). For each of these intransitive triads the weights of the two known edges were considered and the probability of an edge closing the triad was determined; only edges with high or highest probability were added to the network.¹³¹ Figure 23 illustrates this for four intransitive triads.

¹³⁰ Some of these triads are already closed in the base and implicit versions of the network, in which case the first instance is used for analysis.

¹³¹ This does not mean that lower probability edges are not worth studying (they too may offer valuable insights), but the scope of this study makes their consideration here impossible.

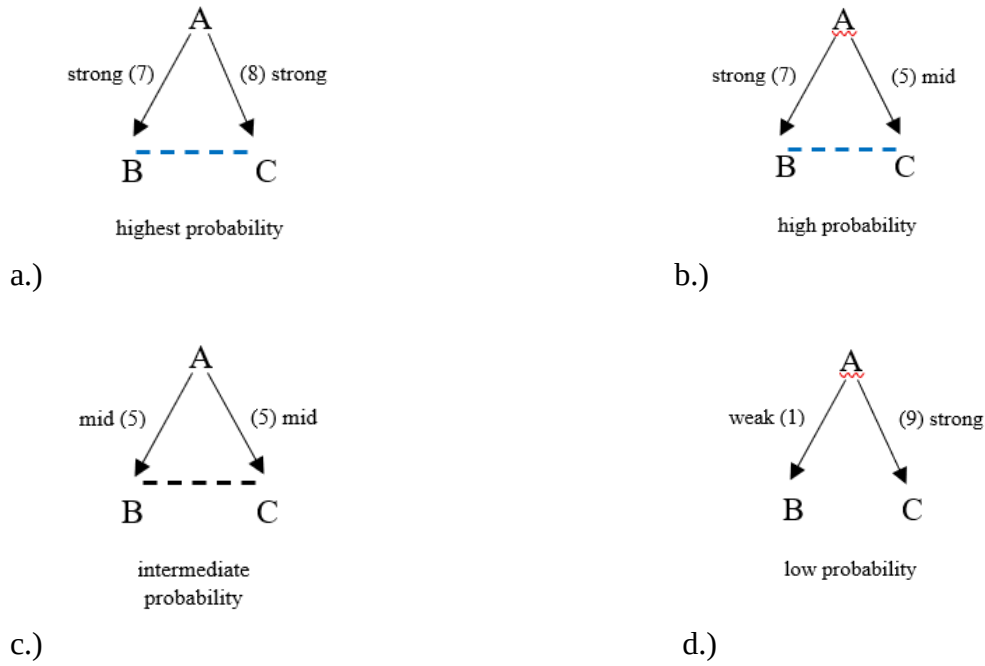


Figure 23: Intransitive triads with edge weights and strength ratings; new (inferred) edges are shown as dashed lines, and their probability is given below each triad. Only edges in blue have been added to the network.

In both a) and b) the inferred edge is of sufficiently high probability to be added to the network, thus closing the triad; in c) the combination results in an inferred edge, but of insufficiently high probability to be included in this study; and in d) the combination of the two edge-weights is insufficient to justify edge-inference. This particular application of the method is designed to limit error, and the number of edges added through inference is therefore smaller than it would be if, for example, medium probability edges were also added.¹³² Its design is such, however, that the parameters can be changed according to research priorities and the specifics of a dataset; different decisions around the threshold for edge addition would, for example, result in a more dense, but less probable, network.

Adding these edges into the subset allows for comparison across the three networks. The purpose of this chapter is not to provide a comprehensive analysis or interpretation of the results, but rather to demonstrate that application of the method described above can result in a statistically useful change in the centrality scores of nodes. Table 10 contains key network statistics for the three subset networks.

¹³² Each new edge has also been manually checked for plausibility to further reduce the risk of error.

Network measure	Base	Implicit	Inferred
Edges	796	1,719	5,738
Density	0.003	0.007	0.022
Av. path length	5.146	4.656	3.607
Diameter	10	10	8
Av. clustering co-efficient	0.282	0.831	0.832

Table 10: Key network statistics for the base, implicit, and inferred subset networks.

The base network consists of four separate **components**, one main and three smaller; each of the smaller represents a testator who is unconnected to anyone else in the subset.¹³³ As expected, the number of edges increases as we move from the base to inferred version. The network diameter, the shortest distance between the two most distant nodes, has decreased in the inferred network, and so too has the average path length; in general, therefore, the network is better connected. The network density has also increased, meaning that of all possible connections within it a greater proportion are present in the implicit and inferred networks than in the base network.¹³⁴ Interestingly, the average clustering co-efficient increases from base to implicit, but barely changes between implicit and inferred. Considering the nature of the original data (testators with largely pendant alters), it makes sense that when implicit edges dominated by familial relationships are added the average clustering co-efficient would increase as the number of connections between an ego's alters increases. As these edges are already present when the inferred edges are added the co-efficient does not increase significantly at that point. The predictable nature of these changes acts as confirmation that alterations to the network's structure as a consequence of edge inference are reasonable, but the purpose of this research is to evaluate its impact on the centrality scores and structural position of individuals within the network.¹³⁵

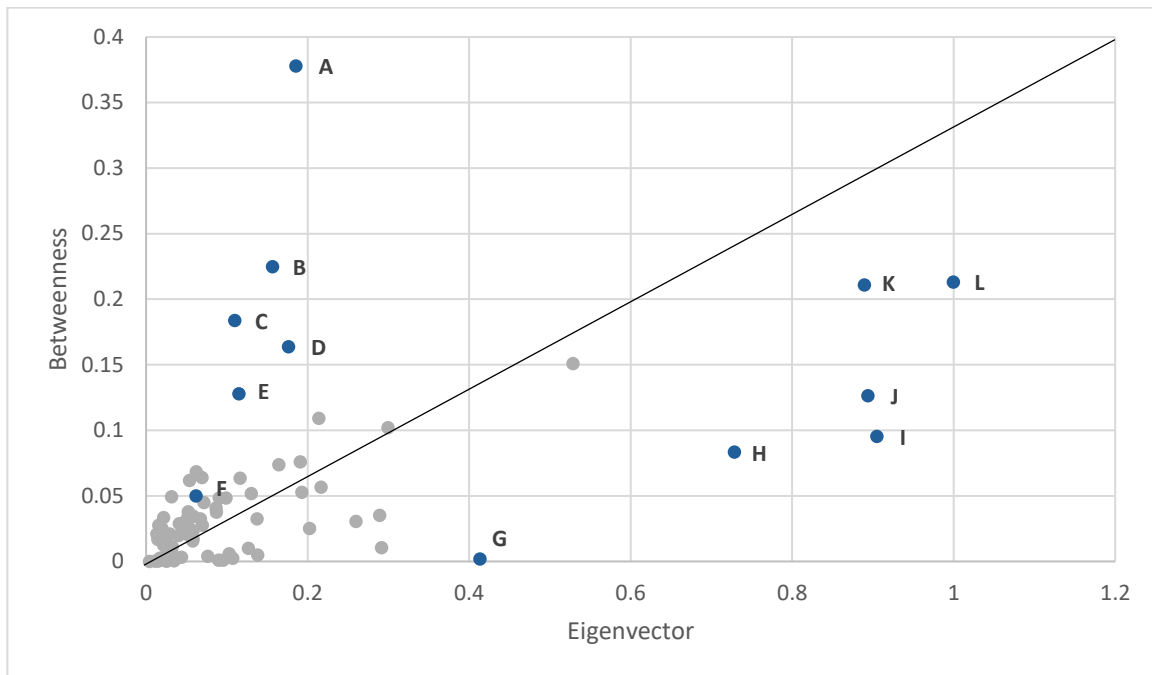
Figure 24 plots betweenness against eigenvector for all those nodes in the subset which have a score for betweenness in the base network, and highlights the influential nature of the Shaw family; each of those individuals who perform unusually highly by eigenvector when compared

¹³³ These individuals are Thomas Spark, Robert Pearson, and William Wright¹ (all of whom are better connected in the full network which consists only of one main component); these nodes and their alters are not generally shown in visualisations.

¹³⁴ David Shaw's work on medieval Wells suggests that 'most medieval towns' were probably 'especially tightly knit', and it is likely therefore that this increase in network density is indicative of a more accurate representation of York society: David G. Shaw, 'Social Networks and the Foundations of Oligarchy in Medieval Towns', *Urban History*, 32(2) (2005), pp. 200-22, (p. 213).

¹³⁵ On the value of such confirmation in terms of the confidence it can give in more unexpected outcomes, see Burge, *Letters*, p. 234.

with their betweenness are either members of the family or a priest connected to their parish (St. Crux).¹³⁶



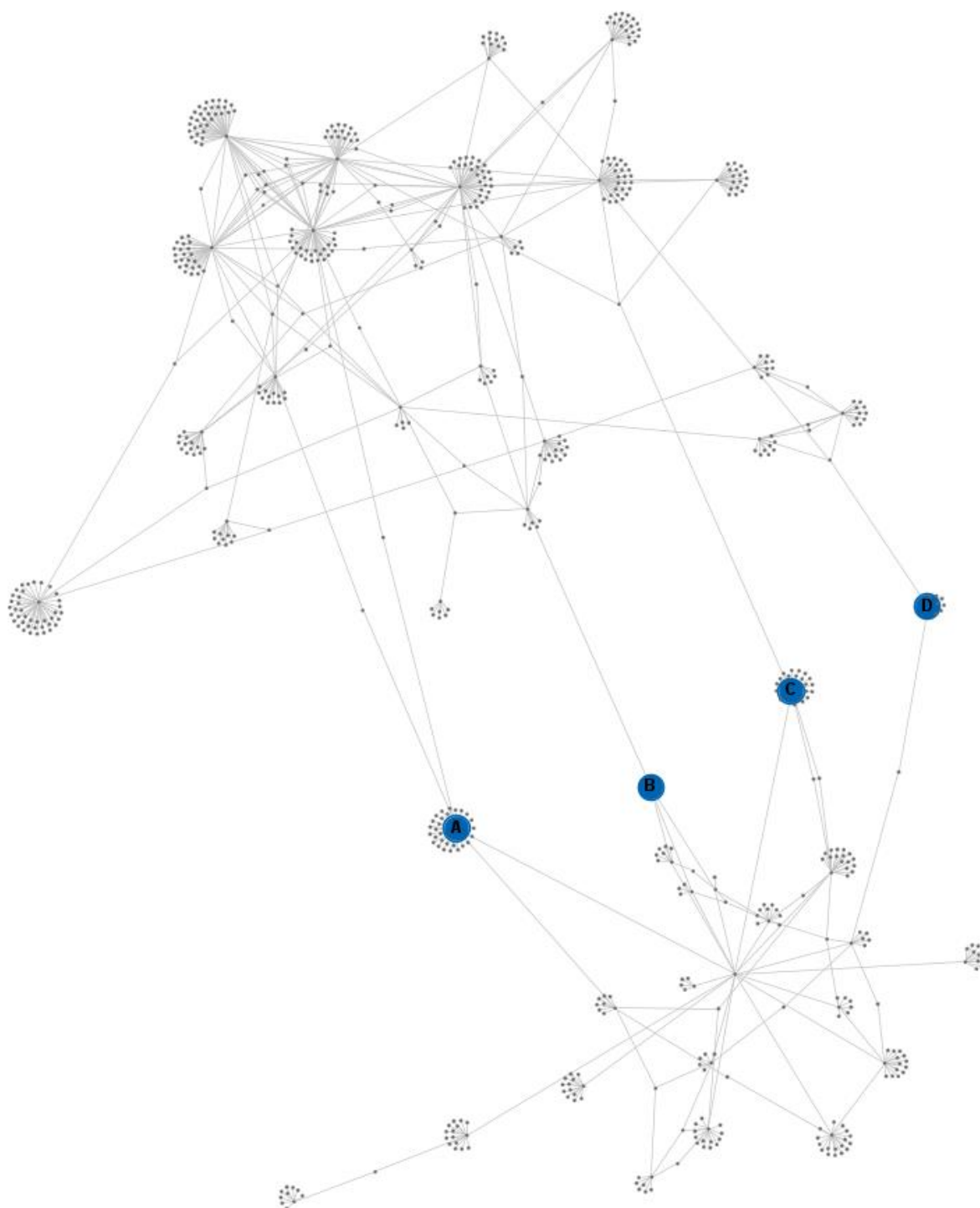
A Sir Laurence Hall; B Paul Gillour; C Thomas Water; D John Tod; E William Wright²; F Sir John Watson; G Sir William Pinder; H Leonard Shaw; I Elisabeth Shaw; J Maude Shaw; K Sir William Merton; L John Shaw¹.

Figure 24: Betweenness plotted against eigenvector for all subset nodes scoring for betweenness in the base network.

Also apparent is the fact that, as well as Sir Laurence Hall (who retains his high betweenness score), there are other individuals who perform well by betweenness while scoring less well for eigenvector. Some of these nodes perform a particular structural function, linking the two parishes. Paul Gillour (merchant, mayor (1522-23), and alderman) and Thomas Water (notary), alongside William Richardson¹ (occupation unknown) and John Williamson (tailor) can be seen in Figure 25a linking St. Crux (top) and the Belfrey (bottom).¹³⁷ If these nodes were removed, as in Figure 25b, the network would fragment and the two parishes would no longer be connected. Neither one of these men has the influence of someone who is a true **cutpoint** (an individual node without which the network would separate), but their ability to connect it partially puts them in a strong position to exert control over, for example, the flow of information through it.

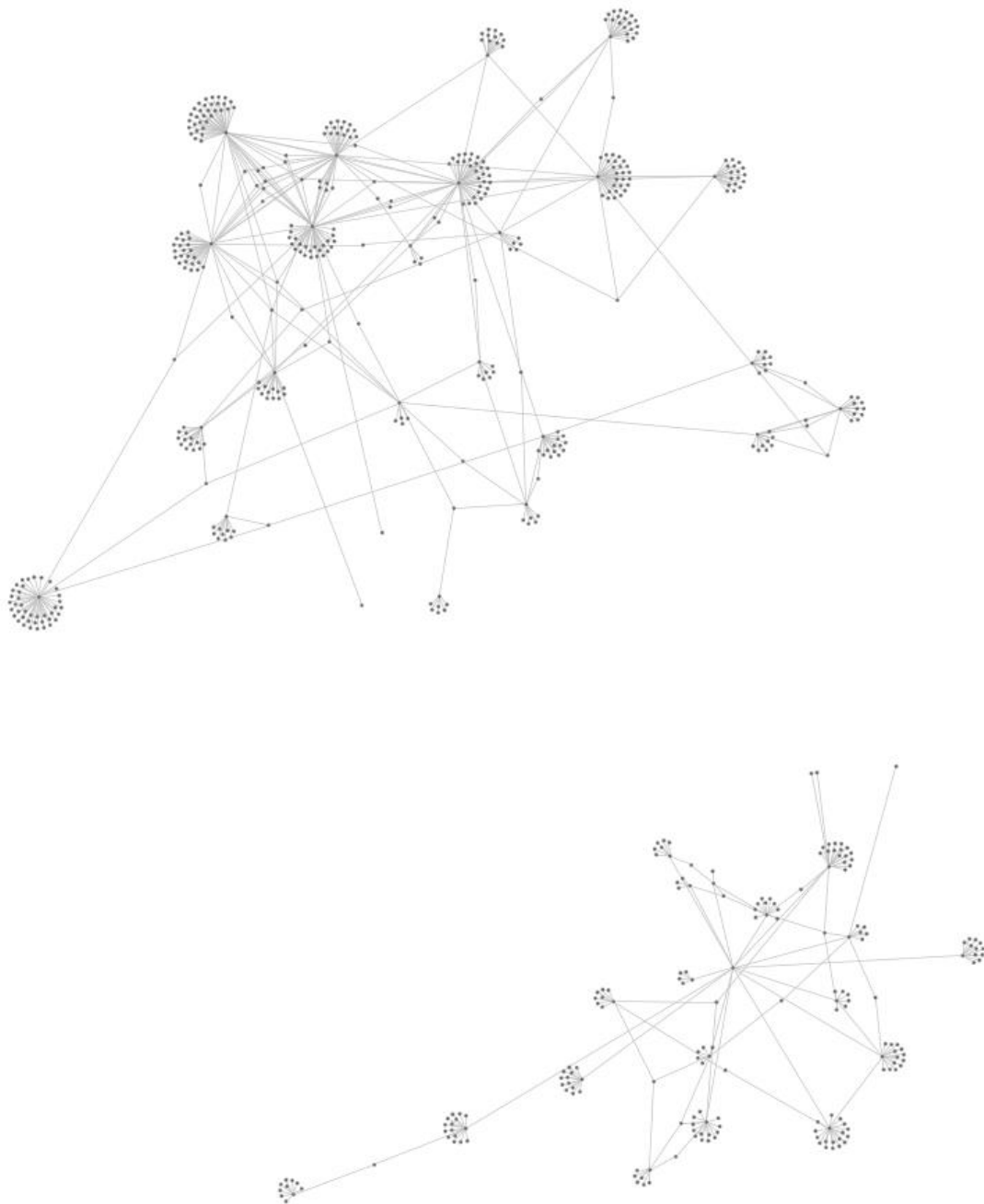
¹³⁶ Both Sir William Merton and Sir William Pinder maintain the high eigenvector scores discussed earlier for the whole network, Pinder's contrasting particularly strongly with his very low betweenness score.

¹³⁷ William Richardson may be the goldsmith who appears in the Freeman's Register for 1516-17: Collins, *Freemen's Register*.



a.)

A Paul Gillour; **B** William Richardson¹; **C** Thomas Water; **D** John Williamson.



b.)

Figure 25: a) Base subset with linking nodes highlighted; b) base subset with linking nodes and their alters removed, showing the division of the main component into the two separate parishes.

Whilst these nodes do not strictly have **structural equivalence**, they are **structurally similar**.¹³⁸ This means that they occupy the same type of structural position in the network and their removal has similar consequences. The occupations of these nodes (merchant and notary, for

¹³⁸ In order to achieve the mathematical definition of structural equivalence the two nodes would have to have exactly the same edges within the network, an extremely unlikely feature in a real-world network. On this, structural similarity, and why equivalence remains a useful concept, see Borgatti et al., *Analysing Social Networks*, p. 220.

example) adds weight to the earlier suggestion for the whole network that men in such occupations were more likely to be found connecting disparate parts of the network by crossing parish boundaries as a result of, in the case of merchants, city-wide trading.

Adding implicit edges does not change the network structure significantly, as evidenced by there being no reduction in its diameter. Although the implicit edges improve connectivity *within* the two parishes, none directly connects one to the other (that function is still performed by the same four nodes). In the inferred network, however, there is a more fundamental change in network-structure and the role played by these linking nodes. This demonstrates the potential of the enhanced network to call into question some of the conclusions drawn from analysis of the base version. Figure 26 shows the inferred network with Gillour, Water, Richardson, and Williamson removed.

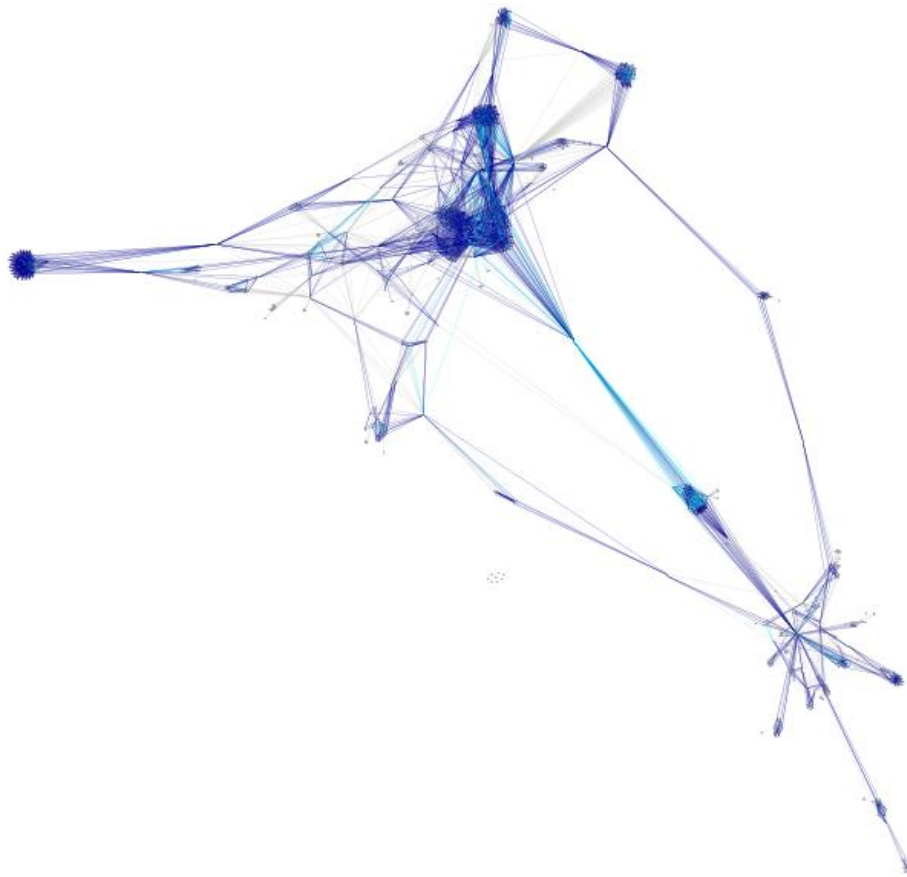


Figure 26: Inferred subset with four base network linking nodes removed; inferred edges are shown in dark blue (high probability) and light blue (highest probability).

Whereas Figure 25b shows the base network fragmenting with their removal, here it maintains its inter-parish connectivity. There are now other nodes which perform the same linking function, and the network therefore has sufficient redundancy to maintain its structure (in network parlance,

it is more **robust**). Two conclusions can be drawn from this: firstly, that the structural significance of some nodes may be inflated in historical social networks because of the partial data on which they are based; and secondly, that the inference of edges can alert historians to the presence of potentially significant nodes who may previously have been overlooked. Not only does this suggest avenues for further research, but it also acts as a caution to consider carefully how gaps in the data might be influencing conclusions derived from historical SNA. In the inferred network, nodes such as John Tod, William Wright², and Sir John Watson (a chantry priest in St. Saviour's from 1520 to his death in 1547) are seen to connect the two parishes.¹³⁹ None of these three left a will, which suggests that their position reflects a genuine measure of centrality (supported by their selection as witnesses, a position, as previously discussed, which can sometimes be reflective of social status).¹⁴⁰ Wright and Tod have scored well for betweenness in all three network versions (the possible link between centrality and their occupations was discussed in chapter two), but Wright's betweenness score has increased in the inferred network (as has that of Watson). Watson has not stood out thus far as being structurally significant, falling within a dense cluster of nodes (see Figure 24) whose betweenness and eigenvector scores sit close to the trend line; such a position would not immediately suggest his ability to connect the two parishes.

Watson features in three St. Crux wills, as witness and curate, giving him a base degree score of three. In the inferred network, however, his degree is thirty-five, an increase consisting of a combination of edges based on co-witnessing (each of the wills in which he features contains a slightly higher than average number of witnesses), and connections to members of the testator's families. Watson's edge to Sir John Thompson (which he gains through John Williamson's will) is what enables him to (with Thompson) connect the two parishes. The change in Watson's structural position demonstrates the impact that only a small increase in betweenness (from 0.028772 to 0.059002) can have, and why it is important to look at the data in different ways (both in terms of centrality profiles and the form in which the data is presented). Watson is not noticeable in chart form, but his structural significance becomes apparent when the data is viewed as a sociogram.

¹³⁹ Webb has Watson as also parochial chaplain of St. Crux but provides no source, and it has not been possible to verify this elsewhere (Cross, for example, does not put him there): Webb, 'Census', p. 292; Cross, *City Clergy*, p. 42. Watson's inclusion in these wills as 'curate', however, does suggest Webb is correct, and his association with St. Crux and its parishioners might in part explain his structural position.

¹⁴⁰ It should be noted that other researchers have found their centrality results to be impacted by the fact that urban officeholders so often feature as witnesses, but also that this does not entirely account for their high scores: Chick, 'Urban Oligarchy', p. 395.

In considering the changing structural significance of these nodes we see how the importance of an individual can be overestimated in the base network because it does not adequately reflect the realities of the social network in question, and conversely that those people who may have been significant in the past can be overlooked because of gaps in the data. Those who are integral to the maintenance of the base network structure (Gillour, Water, Richardson, and Williamson) are seen to be less critical when edges are added which show that others were capable of performing the same function. Qualitative research can be combined with these quantitative methods to ensure individuals are not given undue significance as a result of erroneously inferred edges, and looking at combinations of centrality measures can also help (for example, it does not seem implausible that William Wright would be significant in the inferred network when we consider that in the base version of the full network he scores particularly well for betweenness when compared with his relatively low degree score (see Figure 6).

Having briefly discussed the potential for this method to illustrate some of the problems involved in relying on the results of historical data analysis, and the benefits of experimenting with new approaches, we will now consider the impact of the methodology on the centrality scores of female nodes. Only nine women in the base network score for betweenness; Figure 27 shows their relative betweenness scores in the base and inferred networks.¹⁴¹

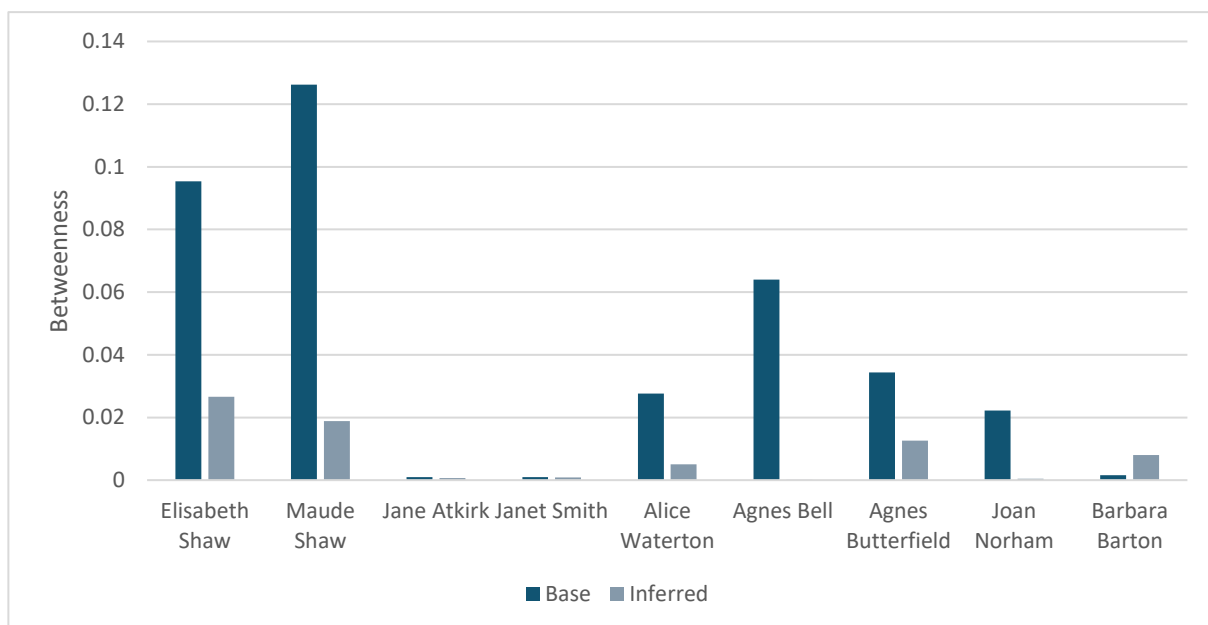


Figure 27: Female betweenness scores in the base and inferred networks, showing only those women who had a betweenness score in the base network.

¹⁴¹ Whilst the Bishophill Anchoress registered a betweenness score she has been excluded from these comparisons as her score is likely to be more reflective of bequests of a religious nature than of social connections.

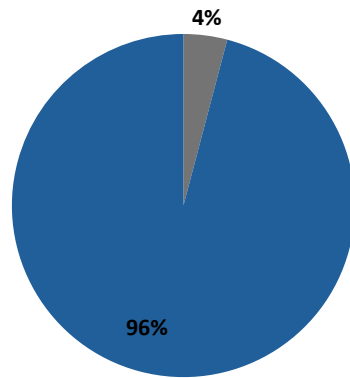
There is an almost universal decrease in betweenness for these women, the sole exception being Barbara Barton. In some cases (Jane Atkirk and Janet Smith) the decrease is minimal from an already low base; in others it is much more marked. Barton sees an increase in her score through a new edge she receives to William Richardson¹ (and through him to the Belfrey side of the network) on the basis of the pair sharing the residue of Agnes Bell's estate.¹⁴² Receiving the residue of an estate is considered to be a strong connection (receiving an edge-weighting of six), and therefore their two individually strong connections to Bell results in there being the highest probability of a connection between them. The inferred edge to Richardson makes it more likely that Barton will sit on shortest paths between people in her own parish of St. Crux, and that of the Belfrey.

The average change to the betweenness scores of these women, however, is a decrease of 0.03332, reflected in their betweenness rankings, all of which are reduced (apart from Barton's).¹⁴³ When compared with results for women as a whole in the subset a different picture emerges, with female nodes seen to have an average increase in betweenness of 0.090955, a consequence of so many having no score in the base network and therefore for whom any change must be an increase. Of the two hundred and ten female nodes with zero betweenness in the base network, eighty-four receive a score in the inferred network (see Figure 28 below).¹⁴⁴ As a result, compared with only nine female scorers for betweenness in the base network a total of ninety-three female nodes score in the inferred network. Whilst this is more reflective of a society in which women are known to have played a key role both socially and economically, it may yet be an under-representation of their position.

¹⁴² Agnes Bell (1530), B.I., Prob.Reg.10, f.16.

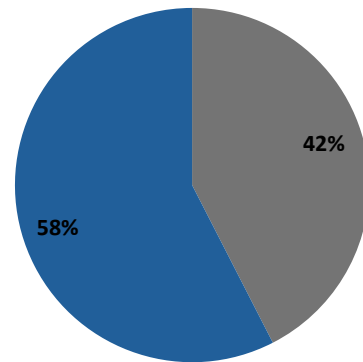
¹⁴³ For their changes in rank for both betweenness and eigenvector between the base and inferred networks, see Table 9, Appendix II.

¹⁴⁴ The proportion of female nodes scoring for betweenness is lower in the base subset than in the whole network (4% as opposed to 7%). The 42% who receive a score in the inferred subset is greater than the 20% in the implicit subset.



■ Score ■ No score

a.)



■ Score ■ No score

b.)

Figure 28: Proportion of female nodes in the subset scoring above zero for betweenness in the a) base and b) inferred networks.

In terms of eigenvector centrality, scores in the base and inferred networks for those male nodes we saw in linking positions show that changes in their eigenvector scores correlate, to varying degrees, with the changes to their betweenness.¹⁴⁵ For those whose betweenness fell, so did their eigenvector, and vice versa. In this case the centrality of these nodes has changed in a similar way across more than one measure, but this is not universally true. In the case of female nodes, for example, there is a greater difference in how their betweenness and eigenvector centrality scores change. While for betweenness only Barbara Barton's score (and rank) increases (of those women who scored at all in the base network), for eigenvector she is joined by Janet Smith and Jane Atkirk (although Atkirk's rank decreases).¹⁴⁶ These three women all now have greater proximity to influential nodes, and therefore their own potential for influence has increased. For the other women who scored for betweenness in the base network, their reduced betweenness correlates with a reduced eigenvector score, but if we consider all women in the subset there is a more generally positive difference in their performance by eigenvector. While ten women score within the top fifty nodes in the base network, this increases to fifteen in the inferred version, with xf Rawson (Elisabeth Shaw's sister) now included. The changes to Rawson's centrality scores are illustrated in Figure 29, which shows her betweenness and eigenvector in each of the network versions.

¹⁴⁵ See Figure 5, Appendix III for a chart illustrating this.

¹⁴⁶ For a chart showing changes in eigenvector scores between the base and inferred networks see Figure 4, Appendix III.

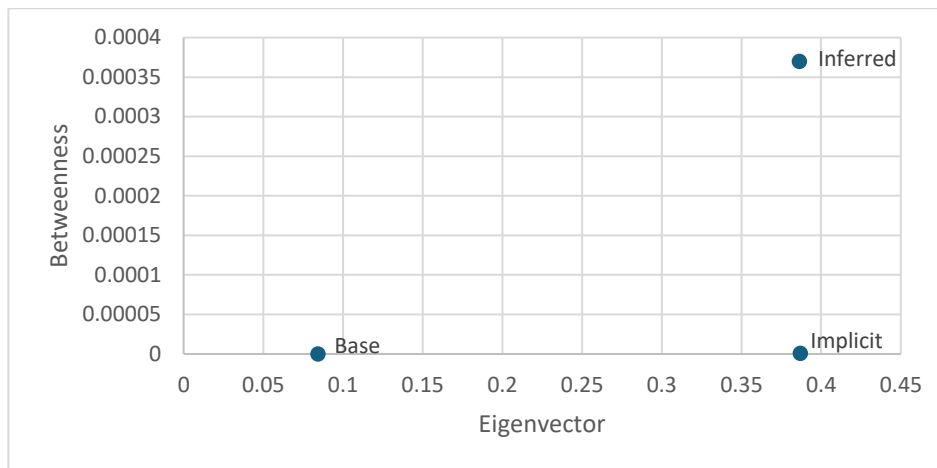


Figure 29: *xf* Rawson's betweenness and eigenvector scores in the three subset network-versions.

In the implicit network Rawson sees no change to her betweenness and a significant increase in eigenvector. In the inferred network, on the other hand, she experiences a marked increase in betweenness but no real change in eigenvector. Her higher scores for these two key centrality measures suggests an increased potential for Rawson to be significant within the network. This does not guarantee that she was more important than the base network indicates, but it does suggest she might be worthy of further research.¹⁴⁷

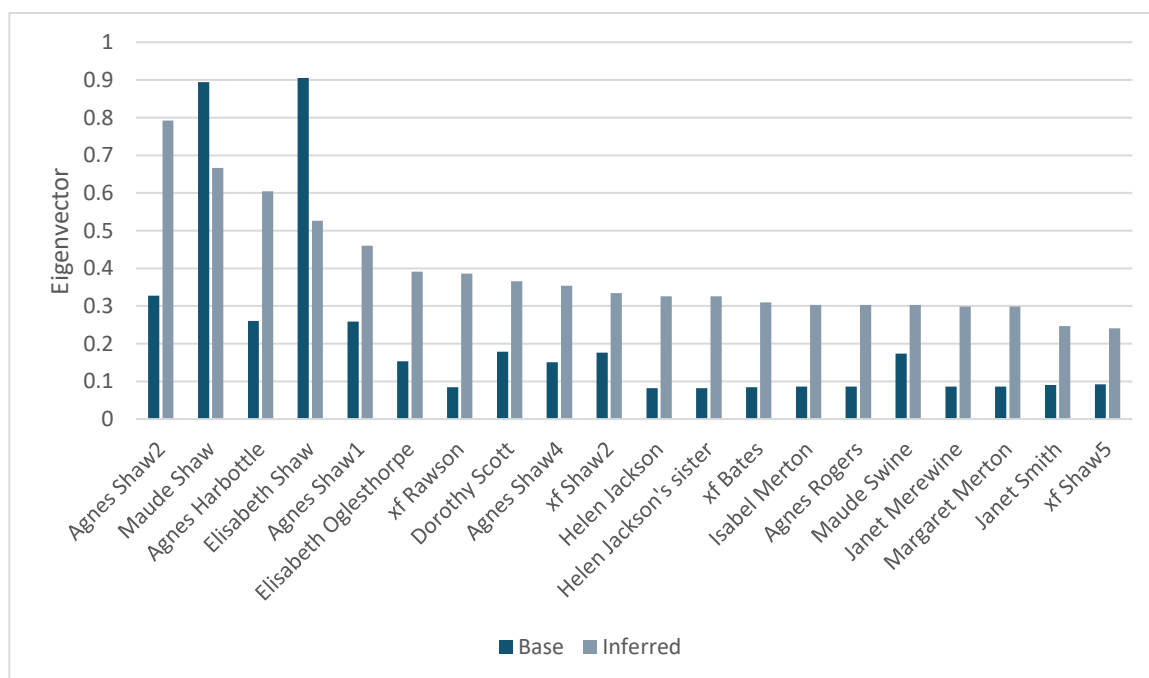


Figure 30: Top twenty female eigenvector scorers in the inferred network with their base network scores for comparison.

¹⁴⁷ See During for the argument that all centrality results should be considered as representing a 'potential for centrality which was either fulfilled, or...for one reason or another remained unfulfilled': During, 'Centrality Measures', p. 99.

Looking at the top twenty female nodes for eigenvector in the inferred network and comparing their score to that in the base network provides a wider illustration of the impact inferred edges might be having on the eigenvector scores of women in the network. Many of the increases seen in Figure 30 above are explained in part by changes already seen in the implicit network, the result of new edges between nodes such as xf Rawson and influential male members of the Shaw family. There are, however, women such as Helen Jackson whose increase in eigenvector is predominantly the result of inferred rather than implied edges. Jackson has only one edge in the base network, the result of ‘3li. 6s. 8d. and one paire of beides of corall with silver gaudies and gilte’ being bequeathed to her in Maude Shaw’s will.¹⁴⁸ She gains two additional edges in the implicit network, one to an unnamed sister and the other to her son (William Jackson²), but as we are not given the name of the sister in question it has not been possible to link Jackson to any other person in the dataset. Shaw describes Jackson as ‘my suster doughter’ (her niece), and the inferral method takes the strength of connection between the two, and checks the strength of connection between Shaw and each of the other individuals she names in her will. As discussed, where there are two edges of sufficient strength a third edge is inferred to close the triad, resulting in Jackson having a total of twenty-nine edges in the inferred network. It is not merely the number of edges which increase her eigenvector score, but rather the specific people to whom she gains connections. Edges with a majority of the Shaw family, Sir William Merton, and Peter Ledale result in a significant increase to Jackson’s eigenvector score, one which we can be reasonably confident is reflective of a historical reality given that we know she is related to the Shaws and sufficiently important to Maude to be given a significant bequest (in fact one of the largest she leaves).

Comparing centrality changes for female nodes across the subset as a whole, 77% of female nodes have an increased eigenvector score in the inferred network (compared to 65% of men), whilst 98% of female nodes see an increase in their betweenness score (compared to 80% of men).¹⁴⁹ The impact of the inference methodology on eigenvector *ranking*, however, differs more significantly from that for betweenness. The average change to a female node’s eigenvector ranking is an increase of twenty-one places, and whilst it is difficult to judge changes in their betweenness rankings as a result of large changes in the number of nodes with betweenness scores, the trend is downwards (for those women who score in both versions the average number of places

¹⁴⁸ Maude Shawe, B.I., Prob.Reg.11, f.278v-279r.

¹⁴⁹ The figure for women is heavily influenced by the initial zero betweenness of the majority of women; of those women who did score for betweenness in the base network 60% have an increased score in the inferred network.

they fall is sixty-two).¹⁵⁰ Where therefore there is an existing score for betweenness in the base network for a female node, its betweenness ranking will (on average) decrease with the addition of new edges (although there are some nodes for whom it will make little difference, and some whose ranking will increase).

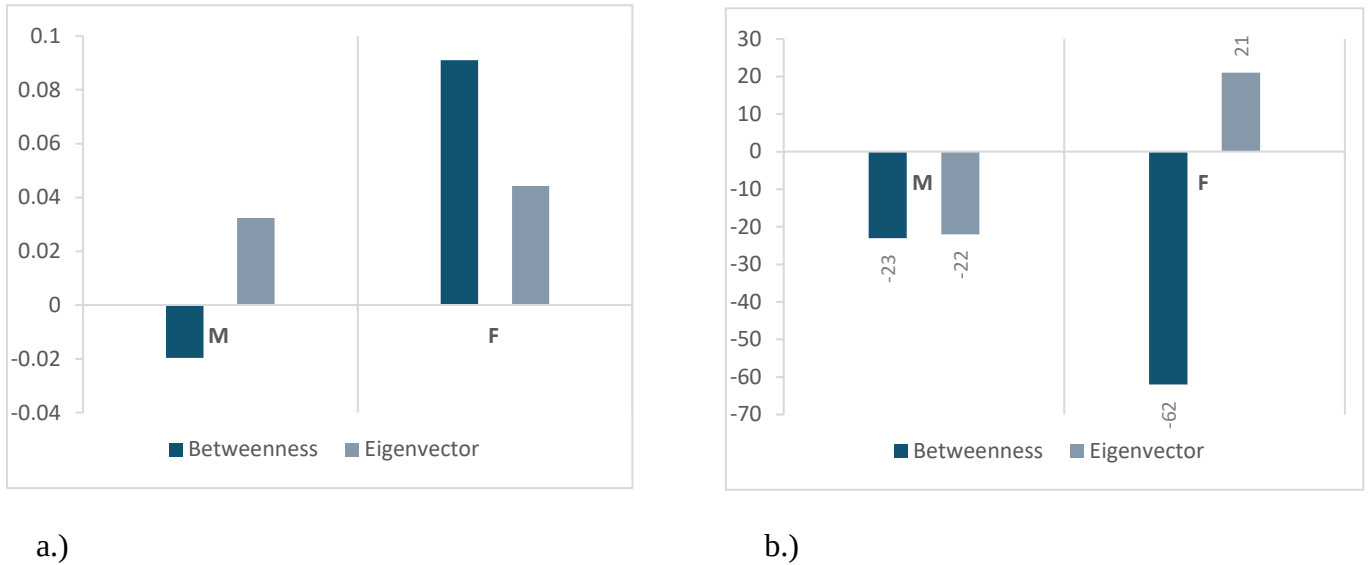


Figure 31: Male (M) and female (F) betweenness and eigenvector average a) score changes and b) ranking changes from base to inferred subsets.

On the basis of the results discussed here we can therefore generalise that the addition of inferred edges to this dataset tends to result in an increase to both betweenness and eigenvector centrality and to eigenvector rank for women, but, on average, a decrease in their betweenness ranking. On the whole men see an increase in eigenvector (albeit a smaller proportion of them than for women) but not betweenness score and, unlike women, their eigenvector ranking decreases. The betweenness ranking of male nodes falls, like that of female nodes, but by a smaller number of places (on average by twenty-three).

This difference is most probably explained by the fact that, although the addition of new edges means that women sit on a higher number of paths, these are either not the shortest path or a similarly short path already exists. For eigenvector, however, the addition of edges means that more of the women in the network have edges with influential nodes to whom they were previously unconnected. If we had applied the methodology with a view to maximising network density, and therefore were less sure of the validity of the new edges, this might raise concerns over how

¹⁵⁰ For a list of the ranking position of these nodes in the base and inferred networks see Table 9, Appendix II. Nodes who scored zero in both versions were excluded from these calculations.

valuable such ranking increases are, because of the possibility that they are based on erroneous data. Given that here the methodology has been applied in such a way as to reduce the risk of erroneously added edges, we can be reasonably confident that the increased centrality of many of these women in the inferred network is a result of their real-world connections now being reflected in the data.

Conclusion

The application of SNA to York wills has shown the ability of quantitative methods both to confirm previous conclusions and suggest new ones. Confirmation of the importance of friaries to the early-sixteenth-century laity sits alongside new questions concerning differences in bequests to prisons in urban as opposed to rural areas. Studying the wills through this new lens has suggested links between occupation and centrality, and cautioned us against inflating the significance of individuals who appear important or influential because of gaps in the data. Clearly SNA has its limitations for historical data; whilst the extent of these will depend upon the data and research objectives involved, such networks will always tell a partial story based on partial data. Whilst the findings of chapters one and two demonstrate that there is merit in the use of such techniques despite the limitations and caveats, chapter three illustrates the potential of new methodologies, specifically designed to work with historical data.

The principal difficulty considered here has been a lack of information on the connections of women in the network, often resulting in their scoring less well than might be expected for many of the key centrality measures. The inference of edges has, on balance, resulted in a more representative reflection of the position of women, with a significantly higher proportion receiving a betweenness score, and a widespread increase in their eigenvector centrality. It has also demonstrated the capacity of SNA to alter our perception of specific women, such as Elisabeth Shaw's sister, *xf* Rawson. Rawson's single appearance in the wills meant that she scored zero for betweenness and had a low eigenvector score in the base network. The addition of implicit edges did little to improve her betweenness, but through her new connections to other members of the Shaw family she saw a significant increase in her eigenvector score. The inferred network subsequently saw her betweenness score increase, meaning that Rawson has gone from being mentioned in one person's will, and thoroughly insignificant in network terms, to having centrality scores which suggest a capacity for influence and make her potentially worthy of further research. She is no longer peripheral to the network (and society), but close to the centre of an influential family.

This new methodology requires further modification and experimentation, but has acted as a proof-of-concept that missing edges in late-medieval networks can be plausibly inferred, and that doing so can alter the structural position of women (and potentially other under-represented groups). There is much more that could be done with both standard SNA and this method,

including applying it to a wider range of wills, contrasting urban and rural networks, looking dynamically at how York networks changed over time (particularly interesting in a period of intense religious change), and studying in greater depth the personal networks of non-elite women.

Aside from the conclusions discussed here this research has also produced a new dataset, a body of work involving the transcription of three hundred and thirty-seven wills (the majority of which are unpublished), and the conversion of their contents into a malleable, searchable form. Such a dataset is valuable in its own right and has the potential to be the foundation of much further research including, for example, a more granular look at the nature of bequests or the language of affect. With further work the inference methodology could be applied to a range of historical periods and sources at scale. For those not interested in taking an SNA approach the results of this analysis and the dataset can still be useful in highlighting significant individuals or institutions which would warrant further research, or in enabling study of the wills from a myriad of angles, from testamentary priorities to material culture. It is hoped that this study is only the beginning of new work on York wills, applying the methods of the present to records of the past to enhance our understanding of late-medieval society, and gradually increasing the size of that ‘infinitesimal sliver’.¹⁵¹

¹⁵¹ Warren et al., ‘Six Degrees’, p. 1.

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Appendix I: The Wills

First name	Last name	Will dated	Will proved	Parish	Occupation	Burial place	Reference
John	Barnes	17/09/1540	09/12/1540	All Saints, North Street	Tanner	Parish Church	P.R.11, f.452r-v
Henry	Daysone	03/09/1540	22/09/1540	All Saints, North Street	Litster	Parish Church	P.R.11, f.429r
Thomasin	Hunsley	30/04/1540	05/09/1540	All Saints, North Street	Widow	Parish Church	P.R.11, f.426r
John	Hall	30/03/1527	06/06/1527	All Saints, North Street	-	Parish Church	P.R.9, f.369v
Richard	Hall	09/08/1526	17/09/1526	All Saints, North Street	Horner	Parish Church	P.R.9, f.349r
John	Newbye	17/01/1529	03/03/1529	All Saints, North Street	Barber	Dominican Priory	P.R.9, f.479r-v
Richard	Olyver	20/06/1535	-	All Saints, North Street	Priest	Holy Trinity Priory	Ab.R.27, f.168r-169r
Herry	Chamer	21/06/1521	21/01/1521	All Saints, Pavement	Merchant	Parish Church	P.R.9, f.202r
William	Robynson	16/03/1527	30/03/1528	All Saints, Pavement	Weaver	Parish Church	P.R.9, f.349r
Jenett	Grenewell	26/09/1537	16/10/1537	All Saints, Pavement	Widow	Parish Church	P.R.11, f.253r
Margaret	Barker	06/03/1540	03/05/1541	All Saints, Pavement	Widow	Parish Church	P.R.11, f.518r
John	Barker	26/03/1520	28/09/1520	All Saints, Pavement	Notary	Parish Church	P.R.9, f.115r
Peter	Gilllott	11/07/1525	21/10/1525	All Saints, Pavement	Merchant	St. Saviour's	P.R.9, f.324r-325r
John	Norman	13/11/1525	01/12/1525	All Saints, Pavement	Alderman	Parish Church	P.R.9, f327r-328r
Roberte	Bechame	22/06/1521	06/02/1521/2	All Saints, Pavement	Priest	St. Crux	Ab.R.27, f.154r-v
Roberte	Comersall	21/08/1520	07/12/1520	All Saints, Pavement	Priest	Parish Church	D&C 2, f.185v-186r
William	Simpson	24/02/1527/8	30/03/1528	All Saints, Pavement	Priest	St. Lawrence's	Ab.R.27, f.161v
Roger	Chamber	28/12/1538	--/10/1543	Holy Trinity, Goodramgate	Parchment maker	Parish Church	P.R.11, f.711r
William	Webster	13/12/1526	04/01/1526	Holy Trinity, Goodramgate	Parchment maker	Parish Church	P.R.9, f.356r-v
William	Metcalfe	09/07/1537	-	Holy Trinity, Goodramgate	-	Parish Church	Ab.R.28, f.173v
John	Bayne	16/09/1535	01/02/1535	Holy Trinity, King's Court	Butcher	Parish Church	P.R.11, f.177r
Simond	Bolton	08/04/1534	10/06/1534	Holy Trinity, King's Court	Butcher	Parish Church	P.R.11, f.103v
Thomas	Dobson	04/01/1537	05/02/1537	Holy Trinity, King's Court	Baker	Augustinian Friary	P.R.11, f.272v-273r
William	Huby	24/03/1531	18/04/1532	Holy Trinity, King's Court	-	Parish Church	P.R.11, f.9r
Richarde	Huchonsone	20/03/1534	30/06/1535	Holy Trinity, King's Court	Butcher	Parish Church	P.R.11, f.142r-v
Roberte	Hyll	11/06/1537	04/07/1537	Holy Trinity, King's Court	-	Parish Church	P.R.11, f.244v
Leonarde	Shawe	01/04/1532	11/05/1532	Holy Trinity, King's Court	Merchant	St. Crux	P.R.11, f.10v
William	Harrington	10/11/1540	18/02/1540	Holy Trinity, King's Court	-	York Minster	P.R.11, f.497r-v
Steven	Foxgyll	14/05/1530	04/07/1530	Holy Trinity, King's Court	Butcher	Parish Church	P.R.9, f.475r
Thomas	Gray	01/09/1523	28/01/1523	Holy Trinity, King's Court	Cook	Parish Church	P.R.9, f.275r
Thomas	Knaton	04/09/1528	29/10/1528	Holy Trinity, King's Court	Butcher	Parish Church	P.R.9, f.412v
Nicolas	Malland	16/04/1521	21/05/1522	Holy Trinity, King's Court	-	Parish Church	P.R.9, f.224r
Margery	Sloothman	25/05/1527	20/08/1527	Holy Trinity, King's Court	Widow	Parish Church	P.R.9, f.374r
Richarde	Thomson	05/09/1523	20/02/1523	Holy Trinity, King's Court	Butcher	Parish Church	P.R.9, f.275v
Thomas	Tone/Toone	04/10/1524	06/03/1524	Holy Trinity, King's Court	Butcher	Parish Church	P.R.9, f.303r
Thomas	Tone/Toone	16/01/1524	06/03/1524	Holy Trinity, King's Court	Butcher	Parish Church	P.R.9, f.328v (codicil)
Thomas	Wright	20/12/1527	03/03/1528	Holy Trinity, King's Court	-	Parish Church	P.R.9, f.392v
Thomas	Threpeland	12/06/1529	28/06/1529	Holy Trinity, King's Court	Priest	Parish Church	Ab.R.27, f.164v-165r
John	Mason	06/09/1537	23/09/1537	Holy Trinity, Micklegate	Glover	Parish Church	P.R.11, f.250v
William	Plewman	31/10/1539	05/12/1539	Holy Trinity, Micklegate	Miller	Parish Church	P.R.11, f.402v
Richarde	Gibson	26/01/1539	20/02/1539	Holy Trinity, Micklegate	Cordwainer	Parish Church	P.R.11, f.407r
Peter	Jacson	01/11/1531	20/01/1531	-	-	-	P.R.11, f.1r
Henry	Holme	09/04/1534	04/05/1534	St. Crux	-	Parish Church	P.R.11, f.98r
John	Williamson	07/08/1520	30/10/1520	St. Crux	Tailor	Parish Church	P.R.9, f.120v
Agnes	Bell	13/12/1530	07/01/1530	St. Crux	-	Parish Church	P.R.10, f.16r
George	Atkryke	17/01/1535	16/02/1535	St. Crux	Merchant	Parish Church	P.R.11, f.178r
Cristofer	Banke	02/12/1536	22/01/1536	St. Crux	Baker	Parish Church	P.R.11, f.214v
William	Paycoke	04/03/1535	01/02/1536	St. Crux	Fisher	Parish Church	P.R.11, f.216v
Herry	Sanderson	17/07/1539	08/08/1539	St. Crux	Cook	Parish Church	P.R.11, f.378v-379r
John	Shawe	05/02/1537	18/02/1537	St. Crux	Merchant	Parish Church	P.R.11, f.276r
Mawde	Shawe	08/12/1532	11/02/1537	St. Crux	Widow	Parish Church	P.R.11, f.278v
Richard	Smythe	06/06/1531	07/06/1533	St. Crux	Cordwainer	Parish Church	P.R.11, f.81v
Peter	Ledale	22/02/1540	12/07/1541	St. Crux	Baker	Parish Church	P.R.11, f.774v-776r
Roberte	Lulley	10/09/1537	19/10/1537	St. Crux	Tailor	Parish Church	P.R.11, f.259.2v
Edwarde	Barton	14/11/1528	26/02/1528	St. Crux	Goldsmith	Parish Church	P.R.9, f.437r

Agnes	Butterfeld	02/05/1522	25/06/1522	St. Crux	Widow	Parish Church	P.R.9, f.227r
John	Butterfeld	06/02/1520	18/03/1520	St. Crux	Innkeeper	Parish Church	P.R.9, f.138v
Thomas	Gilbanke	20/05/1522	04/10/1522	St. Crux	Armourer	Parish Church	P.R.9, f.239r
Hugh	Maxwell	08/03/1525	19/06/1526	St. Crux	-	Parish Church	P.R.9, f.341r
William	Rede	22/10/1522	16/09/1523	St. Crux	Merchant	Parish Church	P.R.9, f.262v
John	Weddell	26/11/1524	08/12/1524	St. Crux	-	Parish Church	P.R.9, f.296r
Thomas	Messenger	27/04/1531	10/05/1531	St. Denys	Miller	Parish Church	P.R.10, f.41r
William	Maltbye	16/06/1535	31/01/1535	St. Denys	Fisher	Parish Church	P.R.11, f.117r
John	Nicholson	18/01/1531	21/03/1531	St. Denys	-	Parish Church	P.R.11, f.6v
Roberte	Brere	26/05/1525	23/06/1525	St. Denys	-	Parish Church	P.R.9, f.314v
Janet	Bygyng	23/06/1522	19/08/1523	St. Denys	-	Parish Church	P.R.9, f.261r
Thomas	Chadwike	10/08/1528	27/10/1528	St. Denys	-	Holy Trinity, King's Court	P.R.9, f.418v
Roberte	Ledale	16/02/1521	24/10/1524	St. Denys	-	Parish Church	P.R.9, f.293r
Rauf	Nelson	30/08/1508	21/02/1520	St. Denys	-	Parish Church	P.R.9, f.133
Robert	Petie	29/05/1527	10/12/1528	St. Denys	Tappeter	Parish Church	P.R.9, f.420r
Roberte	Plaskett	25/11/1524	08/12/1524	St. Denys	-	Parish Church	P.R.9, f.295v
Adam	Silbarne	29/03/1529	28/07/1529	St. Denys	Tanner	Parish Church	P.R.9, f.447v
John	Sympson	29/05/1525	19/06/1525	St. Denys	-	Parish Church	P.R.9, f.313v
John	Willingham	17/06/1523	10/07/1523	St. Denys	-	Parish Church	P.R.9, f.256v
John	Bywell	12/11/1521	21/01/1521	St. Edward's	-	Parish Church	P.R.9, f.202r
William	Snar	11/04/1521	22/05/1521	St. George's	Priest	Parish Church	Ab.R.27, f.152v
Richard	Eshbie	12/01/1535	26/02/1535	St. Gregory's	Cordwainer	Parish Church	P.R.11, f.178v-179r
Henrie	Whittington	08/04/1538	20/05/1538	St. Gregory's	Tailor	Parish Church	P.R.11, f.292r
Emmott	Whittyngton	12/06/1538	--/09/1538	St. Gregory's	Widow	Parish Church	P.R.11, f.320v-321r
James	Garth	19/07/1532	12/09/1532	St. Helen's, Stonegate	Merchant	Parish Church	P.R.11, f.20r
Edmunde	Holme	04/02/1537	02/04/1538	St. Helen's, Stonegate	-	Parish Church	P.R.11, f.286r
Henry	Archer	18/03/1519	20/04/1520	St. Helen's, Stonegate	Scrivener	Parish Church	P.R.9, f.96v-97r
William	Cooke	22/05/1521	04/06/1521	St. Helen's, Stonegate	Founderer	Parish Church	P.R.9, f.158r
Isabell	Baiseburne	30/09/1521	08/11/1521	St. Helen's, Stonegate	Widow	Parish Church	P.R.9, f.190v
Giles	Slatter	04/10/1521	17/01/1521	St. Helen's, Stonegate	Furrier	Parish Church	P.R.9, f.201v
Michael	Wray	23/10/1526	03/11/1526	St. Helen's, Stonegate	-	Parish Church	P.R.9, f.353v-354r
Margaret	Stubbis	04/03/1530	09/03/1530	St. Helen's, Stonegate	Widow	St. Leonard's	D&C 2, f.157v-158r
John	Ustwayt	26/05/1539	24/09/1539	St. Helen's, Stonegate	-	Parish Church	D&C 2, f.183v
Richard	Wycliff	26/08/1535	11/09/1535	St. Helen's, Stonegate	-	Parish Church	D&C 2, f.174r
John	Mylner	17/07/1529	29/07/1529	St. John-del-Pyke	Telar	Parish Church	P.R.9, f.447
Robert	Johnson	13/02/1522	25/02/1522	St. John-del-Pyke	-	Parish Church	D&C 2, f.135r
Thomas	Pye	02/03/1535	06/03/1535	St. John-del-Pyke	-	Parish Church	D&C 2, f.177v
Herry	Smyth	06/01/1523	19/01/1524	St. John-del-Pyke	-	York Minster	D&C 2, f.138v
Richard	Troghton	--/--/1537	18/01/1537	St. John-del-Pyke	-	Parish Church	D&C 2, f.177r
William	Powell	05/01/1520	23/01/1520	St. John's, Hungate	-	Carmelite Friary	P.R.9, f.133v-134r
Cuthbert	Burkebeke	16/10/1530	20/01/1530	St. John's, Ouse Bridge End	-	Parish Church	P.R.10, f.19r-v
Thomas	Bek	08/01/1530	27/01/1530	St. John's, Ouse Bridge End	-	St. Nicholas' Church, Micklegate	P.R.10, f.21v
Christiane	Beke	26/07/1538	21/08/1538	St. John's, Ouse Bridge End	Widow	Parish Church	P.R.11, f.312r
Roberte	Braithwaite	22/11/1537	26/04/1538	St. John's, Ouse Bridge End	-	Parish Church	P.R.11, f.287v
Rauf	Karrell	10/09/1538	28/11/1538	St. John's, Ouse Bridge End	Cordwainer	Parish Church	P.R.11, f.404v
George	Ledaile	20/06/1536	30/07/1536	St. John's, Ouse Bridge End	-	Parish Church	P.R.11, f.199v
Bettesse	Lee	15/08/1538	06/11/1538	St. John's, Ouse Bridge End	Widow	Parish Church	P.R.11, f.323r
John	Lee	16/01/1532	11/02/1532	St. John's, Ouse Bridge End	-	Parish Church	P.R.11, f.38v
Isabell	Whitfeld	19/04/1534	17/08/1534	St. John's, Ouse Bridge End	Widow	Parish Church	P.R.11, f.105r
Gregorie	Woodall	14/03/1538	30/06/1539	St. John's, Ouse Bridge End	Priest	Parish Church	P.R.11, f.368v-369r
Agnes	Thornton	16/03/1539	11/02/1540	St. John's, Ouse Bridge End	Widow	Parish Church	P.R.11, f.491v
Bryan	Bradley	03/02/1527	03/03/1527	St. John's, Ouse Bridge End	Waxchandler	Parish Church	P.R.9, f.392r
Hugh	Holme	21/03/1520	14/02/1521	St. John's, Ouse Bridge End	-	Parish Church	P.R.9, f.208r
Henry	Mores	16/07/1529	30/07/1529	St. John's, Ouse Bridge End	-	Parish Church	P.R.9, f.448r
Thomas	Robynson	22/12/1528	31/07/1529	St. John's, Ouse Bridge End	Waxchandler	Parish Church	P.R.9, f.469v
Richard	Shereburne	16/09/1528	14/10/1528	St. John's, Ouse Bridge End	-	Parish Church	P.R.9, f.416v
Roberte	Stevynson	27/07/1521	31/01/1521	St. John's, Ouse Bridge End	Glover	Parish Church	P.R.9, f.355r
John	Thornton	10/08/1529	09/07/1530	St. John's, Ouse Bridge End	Merchant	Parish Church	P.R.9, f.464v-465r
Edward	Wayde	12/04/1520	07/11/1520	St. John's, Ouse Bridge End	Shoemaker	Parish Church	P.R.9, f.121r
Henrie	Wod	16/05/1526	25/05/1529	St. John's, Ouse Bridge End	Waxchandler	Parish Church	P.R.9, f.442r
Miles	Foster	07/07/1533	28/07/1533	St. Lawrence's	-	Parish Church	P.R.11, f.61r-v

Christopher	Feron	09/12/1521	24/01/1521	St. Lawrence's	Tanner	Parish Church	P.R.9, f.203v
Thomas	Garton	05/09/1521	31/01/1521	St. Lawrence's	-	Parish Church	P.R.9, f.203v
Thomas	Gookman	--/--/1530	20/02/1539	St. Lawrence's	-	-	D&C 2, f.185r
Thomas	Barton	21/05/1523	02/06/1523	St. Lawrence's	Priest	Parish Church	D&C 2, f.136r
Robert	Helmeslaye	01/03/1535	13/06/1536	St. Margaret's	-	Parish Church	P.R.11, f.195v-196r
Roger	Annytson	02/06/1526	31/07/1526	St. Margaret's	-	Parish Church	P.R.9, f.347r
Nicolas	Pullan	23/08/1522	22/10/1522	St. Margaret's	-	Parish Church	P.R.9, f.239v
Thomas	Rawling	05/10/1523	17/02/1523	St. Margaret's	-	Parish Church	P.R.9, f.276r
Thomas	Maison	07/06/1538	13/08/1538	St. Martin le Grand	Glover	Parish Church	P.R.11, f.313v
Margarete	Harbotell	03/02/1538	13/02/1537	St. Martin le Grand	Widow	Parish Church	P.R.11, f.275v
John	Harper	28/10/1539	22/11/1539	St. Martin le Grand	-	Parish Church	P.R.11, f.404v
Thomas	Jakson	24/03/1538	30/05/1539	St. Martin le Grand	Plumber	Parish Church	P.R.11, f.363r
James	Karlell	01/12/1538	19/12/1538	St. Martin le Grand	Draper	Parish Church	P.R.11, f.338v
Thomas	Londe	02/12/1533	23/01/1533	St. Martin le Grand	Saddler	Parish Church	P.R.11, f.68r
James	Blande	08/05/1523	17/09/1523	St. Martin le Grand	-	Parish Church	P.R.9, f.286r
Thomas	Drawswerde	28/01/1528	30/07/1529	St. Martin le Grand	-	Parish Church	P.R.9, f.448r
Roberte	Foumes	10/04/1520	20/04/1520	St. Martin le Grand	-	Parish Church	P.R.9, f.96r
Thomas	Hall	12/08/1522	22/10/1522	St. Martin le Grand	-	Parish Church	P.R.9, f.239v
William	Hogeson	--/--/1523	16/04/1524	St. Martin le Grand	Armourer	Parish Church	P.R.9, f.282v
Robert	Stayneburne	23/07/1525	19/09/1525	St. Martin le Grand	-	Parish Church	P.R.9, f.318r
William	Cokkes	17/09/1524	12/08/1527	St. Martin le Grand	Cordwainer	Parish Church	P.R.9, f.373v-374r
Elisabeth	Goldsmyth (Harman)	02/11/1534	15/11/----	St. Martin's, Micklegate	Widow	Parish Church	P.R.11, f.151r
William	Goldsmyth	04/07/1525	20/05/1534	St. Martin's, Micklegate	Vintner	Parish Church	P.R.11, f.99r
John	Lawrence	20/07/1538	30/10/1538	St. Martin's, Micklegate	Tell maker	Parish Church	P.R.11, f.327v
William	Pennyngton	23/10/1534	13/01/1534	St. Martin's, Micklegate	Innkeeper	Parish Church	P.R.11, f.156v
Robert	Wilkinson	19/04/1538	26/08/1538	St. Martin's, Micklegate	-	Parish Church	P.R.11, f.312r
Gilberte	Walron	24/09/1521	15/11/1521	St. Martin's, Micklegate	Innkeeper	Parish Church	P.R.9, f.192v
William	Nickson	12/01/1532	--/02/1532	St. Mary, Bishophill Senior	-	Parish Church	P.R.11, f.20v & f.28v (copy)
John	Goodyere	28/03/1520	04/08/1520	St. Mary, Bishophill Senior	-	Parish Church	P.R.9, f.109v
William	Goodyere	04/05/1522	20/06/1522	St. Mary, Bishophill Senior	-	Parish Church	P.R.9, f.227r
William	Morton	03/02/1522	21/02/1522	St. Mary, Bishophill Senior	-	Parish Church	P.R.9, f.248r
Thomas	Michelson	05/11/1532	20/01/1532	St. Mary's, Castlegate	-	Parish Church	P.R.11, f.36v
William	Foxgale	02/09/1522	08/05/1523	St. Mary's, Castlegate	-	St. Michael's, Spurriergate	P.R.9, f.253r
Richarde	Halidaye	01/08/1521	22/11/1521	St. Mary's, Castlegate	-	Parish Church	P.R.9, f.184r
John	Marshall	15/12/1524	31/01/1526	St. Mary's, Castlegate	Merchant	Parish Church	P.R.9, f.357v
Antony	Welburne	17/08/1524	02/01/1524	St. Mary's, Castlegate	-	Parish Church	P.R.9, f.295v
Elisabeth	Welburne	15/01/1525	06/07/1526	St. Mary's, Castlegate	-	Parish Church	P.R.9, f.342v
William	Awger	02/01/1533	21/01/1533	St. Maurice's	-	Parish Church	P.R.11, f.67v
William	Meltonby	17/08/1523	16/09/1523	St. Maurice's	-	Parish Church	P.R.9, f.262v
John	Robynson	16/05/1521	07/07/1521	St. Maurice's	-	Parish Church	P.R.9, f.157v
Lancelote	Wharton	06/05/1523	05/07/1523	St. Maurice's	-	Parish Church	P.R.9, f.267r
Elesabeth	Langton	12/06/1538	22/06/1538	St. Maurice's	-	Parish Church	D&C 2, f.178r
Christofer	Beilby	09/12/1523	04/02/1523	St. Michael le Belfrey	-	Parish Church	P.R.9, f.276r
Paule	Gillour	15/07/1522	28/11/1522	St. Michael le Belfrey	-	Parish Church	P.R.9, f.283v
William	Barton	24/06/1528	07/08/1528	St. Michael le Belfrey	Husbandman	Parish Church	D&C 2, f.148r
Nicholas	Burton	09/12/1524	28/05/1528	St. Michael le Belfrey	-	Parish Church	D&C 2, f.147v
Robert	Drape	06/05/1540	--/08/1540	St. Michael le Belfrey	Baker	Parish Church	D&C 2, f.186v-187r
George	Evers	19/11/1520	03/12/1520	St. Michael le Belfrey	Notary	Parish Church	D&C 2, f.124r-125r
Robert	Fons	01/05/1536	26/06/1536	St. Michael le Belfrey	-	York Minster	D&C 2, f.174v-175v
Jamys	Hall	08/11/1518	04/12/1538	St. Michael le Belfrey	Fletcher	Parish Church	D&C 2, f.181v
Christofer	Horner	12/02/1522	09/04/1523	St. Michael le Belfrey	Mason	Parish Church	D&C 2, f.135v
John	Marshall(2)	04/11/1529	13/11/1529	St. Michael le Belfrey	Horner	Parish Church	D&C 2, f.154r-v
Thomas	Mason (Baxter)	02/03/1526	12/06/1529	St. Michael le Belfrey	Baker	York Minster	D&C 2, f.151v-152r
Robert	Morley	25/04/1522	30/05/1522	St. Michael le Belfrey	Barber	Parish Church	D&C 2, f.130v-131r
John	Nicolson	18/12/1537	23/01/1537	St. Michael le Belfrey	-	Parish Church	D&C 2, f.177v
Johanna	Norrane	26/01/1522	--/02/1522	St. Michael le Belfrey	-	Parish Church	D&C 2, f.135r-v
Richard	Norton	15/12/1522	18/12/1522	St. Michael le Belfrey	Baxter	Parish Church	D&C 2, f.133r-v
Robert	Pereson	-	04/12/1529	St. Michael le Belfrey	-	Parish Church	D&C 2, f.154v-155r
John	Rayncoke	16/04/1538	17/05/1539	St. Michael le Belfrey	Cordwainer	Parish Church	D&C 2, f.183r
Thomas	Spark	30/03/1540	10/09/1540	St. Michael le Belfrey	-	-	D&C 2, f.188r

John	Thomson	07/08/1520	17/08/1520	St. Michael le Belfrey	Merchant	Parish Church	D&C 2, f.123v
William	Thompson	11/04/1539	20/02/1539	St. Michael le Belfrey	Glasier	Parish Church	D&C 2, f.184v
Thomas	Water	05/09/1539	30/01/1539	St. Michael le Belfrey	Soldier & notary	York Minster	D&C 2, f.188v-190r
Alice	Wattirton	17/09/1528	28/09/1528	St. Michael le Belfrey	Widow	York Minster	D&C 2, f.148r-v
Isabell	Wild	15/02/1540	20/10/1541	St. Michael le Belfrey	Widow	Parish Church	D&C 2, f.200v
Roberte	Wilde	28/11/1532	16/05/1533	St. Michael le Belfrey	Merchant	-	D&C 2, f.165v
William	Wright	-	09/01/1522	St. Michael le Belfrey	Notary	Parish Church	D&C 2, f.134v
Rauf	Pullan	11/02/1539	05/03/1540	St. Michael le Belfrey	Goldsmith	Parish Church	P.R.11, f.529r-v
John	Metcalf	02/10/1530	27/01/1530	St. Michael's, Spurriergate	Merchant	Parish Church	P.R.10, f.20r-v
Richard	Baitman	24/09/1537	26/01/1537	St. Michael's, Spurriergate	Mariner	Parish Church	P.R.11, f.271r
John	Beisbey	23/07/1535	09/08/1535	St. Michael's, Spurriergate	-	Franciscan Friary	P.R.11, f.147r-148v
Thomas	Dawson (Bartrame)	29/08/1539	12/12/1539	St. Michael's, Spurriergate	Merchant	Parish Church	P.R.11, f.403r-v
Thomas	Glasyn	30/08/1531	11/04/1532	St. Michael's, Spurriergate	Capper	Parish Church	P.R.11, f.9r
Agnes	Hardsong	08/04/1538	20/05/1538	St. Michael's, Spurriergate	Widow	Parish Church	P.R.11, f.290v
John	Roger	27/12/1531	21/03/1531	St. Michael's, Spurriergate	Fishmonger	Parish Church	P.R.11, f.1v
Rauf	Swan	11/03/1537	19/03/1537	St. Michael's, Spurriergate	-	Parish Church	P.R.11, f.282r
Cicill	Swane	14/05/1540	09/03/1540	St. Michael's, Spurriergate	Widow	Parish Church	P.R.11, f.498r
William	Thikpenny	22/09/1539	10/01/1541	St. Michael's, Spurriergate	Fishmonger	Parish Church	P.R.11, f.586r
Thomas	Bankus	21/07/1521	18/10/1521	St. Michael's, Spurriergate	Draper	Parish Church	P.R.9, f.195v
Alicie	Blakay	13/08/1525	11/09/1526	St. Michael's, Spurriergate	Capper & widow	Parish Church	P.R.9, f.355r
Hugh	Bunting	17/07/1522	09/07/1530	St. Michael's, Spurriergate	Fletcher	Parish Church	P.R.9, f.474v-475r
Thurstane	Luge	02/07/1527	15/10/1528	St. Michael's, Spurriergate	Barber	Parish Church	P.R.9, f.416v
John	Gelder	06/01/1533	05/02/1533	St. Michael's, Spurriergate	-	Parish Church	P.R.11, f.83v
Richarde	Nicolson	29/01/1526	08/02/1526	St. Michael's, Spurriergate	-	Parish Church	P.R.9, f.358r
Roland	Garthe	26/10/1528	13/09/----	St. Michael's, Spurriergate	Fishmonger	Parish Church	P.R.9, f.485v
William	Godson	24/01/1526	06/05/1527	St. Michael's, Spurriergate	Haberdasher	Parish Church	P.R.9, f.368r
George	Keld	20/09/1524	24/10/1524	St. Michael's, Spurriergate	Surgeon & barber	Parish Church	P.R.9, f.293r
Brian	Lorde	16/10/1526	11/05/1527	St. Michael's, Spurriergate	Merchant	Parish Church	P.R.9, f.368v
Antony	Middleton	15/10/1519	20/06/1520	St. Michael's, Spurriergate	Merchant	Parish Church	P.R.9, f.107r-v
Thomas	Plaskett	03/08/1536	12/03/1536	Holy Trinity, Micklegate (St. Nicholas')	-	St. John's Church, Ouse Bridge End	P.R.11, f.219r
John	Lamaman	21/11/1532	16/06/1535	Holy Trinity, Micklegate (St. Nicholas')	-	Holy Trinity Priory	P.R.11, f.155v-156r
Katerine	Barker	16/06/1531	20/10/1531	Holy Trinity, Micklegate (St. Nicholas')	Widow	Parish Church	P.R.10, f.80r-v
John	Dogeson	20/04/1531	22/05/1531	Holy Trinity, Micklegate (St. Nicholas')	-	Parish Church	P.R.10, f.47v
Janet	Cootes	18/11/1530	27/01/1530	Holy Trinity, Micklegate (St. Nicholas')	Widow	Parish Church	P.R.10, f.20v
Margret	Speghe	22/09/1532	31/01/1532	Holy Trinity, Micklegate (St. Nicholas')	Widow	Holy Trinity Priory	P.R.11, f.37r-v
Thomas	Mason	09/02/1528	09/04/1529	Holy Trinity, Micklegate (St. Nicholas')	-	Parish Church	P.R.9, f.435r
John	Moresby	04/01/1526	25/01/1526	Holy Trinity, Micklegate (St. Nicholas')	Tanner	Holy Trinity Priory	P.R.9, f.357r
Cristofer	Richardson	15/03/1527	26/03/1528	Holy Trinity, Micklegate (St. Nicholas')	Miller	Parish Church	P.R.9, f.394v
Kateryn	Smyth	06/06/1522	12/06/1522	Holy Trinity, Micklegate (St. Nicholas')	-	Parish Church	P.R.9, f.226v
Henry	Swynburne	12/07/1523	19/08/1523	Holy Trinity, Micklegate (St. Nicholas')	-	Parish Church	P.R.9, f.261v
James	Toller	28/03/1530	20/07/1530	Holy Trinity, Micklegate (St. Nicholas')	Smith	Parish Church	P.R.9, f.473v
John	Whitehede	25/01/1519	23/07/1521	Holy Trinity, Micklegate (St. Nicholas')	Woolman	Parish Church	P.R.9, f.166
Henry	Wright	01/05/1530	27/09/1531	Holy Trinity, Micklegate (St. Nicholas')	Plumber	Parish Church	P.R.10, f.73r-v
Richarde	Dicson	05/06/1522	05/12/1522	St. Olave's	Hatter	Parish church	P.R.9, f.241r
John	Asbe	13/07/1530	19/06/1531	St. Olave's	-	Parish Church	P.R.10, f.49v
Richard	Heslyngton	07/02/1530	--/--/1530	St. Olave's	-	Parish Church	P.R.10, f.24r
Richarde	Diatson	30/05/1534	07/05/1535	St. Olave's	Baker	Parish Church	P.R.11, f.130r
Issabell	Sparrie	26/04/1535	07/12/1535	St. Olave's	-	Parish Church	P.R.11, f.160v
Richarde	Turnor	23/05/1531	09/11/1534	St. Olave's	-	Parish Church	P.R.11, f.104v
Wiliam	Halton	08/02/1539	10/04/1540	St. Olave's	-	Parish Church	P.R.11, f.409v
Margaret	Turner	20/03/1531	10/11/1540	St. Olave's	Widow	-	P.R.11, f.465v
Edmunde	Warde	13/09/1540	04/06/1541	St. Olave's	-	Parish Church	P.R.11, f.536r
Richarde	Benson	16/11/1522	20/02/1522	St. Olave's	Smith	Parish Church	P.R.9, f.256v
Thomas	Buttrie	13/05/1530	30/06/1530	St. Olave's	-	Parish Church	P.R.9, f.476r
Isabell	Hall	10/03/1523	16/03/1523	St. Olave's	Widow	Parish Church	P.R.9, f.280r
Richarde	Jacson	21/09/1525	03/10/1525	St. Olave's	-	Parish Church	P.R.9, f.322v
Henry	Lame	28/02/1520	20/03/1521	St. Olave's	Husbandman	Parish Church	P.R.9, f.141v
Thomas	Brax	16/01/1534	19/08/1535	St. Peter the Little	Baker	Parish Church	P.R.11, f.158v
John	Richardeson	26/09/1538	01/10/1538	St. Peter-le-Willows	-	Parish Church	P.R.11, f.321v

Richard	Paulyng	31/05/1530	04/07/1530	St. Peter-le-Willows	Tanner	Parish Church	P.R.9, f.475r
Margarete	Symson	28/12/1526	29/04/1527	St. Peter-le-Willows	-	Parish Church	P.R.9, f.367v
Thomas	Awkelande	18/07/1538	25/10/1538	St. Sampson's	Weaver	Parish Church	P.R.11, f.332r
Thomas	Heton	22/05/1539	13/11/1539	St. Sampson's	Miller	Parish Church	P.R.11, f.387r
Robert	Johnson	12/08/1540	09/03/1540	St. Sampson's	-	Parish Church	P.R.11, f.505v
John	Rasyng	04/09/1527	22/11/1527	St. Sampson's	Merchant	Parish Church	P.R.9, f.383r-v
Katherine	Turdoff	21/07/1525	07/08/1525	St. Sampson's	Widow	Parish Church	P.R.9, f.317r
William	Turdoffe	--/--/1520	31/03/1520	St. Sampson's	-	Parish Church	P.R.9, f.93r
Martin	Awnderson	26/10/1520	10/12/1520	St. Saviour's	Priest	Parish Church	Ab.R.27, f.151v
Thomas	Bennett	13/09/1520	18/03/1520	St. Wilfrid's	-	Parish Church	P.R.9, f.139v
Agnes	Bironte	17/02/1520	16/04/1521	St. Wilfrid's	Widow	Hospital of St. Leonard's	P.R.9, f.141r
Margarete	Heryngton	--/--/1523	20/07/1523	St. Wilfrid's	Widow	Carmelite Friary	P.R.9, f.257v
John	Smyth	10/08/1529	09/11/1529	St. William's Chapel	Priest	St. John's Church, Ouse Bridge End	D&C 2, f.154r
Robert	Thomson	27/09/1521	21/01/1521	Unspecified	Tanner	All Saints (unspecified)	P.R.9, f.202r
Thomas	Barton	09/03/1537	25/10/1538	Unspecified	-	St. Nicholas' Church, Micklegate	P.R.11, f.331v
John	Pulley	--/--/1530	07/11/1531	Unspecified	Clerk	-	P.R.10, f.94v
John	Chapman	04/03/1527	20/05/1531	Unspecified	Merchant	York Minster	P.R.10, f.52v-54v
John	Burton	11/08/1537	21/08/1537	Unspecified	-	York Minster	P.R.11, f.249r
John	Carter	15/03/1536	26/03/1537	Unspecified	-	St. Mary, Bishophill Senior	P.R.11, f.222v
William	Coca	20/01/1536	12/04/1537	Unspecified	Priest	Holy Trinity, Micklegate	P.R.11, f.225r-v
Henry	Cundall	26/03/1533	28/07/1533	Unspecified	Priest	-	P.R.11, f.49r
Nicholase	Dickson	09/07/1538	04/10/1538	Unspecified	-	Parish Church	P.R.11, f.331v
John	Easingwold	24/02/1526	29/07/1532	Unspecified	Fishmonger	Parish Church	P.R.11, f.15v
Cristofer	Fysher	17/09/1538	24/09/1538	Unspecified	Blacksmith	-	P.R.11, f.320-v
Henrie	Hamerton	04/08/1537	13/12/1537	Unspecified	-	St. Mary, Bishophill Senior	P.R.11, f.261v
John	Hooede	03/04/1536	10/04/1536	Unspecified	-	Parish church	P.R.11, f.183v
William	Hubanke	28/03/1538	29/04/1538	Unspecified	Tanner	Parish church	P.R.11, f.287r-v
Ketheryne	Kinge	02/05/1539	11/08/1539	Unspecified	Widow	Parish church	P.R.11, f.337v-378r
Thomas	Lame	18/03/1535	08/04/1536	Unspecified	Tailor	York Minster	P.R.11, f.185r
Robert	Lowder	28/02/1533	18/11/1533	Unspecified	-	St. Martin le Grand	P.R.11, f.64r
John	Lupton	24/11/1537	05/02/1537	Unspecified	Blacksmith	Parish Church	P.R.11, f.271v
Jane	Nelson	10/01/1533	21/05/1533	Unspecified	Widow	Holy Trinity Priory	P.R.11, f.57v
Agnes	Norman	09/01/1533	11/03/1533	Unspecified	Widow	Parish Church	P.R.11, f.68r
Richard	Pigott	13/06/1538	30/08/1538	Unspecified	-	St. Wilfrid's	P.R.11, f.309v
Agnes	Sadler	17/07/1535	23/09/1535	Unspecified	Widow	St. Sampson's	P.R.11, f.163v
Elizabeth	Shaw	16/05/1532	08/08/1532	Unspecified	Widow	-	P.R.11, f.15v
Jenet	Sparke	08/01/1533	29/01/1533	Unspecified	-	-	P.R.11, f.85r
Thomas	Balay	03/04/1540	03/06/1540	Unspecified	-	St. Margaret's	P.R.11, f.438v
John	Beilbie	21/12/1539	05/06/1540	Unspecified	Gentleman	St. Mary Bishopshill Senior	P.R.11, f.439r-v
Thomas	Staveley	03/02/1537	13/06/1538	Unspecified	-	-	P.R.11, f.297r
Rauf	Sympson	03/08/1538	26/09/1538	Unspecified	Alderman	Parish Church	P.R.11, f.321r
Thomas	Thornton	03/02/1531	26/02/1533	Unspecified	Merchant	-	P.R.11, f.65r
William	Thrusleyf	25/09/1536	20/03/1536	Unspecified	-	St. Denys	P.R.11, f.220r
Robert	Turner	14/01/1534	19/12/1537	Unspecified	Waxchandler	St. Helen Stonegate	P.R.11, f.267v
Richarde	Usburn	15/05/1538	12/07/1538	Unspecified	-	St. Olave's	P.R.11, f.310v
Brian	Hastings	02/08/1537	08/10/1540	Unspecified	Sheriff	St. Oswald's, Sandall	P.R.11, f.461r
Cristofer	Magege	11/09/1540	04/11/1540	Unspecified	Mariner	St. Michael's	P.R.11, f.469v
William	Shawe	06/07/1540	27/10/1540	Unspecified	-	St. Olave's	P.R.11, f.469r
Roberte	Asby	10/12/1520	04/01/1520	Unspecified	Yeoman	-	P.R.9, f.129r
John	Bakehus	01/08/1521	15/11/1521	Unspecified	Butcher	Parish Church	P.R.9, f.200r
John	Bishope	02/10/1527	09/03/1527	Unspecified	Baxter	Parish Church	P.R.9, f.385v
Robert	Body	04/08/1520	04/08/1520	Unspecified	Unspecified	Holy Trinity, King's Court	P.R.9, f.238v
Thomas	Burton	22/07/1525	13/11/1525	Unspecified	Alderman	-	P.R.9, f.326v-327r
Thomas	Constance	13/05/1527	30/03/1528	Unspecified	Unspecified	Augustinian Friary	P.R.9, f.394r-394v
Matthew	Cottes	08/08/1520	12/09/1520	Unspecified	Cordwainer	Holy Trinity Priory	P.R.9, f.114v-115r
William	Cure	18/12/1522	09/04/1523	Unspecified	Unspecified	York Minster	P.R.9, f.246r
Roberte	Dicconson	12/02/1519	27/03/1520	Unspecified	Merchant	Carmelite Friary, Scarborough	P.R.9, f.94v
Edon	Elwald	18/03/1523	07/04/1524	Unspecified	Widow	Parish Church	P.R.9, f.278r

Thomas	Ewre (Godsalve)	14/01/1528	09/04/1529	Unspecified	Waxchandler	York Minster	P.R.9, f.435v
Alexander	Foster	15/11/1520	16/12/1523	Unspecified	-	York Minster	P.R.9, f.271r
John	Gregges	18/07/1526	22/10/1526	Unspecified	Vintner	-	P.R.9, f.351r
Nicholes	Johnson	25/08/1521	15/12/1521	Unspecified	Roper	Parish Church	P.R.9, f.184r
Thomas	Johnson	24/12/1520	18/03/1520	Unspecified	-	Holy Trinity Priory	P.R.9, f.139v
Johannes	Laake	06/05/1527	16/08/1530	Unspecified	-	-	P.R.9, f.469r
Agnes	More	16/08/1521	15/11/1521	Unspecified	-	Dominican Priory	P.R.9, f.192v
William	Nelson	21/03/1524	12/04/1525	Unspecified	Gentleman	Holy Trinity Priory	P.R.9, f.305r-v
Cristofer	Payneter	18/01/1520	30/01/1520	Unspecified	Tailor	-	P.R.9, f.131v
John	Pikeryng	31/07/1521	15/11/1521	Unspecified	Tanner	Parish Church	P.R.9, f.192v
Alexander	Plompton	14/07/1521	15/11/1521	Unspecified	Miller	Parish Church	P.R.9, f.192r
Thomas	Rag	26/08/1522	22/10/1522	Unspecified	Corvesor	-	P.R.9, f.239v
Rauf	Raice	09/08/1522	04/11/1522	Unspecified	Cordwainer	-	P.R.9, f.240r
Herry	Shaw	03/04/1520	20/06/1520	Unspecified	Smith	Parish Church	P.R.9, f.107v
John	Symson	23/03/1522	08/05/1523	Unspecified	Tanner	-	P.R.9, f.253r
Isabell	Westby	--/--/1522	04/10/1522	Unspecified	Widow	Dominican Priory	P.R.9, f.236v
John	Barkar	29/07/1520	11/08/1520	Unspecified	Cordwainer	Parish Church	D&C 2, f.122r
John	Eden	03/02/1520	18/04/1521	Unspecified	-	York Minster	D&C 2, f.125v-126r
John	Greyn	23/11/1524	15/12/1524	Unspecified	Glover	-	D&C 2, f.139r-v
Christofer	Holme	21/04/1523	No probate	Unspecified	Notary	York Minster	D&C 2, f.179v-180r
William	Johnson	20/03/1530	19/05/1531	Unspecified	Capper	York Minster	D&C 2, f.158r
Thomas	Litstar	03/09/1528	03/10/1528	Unspecified	Hosier	Unspecified	D&C 2, f.149v
William	Rooche	18/07/1518	19/11/1521	Unspecified	-	York Minster	D&C 2, f.128v
Agnes	White	15/03/1528	18/03/1528	Unspecified	-	York Minster	D&C 2, f.150r-v
Thomas	Shawe	10/09/1516	18/08/1520	Unspecified	Guild Master	Unspecified	Ab.R.27, f.151v
Robert	Barra	04/10/1526	28/06/1527	Unspecified	Doctor by decree, canon & prebend	Unspecified	D&C 2, f.143v-144r
William	Burton	30/11/1520	05/12/1520	Unspecified	Clerk & vicar choral	York Minster	D&C 2, f.125r
William	Crosbye	24/05/1540	31/07/1540	Unspecified	Priest	York Minster	D&C 2, f.185v-186r
John	Fewlare	07/08/1530	17/08/1530	Unspecified	Priest	York Minster	D&C 2, f.156r-156v
Thomas	Forne	13/07/1533	12/11/1533	Unspecified	Priest	York Minster	D&C 2, f.167r-168v
Henrie	Gelsthop	29/06/1538	08/07/1538	Unspecified	Priest	York Minster	D&C 2, f.178v-179r
William	Grave	06/02/1520/1	25/02/1520/1	Unspecified	Priest	St. Saviour's	Ab.R.27, f.152r-v
John	Hertley	09/07/1529	06/08/1529	Unspecified	Priest	York Minster	D&C 2, f.163r-v
Brian	Higden	03/06/1539	05/05/1540	Unspecified	Dean of York Minster	York Minster	TNA, PRO, PROB 11/26 f.19
Henry	Jakson	01/07/1540	17/02/1540/1	Unspecified	Priest	St. Martin's	D&C 2, f.191v-192r
William	Melton	20/08/1528	19/08/1533	Unspecified	Chancellor of York Minster	-	D&C 2, f.166r-v
Willyam	Mertone	03/05/1540	28/08/1540	Unspecified	Priest	St. Crux	Ab.R.27, f.182r-v
John	Nosterfeld	20/03/1531/2	04/05/1532	Unspecified	Priest	York Minster	D&C 2, f.156r-v
Richard	Plummar	15/10/1524	15/02/1524/5	Unspecified	Priest	St. John's Church, Ouse Bridge End	D&C 2, f.138v-139r
John	Rayner	22/01/1540/1	24/01/1540/1	Unspecified	Priest	York Minster	D&C 2, f.190v-191r
Thomas	Seton	21/10/1522	19/12/1522	Unspecified	Priest	York Minster	D&C 2, f.133v & r
John	Sheffeld	19/11/1534	31/12/1534	Unspecified	Priest	-	D&C2, f.170v-172r
Peter	Sympson	06/08/1528	-	Unspecified	Priest	York Minster	D&C 2, f.151r
John	Usher	pre. 06/1526	19/06/1526	Unspecified	Priest	York Minster	D&C 2, f.141r
Richard	Wyat	08/07/1522	31/10/1522	Unspecified	Priest	Southwell Minster	Ab.R.27, f.159r-v

Appendix II: Supplementary Tables

Parish	Number of wills
All Saints, Fishergate	0
All Saints, North Street	7
All Saints, Pavement	10
All Saints, Peaseholme	0
Holy Trinity, Goodramgate	3
Holy Trinity, King's Court	17
Holy Trinity, Micklegate (St. Nicholas')	17
St. Andrew's, Andrewgate	0
St. Andrew's, Fishergate	0
St. Clement's	0
St. Crux's	19
St. Cuthbert's	0
St. Denys'	13
St. Edward's	1
St. George's	1
St. Giles'	0
St. Gregory's	3
St. Helen-on-the-Walls	0
St. Helen's, Fishergate	0
St. Helen's, Stonegate	10
St. John-del-Pyke	5
St. John's, Hungate	1
St. John's, Ouse Bridge End	20
St. Lawrence's	5
St. Margaret's	4
St. Martin le Grand	13
St. Martin's, Micklegate	6
St. Mary Bishophill Junior	0
St. Mary Bishophill Senior	4
St. Mary, Castlegate	6
St. Maurice's	5
St. Michael le Belfrey	26
St. Michael's, Spurriergate	21
St. Olave's	14
St. Peter-le-Willows	3
St. Peter the Little	1
St. Sampson's	6
St. Saviour's	1
St. Stephen's	0
St. Wilfrid's	3
Parish unspecified	92

Table 1: Number of surviving wills per York parish, 1520-1540.

Rank	Institution	In-degree
1	Carmelite Friary	99
2	Franciscan Friary	92
3	Augustinian Friary	91

4	Dominican Priory	89
5	York Minster	44
6	Guild of Corpus Christi	36
7	St. Michael le Belfrey	31
=8	Castle Prison	25
=8	St. Crux	25
=8	Holy Trinity, Micklegate (St. Nicholas')	25
11	St. Michael's, Spurriergate	24
12	St. John's, Ouse Bridge End	23
13	Hospital of St. Thomas the Martyr	21
=14	Holy Trinity Maisondieu	20
=14	Little Shambles Maisondieu	20
=14	Ouse Bridge Maisondieu	20
=14	St. Mary in the Horsefair Maisondieu	20
=14	Holy Trinity, King's Court	20
=19	Fetter Lane Maisondieu	19
=19	Hertergate/Castle Hill Maisondieu	19
=19	Monk Bridge Maisondieu	19
=19	Unknown Fossgate Maisondieu	19
=19	North Street Maisondieu	19
=19	Peter Lane Maisondieu	19
=19	Shoemaker's Hospital	19
=19	St. Andrewgate Maisondieu	19
=19	Stonebow Lane Maisondieu	19
=19	White Friar's Lane Maisondieu	19
29	St. Olave's	17
=30	St. Nicholas' Hospital	15
=30	St. Martin le Grand	15
32	St. Denys'	14
=33	Hospital of St. Katherine	12
=33	St. Helen's, Stonegate	12
=33	Civic Maisondieu	12
=36	Holy Trinity Priory	11
=36	Trinity Hospital (Guild of the Trinities)	11
=36	All Saints, Pavement	11
=39	Hospital of St. Loy	10
=39	Archbishop's Prison	10
=41	All Saints, North Street	9
=41	St. Mary Bishophill Senior	9
=43	Hospital of St. Helen	8
=43	St. Sampson's	8
=45	Hospital of St. Leonard's	7
=45	St. Mary's, Castlegate	7
=45	St. Martin's, Micklegate	7
=45	St. John-del-Pyke	7
=45	St. Margaret's	7
=50	Hospital of St. Anthony, Gillygate	6
=50	Hospital of St. Mary Magdalen	6
=50	St. Anthony's Hospital, Peasholme Green	6
=50	St. Giles' Hospital	6
=50	Men's Kidcote	6
=50	Women's Kidcote	6
=50	St. Lawrence's	6
=50	St. Maurice's	6
=50	Kidcote (unspecified)	6

=59	Guild of St. Anthony	5
=59	Guild of St. Christopher and St. George	5
=59	Guild of St. John	5
=59	St. Peter-le-Willows	5
=63	Guild of St. Christopher	4
=63	Holy Trinity, Goodramgate	4
=63	Guild of cordwainers	4
=63	Fishergate Hospital (Hospital of St. Helen)	4
=63	St. William's College	4
=63	Clementhorpe Nunnery	4
=63	St. Wilfrid's	4
=70	St. Saviour's	3
=70	St. Gregory's	3
=70	St. Mary's Abbey	3
=70	Bidcote Prison	3
=70	St. William's Chapel	3
=75	Guild of the Trinities	2
=75	St. Peter the Little	2
=75	Guild of butchers	2
=75	Guild of fishmongers	2
=79	The Clee	1
=79	Guild of the Weavers	1
=79	St. Andrew's, Fishergate	1
=79	Guild of St. Anne	1
=79	St. Christopher's Guild Chapel and Maisondieu	1
=79	St. Edward's	1
=79	St. George's	1
=79	St. Leonard's	1
=79	St. John's, Hungate	1
=79	The Common Chamber	1
=79	Guild of Bakers	1
=79	St. Anthony's Hall (chapel)	1
=79	Guild of blacksmiths	1
=79	All Saints, Unspecified	1
=79	House of Saint Robert	1
=79	Guild of barbers	1
=79	Guild of ropers	1

Table 2: York-based institutions ordered by in-degree score in the bipartite base network.

Id	In-degree	Parish and dates (for clergy)
Sir Laurence Hall	25	St. Michael le Belfry, parochial chaplain, c.1520-1548
Sir Thomas Ovington	18	St. Martin le Grand, vicar, 1515-1551
Sir John Stapleton	15	Holy Trinity, King's Court, rector, 1535-c.1544
William Bachelor	14	NA
Sir George Richardson	13	All Saints Pavement, rector, 1509/10-c.1535
Sir John Simpson ¹	13	Holy Trinity Micklegate (St. Nicholas'), curate, 1524/5-c.1538
Sir John Stevenson	13	St. John's, Ousebridge End, parochial chaplain, 1525-1537
Sir Thomas Worrell	12	St. Mary's Castlegate, cantarist, poss. 1524, 1528-1533; possible connection to St. Michael's, Spurriergate, 1526, 1550
Sir Richard Wilkinson	11	St. Olave's, curate, 1530-1550
Sir Thomas Tailor	11	Holy Trinity, King's Court, cantarist, 1526-1529; vicar, 1529-1535
Sir William Buckbarrow	11	St. Margaret's, rector, 1515-1521; St. Denys', rector, 1521-c.1544
Sir William Merton	11	St. Crux, rector, 1516-c.1540

Christopher Clerk	10	NA
Christopher Conyers	9	NA
Peter Ledale	9	NA
Richard Williamson	9	NA
Sir Robert Jackson	9	St. Martin's, Micklegate, rector, 1519-1542
William Holme	9	NA
Bartholomew York ²	8	NA
Doctor Edward Kellett	8	York Minster, prebendary, 1524-1539; precentor, 1538-1539

Table 3: Top twenty scoring nodes by in-degree in directed, one-mode base network, with parish information for members of the clergy.

Sources: Cross, *City Wills*: Hall, pp. 44-45; Ovington, p. 7; Worrell, pp. 53-55; Buckbarrow, pp. 32-33; Merton, pp. 19-21; Jackson, p. 11. Webb, 'Census': Stapleton, p. 289; Richardson, pp. 286-87; Simpson, p. 288; Stevenson, p. 290; Tailor, p. 290. H. E. C. Stapleton, *The History of St. Olave's Church, York* (York: St. Olave's Parochial Church Council, 2002); Wilkinson, p. 15. Cross, *Minster Wills*: Kellett, p. 38.

Node	Betweenness score	Degree rank
Sir Laurence Hall	0.073397	32
John Rasing	0.059187	22
John Shaw ¹	0.058261	2
Sir William Merton	0.057818	3
Sir John Stapleton	0.057519	112
John Chapman ¹	0.057394	7
Sir John Sheffield	0.052243	1
John Norman ¹	0.041829	29
William Harrington	0.041363	20
Thomas Water	0.040142	35
Peter Ledale	0.038277	15
John Thornton ¹	0.038119	35
Sir George Richardson	0.036127	129
John Barnes ¹	0.035642	12
Sir Thomas Ovington	0.03401	68
Peter Jackson ¹	0.033764	35
Christopher Conyers	0.033741	227
Leonard Shaw	0.033661	6
Thomas Dawson ¹	0.033545	26
William Nelson ¹	0.033138	12

Table 4: Top twenty scoring nodes in the one-mode base network in descending betweenness score, with their degree ranks.

Implicit familial relationships added	Implicit non-familial relationships added
Parental (usually mother-child)	Co-witness
Sibling - sibling	Co-executor
Sibling-in-law - sibling-in-law	Co-supervisor
Step-sibling - step-sibling	Testator's spouse - parish priest
Grandparent - grandchild	Testator's spouse - parish church
Parent-in-law - daughter-/son-in-law	Testator's spouse - apprentice
Step-parent - step-child	Testator's spouse - named servant
Aunt (and great aunt) - niece/nephew	Testator's spouse - named neighbour

Uncle (and great uncle) - niece/nephew	Godparent - godchild
Cousin - cousin	Godparent - testator's spouse
Cousin-by-marriage - cousin-by-marriage	Tutor - tutee
	Guardian - ward
	Co-servant (where each named)
	Co-coffin bearer (where each named)
	Colleague - colleague (usually clergy)

Table 5: Types of implicit connection derived from the wills and used to generate new edges in the implicit network.

Rank	Node	Degree	
1	Sir Laurence Hall	82	↑57
2	Sir William Merton	77	↑27
3	Sir John Sheffield	62	↑2
4	John Shaw ¹	60	↑9
5=	Sir John Stapleton	55	↑40
5=	Peter Ledale	55	↑19
7	Sir Thomas Ovington	53	↑35
8	Elisabeth Shaw	50	↑1
9	William Harrington	49	↑18
10=	Dean Brian Higden	48	↑8
10=	Maude Shaw	48	↑9
12=	John Barnes ¹	45	↑8
12=	John Chapman ¹	45	↑5
12=	Leonard Shaw	45	↑4
15=	William Bachelor	43	↑29
15=	Henry Chambers	43	-
17=	Sir Thomas Forne	42	↑6
17=	William Cure	42	↑3
19=	Sir Richard Wilkinson	41	↑30
19=	Thomas Mason ¹	41	↑17
21=	Sir Thomas Worrell	39	↑27
21=	Anthony Middleton ¹	39	-
23=	Sir John Stevenson	37	↑24
23=	Peter Jackson ¹	37	↑13
23=	Sir William Buckbarrow	37	↑26
23=	John Thornton ¹	37	↑13
23=	Thomas Dawson ¹	37	↑9
23=	William Nelson ¹	37	-
23=	Sir Gregory Woodall	37	-
30	Sir William Simpson	36	↑2
31	Sir Richard Oliver	35	↑6
32=	Sir George Richardson	34	↑21
32=	Richard Hutchinson	34	↑5
32=	Alice Blakey ¹	34	-
35	Sir Henry Gelstrop	33	↑15
36=	Sir John Simpson ¹	32	↑19
36=	John Rasing	32	↑3
36=	Sir John Watson	32	↑26
36=	Paul Gillour	32	-
36=	Robert Johnson ²	32	↑6
41=	William Holme	31	↑22
41=	Christopher Conyers	31	↑22

41=	John Mason ²	31	↑4
41=	Sir Thomas Tailor	31	↑20
41=	Henry Dawson	31	↑8
41=	Sir John Rayner	31	-
41=	Agnes Norman	31	↑7
41=	Agnes Thornton	31	↑10
49=	Sir Robert Jackson	30	↑21
49=	Christopher Clerk	30	↑20
49=	Peter Gilliott	30	-
49=	Thomas Thornton	30	↑12
49=	Ralph Simpson	30	↑8

Table 6: Top fifty nodes by degree in the implicit network; the numbered arrows show by how much the degree score has increased.

Parish	Guild	Co-membership	Dates	Edge inferred
Belfrey	Corpus Christi	William Wright ¹ & Robert Fons	1522, 1536	No
St. Crux	Corpus Christi	Maude Shaw & Sir William Merton	1532, 1540	Yes
St. Crux	Trinities	Leonard Shaw & John Shaw ¹	1532, 1537	Yes

Table 7: Guild co-memberships and resulting edges.

Group	Includes	Edge-weight	Variant edge-weight	Strength category
A	Prisoners	0	-	Weak
	The poor		-	
	Friaries		-	
	Religious institutions (excl. York churches)		-	
	Charitable institutions		-	
	York Minster		-	
	Vicars Choral (collective)		-	
B	Tenant	1	0	Weak
	Named person (no bequest, role, or relationship)		0	
	Business acquaintance		0	
	Co-parish		-	
	Guild (occupation)		0	
	York parish priest (unnamed)		-	
	Parish (obligatory/burial, spouse)		0	
C	Great-niece/nephew-in-law	2	0	Weak
	Servant (collective)		1	
	Servant (of someone else)		0	
	Co-witness		1	
	Civic (fellow 24, alderman, co-mayor)		-	
	Fraternities/guild (religious)		1	
	Named clergyman (no bequest)		0	
	Employer of their child		1	
	Church of employment		0	
	Shared surname (no bequest)		0	
	York church (non-parish)		-	
D	Parish church (additional bequest)	3	0	Intermediate
	Kinsperson		1	
	Servant (singular/of spouse)		1	
	Bequest (relationship unspecified, different surname)		0	
	Named priest (bequest)		0	
	Co-servant		-	
			-	

E	Future sibling-in-law		1	Intermediate
	Church of employment (plus bequest)		0	
	Step-cousin		0	
	Apprentice	4	2	
	Cousin		1	
	Step-sibling		2	
	Sibling-in-law		2	
	Burial location (non-parish)		-	
	Co-guardians		2	
	Future parent-in-law		2	
	Co-supervisor		1	
	Bequest (relationship unspecified, shared surname/known relation)		2	
	Bequest (named as 'brother' in will, but unlikely to be biological)		2	
	Aunt/Uncle-by-marriage/step-uncle		1	
F	Step-parent	5	2	Intermediate
	Parent-in-law		2	
	Daughter/son-in-law		2	
	Witness (no bequest)		3	
	Great-great-aunt		1	
G	Received residue of estate	6	1	Strong
	Guardian/ward		2	
	Deceased parent		-	
	Deceased child		-	
	Witness (with bequest)		-	
	Step-child		2	
	Deceased spouse		-	
	Betrothed		3	
	Co-executor		2	
	Employer/colleague		-	
H	Godparent/child		2	Strong
	Great-niece/nephew		2	
	Supervisor	7	3	
	Overseer		3	
	Grandparent		3	
	Grandchild		3	
	Aunt/Uncle		2	
	Niece/Nephew		2	
	Executor	8	3	
	Sibling		3	
I	Parent		3	Strong
	Child		5	
	Reciprocal mention		-	
	Spouse	9	4	
	Parent		3	
J	Child		5	Strong

Table 8: Edge weighting groups with variants for geographical distance.

Betweenness

Name	Base rank	Inferred rank	Base score	Inferred score
Maude Shaw	11	29 ↓18	0.126214	0.666776 ↑
Elisabeth Shaw	14	19 ↓5	0.09531	0.525978 ↑
Agnes Bell	19	257 ↓238	0.063961	0.023293 ↓
Agnes Butterfield	33	39 ↓6	0.034357	0.025511 ↓
Alice Waterton	43	68 ↓25	0.027604	0.019957 ↓

Joan Norham	49	184	↓135	0.022221	0.017223	↓
Barbara Barton	74	50	↑24	0.001599	0.073436	↑
Janet Smith	77	153	↓76	0.000966	0.247087	↑
Jane Atkirk	78	177	↓99	0.000926	0.169295	↑

Eigenvector

Name	Base rank	Inferred rank		Base score	Inferred score	
Maude Shaw	3	9	↓6	0.894068	0.666776	↓
Elisabeth Shaw	2	14	↓12	0.905106	0.525977	↓
Agnes Bell	162	363	↓201	0.0694	0.023293	↓
Agnes Butterfield	188	348	↓160	0.058522	0.025511	↓
Alice Waterton	161	390	↓229	0.069695	0.019958	↓
Joan Norham	225	450	↓225	0.047127	0.017223	↓
Barbara Barton	305	223	↑82	0.025481	0.073436	↑
Janet Smith	80	58	↑22	0.090136	0.247087	↑
Jane Atkirk	55	134	↓80	0.095539	0.169295	↑

Table 9: Betweenness and eigenvector scores and rankings in the base and inferred networks for female nodes with a betweenness score in the base network; the arrows show the change to their ranking in each network version and whether their scores have increased or decreased.

Appendix III: Supplementary Figures

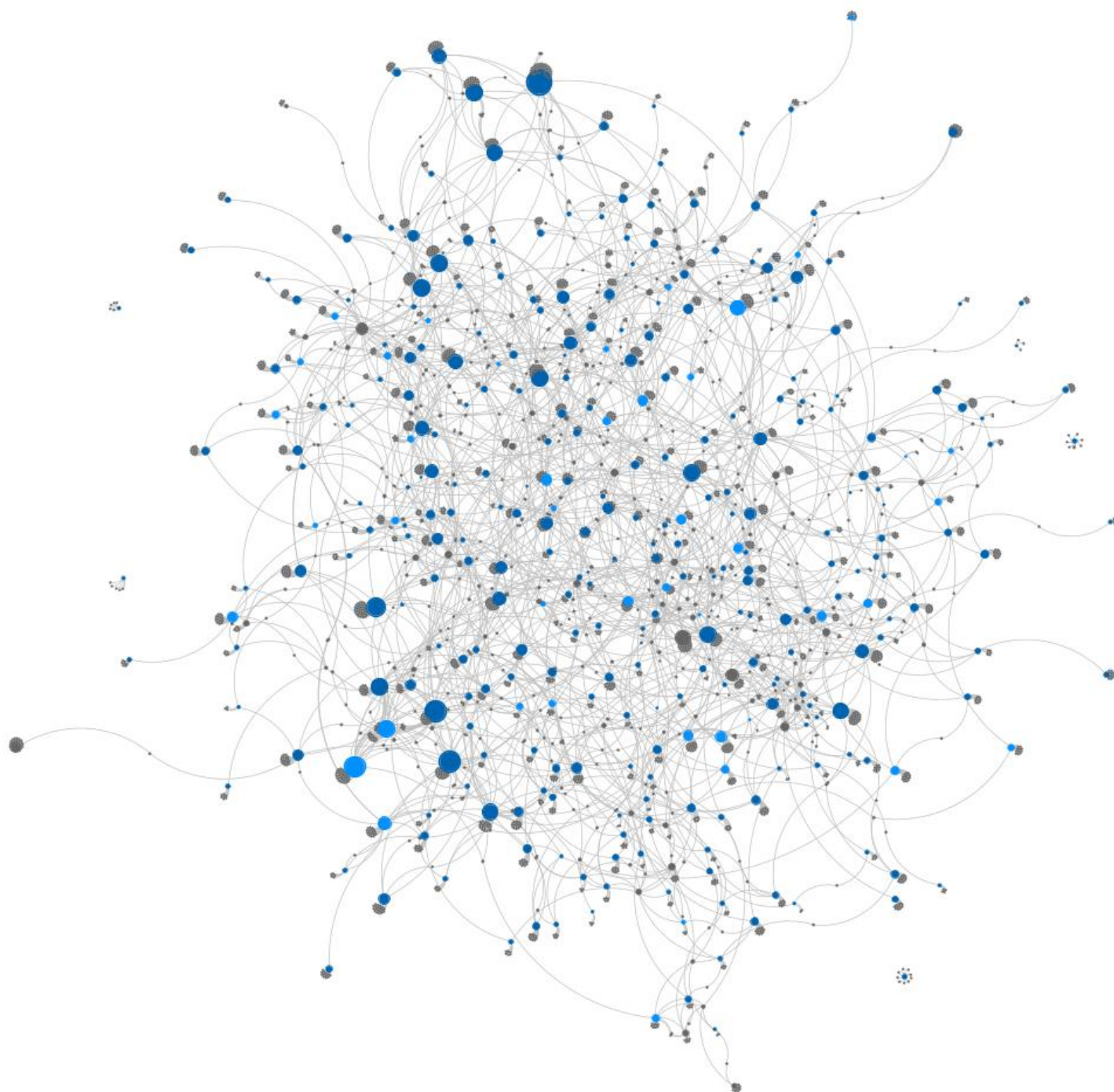
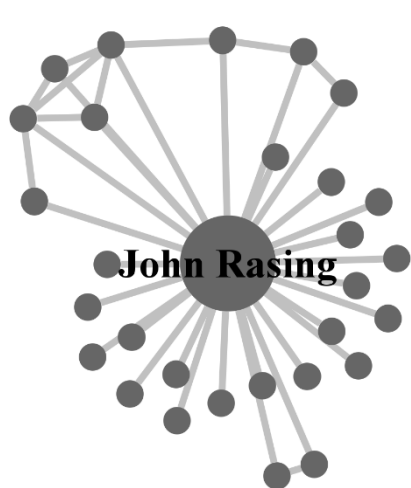
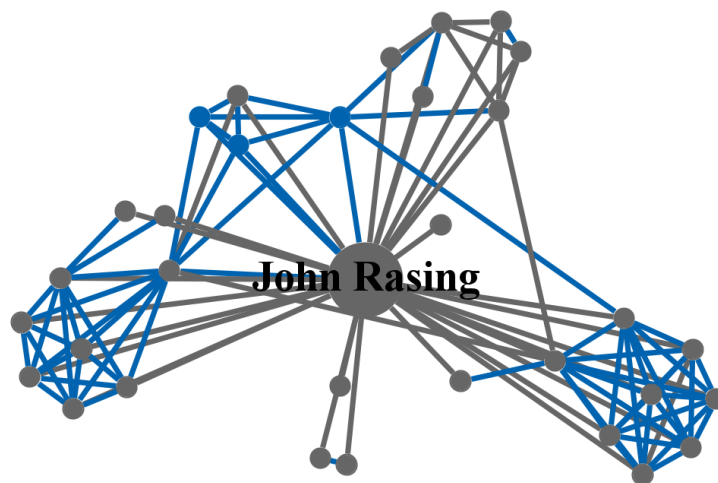


Figure 1: Curved line visualisation of base one-mode network; male testators are shown in dark blue, female testators in light blue, and nodes are sized according to degree, with larger nodes signifying higher degree scores.

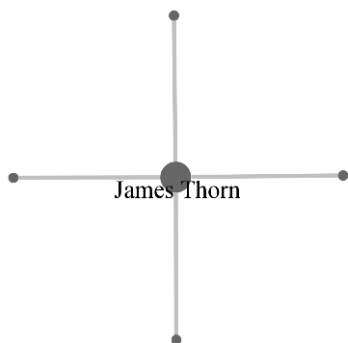


a.)

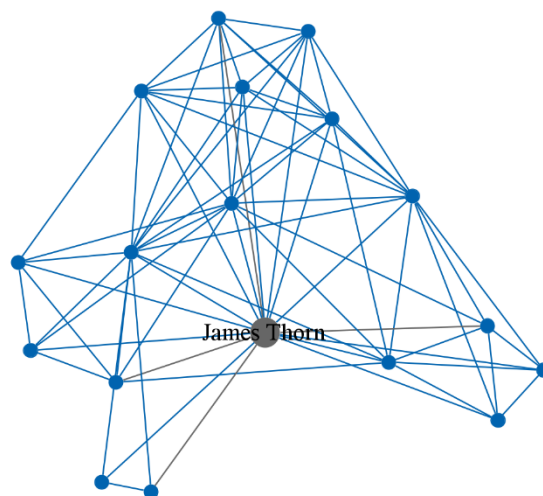


b.)

Figure 2: Ego networks at one-depth for John Rasing in a) base and b) implicit networks; new edges and nodes are shown in blue. Note the dense clusters of implicit edges around some alters.



a.)



b.)

Figure 3: James Thorn's ego network at one-depth in a) base and b) implicit networks.

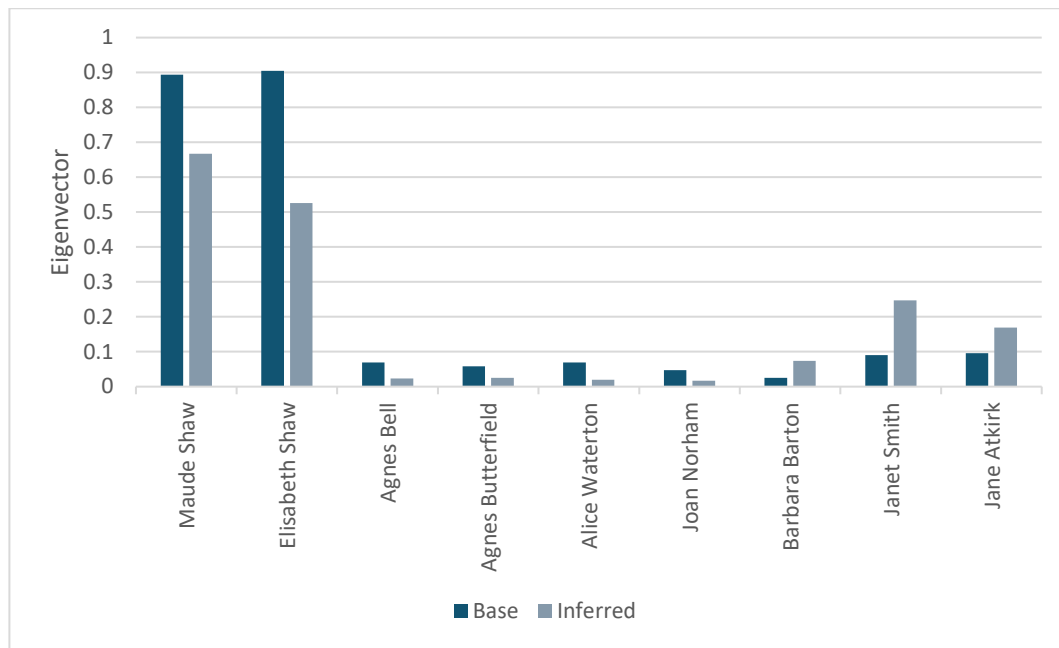


Figure 4: Female eigenvector scores in the base and inferred networks, showing only those women who had a betweenness score in the base network.

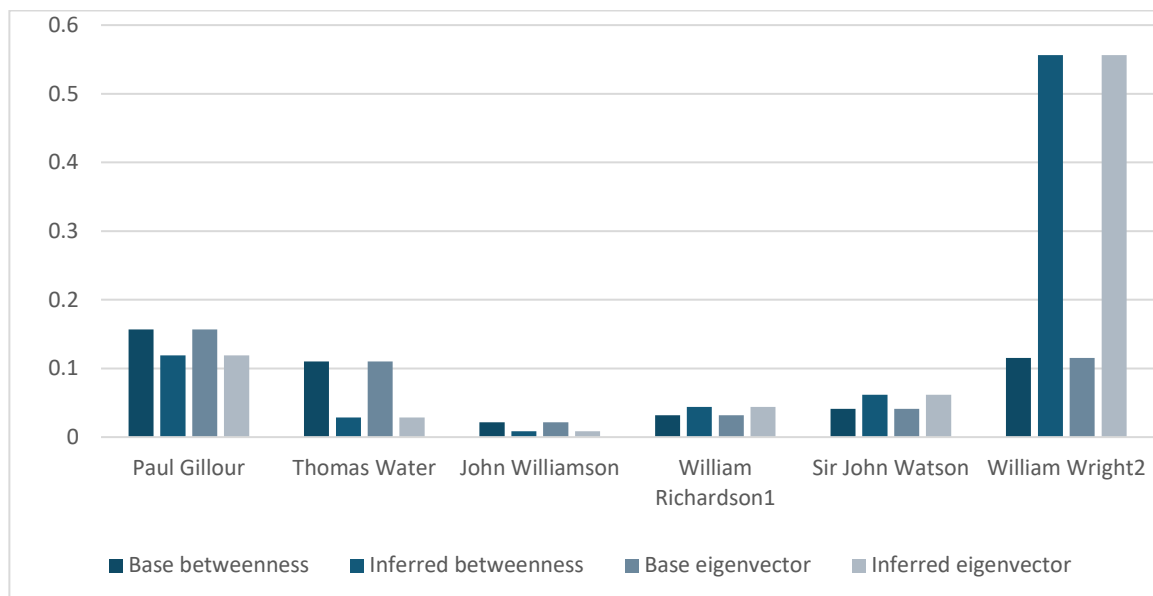


Figure 5: Base and inferred betweenness and eigenvector score comparison showing correlating increases and decreases for linking nodes.

Appendix IV: Dataset Extract

Testator: John Asbe

ID	Ref.	Will dated	Probate	Testator	Sex	Parish	Occupation	Burial place	Clergy
1	10, f.49v	13/07/1530	19/06/1531	John Asbe	Male	St. Olave's	Unspecified	St. Olave's	No

Bequest 1	Purpose	Additional purpose	Details	Value
Money	Forgotten tithes	NA	NA	12d.

Legatee 1	Relationship to testator	Sex	Occupation	Category of legatee	Location	Latitude	Longitude
St. Olave's Church	Parish church	NA	NA	Religious institution	St. Olave's Church	53.96316485	-1.088762284

Bequest 2	Purpose	Additional purpose	Details	Value
Liturgical item	Liturgical	NA	Towel of linen cloth	Unspecified

Legatee 2	Relationship to testator	Sex	Occupation	Category of legatee	Location	Latitude	Longitude
St. Olave's Church	Parish church	NA	NA	Religious institution	St. Olave's Church	53.96316485	-1.088762284

Bequest 3	Purpose	Additional purpose	Details	Value
Clothing	NA	NA	Two jackets, two coats, two pairs of hose, a bonnet	Unspecified

Legatee 3	Relationship to testator	Sex	Occupation	Category of legatee	Location	Latitude	Longitude
William Clarke	Son	Male	Unspecified	Child	York city	Unknown	Unknown

Bequest 4	Purpose	Additional purpose	Details	Value
Residue of estate	NA	NA	NA	Unspecified

Legatee 4	Relationship to testator	Sex	Occupation	Category of legatee	Location	Latitude	Longitude
Elsabet Asbe	Wife	Female	Unspecified	Spouse	St. Olave's parish	Unknown	Unknown

Bequest 5	Purpose	Additional purpose	Details	Value
Residue of estate	NA	NA	NA	Unspecified

Legatee 5	Relationship to testator	Sex	Occupation	Category of legatee	Location	Latitude	Longitude
Annes Asbe	Daughter	Female	Unspecified	Child	Unspecified	Unknown	Unknown

Executor 1	Sex	Occupation	Relationship to testator
Elsabet Asbe	Female	Unspecified	Wife

Executor 2	Sex	Occupation	Relationship to testator
Annes Asbe	Female	Unspecified	Child

Supervisor 1	Sex	Occupation	Relationship to testator
No supervisor appointed	NA	NA	NA

Witness 1	Sex	Occupation	Relationship to testator
Richard Wilkynson	Male	Unspecified	Unspecified

Witness 2	Sex	Occupation	Relationship to testator
Richard Newton	Male	Unspecified	Unspecified

Witness 3	Sex	Occupation	Relationship to testator
William Dyttonson	Male	Unspecified	Unspecified

Appointed guardian	Guardian sex	Guardian occupation	Guardian relationship to testator	Ward	Ward sex	Relationship of ward to testator	Relationship of ward to guardian
No guardian appointed	NA	NA	NA	NA	NA	NA	NA

Additional name (no bequest)	Sex	Occupation	Relationship to testator
William Dyttonson	Male	Unspecified	Unspecified

Appendix V: Glossary of Key Terms

Affinal: an affinal connection is one that has come about through marriage (in this case usually in-laws and step-children/siblings).

Alter: a node's immediate connections, i.e. those directly connected to the node by an edge.

Average clustering co-efficient: an average of the clustering co-efficient for all nodes in the network (see Clustering co-efficient).

Average path length: the average of all shortest paths in a network.

Base network: a network consisting only of testator-legatee edges which are explicitly detailed in the wills.

Betweenness centrality: a measure of the number of times a node sits on the shortest path between all pairs of nodes in the network; the more often a particular node sits on the shortest path the higher its betweenness centrality.

Bipartite: a network containing nodes of more than one type, e.g. individuals and institutions.

Bridge: an edge which connects two parts of a network which would otherwise be unconnected; removal of the edge would cause the network to fragment (see also Cutpoint).

Clustering co-efficient: a measure of the extent to which nodes in a network cluster together i.e. how connected the network is. At node-level, a measure of how connected to one another an individual node's alters are.

Component: a group of nodes in a network which are disconnected from other nodes or groups.

Consanguinal: related by blood or a common ancestor, rather than by marriage.

Cutpoint: a node which connects two parts of a network which would otherwise be unconnected; removal of the node would cause the network to fragment (see also Bridge).

Degree: the total number of people or places to which a node is connected, either through mentions in a will of their own or that of someone else in the network.

Density: a measure which indicates what proportion of all possible edges in a network are present; thus, how densely connected the network is.

Directed: a network in which the direction of an edge is used, e.g. a connection *from* A to B rather than simply *between* A and B. Directional data is data for which a direction is provided or used.

Directional: (see Directed).

Edge: a connection between two nodes in a network; the alternative 'tie' is not generally used here.

Ego: the central node in an ego network.

Egocentric: the study of the networks of individuals. An egocentric study of York residents would involve the selection of certain individuals and an analysis of their networks rather than the inclusion of all residents.

Ego network: the alters around an individual node (ego) and (strictly) the connections between those alters.

Eigenvector centrality: a measure of a node's influence in a network based on how highly connected its alters are.

Executor: the person or people responsible for handling a deceased person's estate and carrying out any stipulations in his/her will. In the York wills executors are most often family members, usually a spouse alone or with named older children.

Force Atlas: a layout algorithm in Gephi which arranges networks for maximum legibility. Nodes which are more central to the network structure will appear closer together and more centrally within the visualisation. Nodes which are structurally peripheral will appear further apart and further from the centre of the visualisation.

Geodesic path: the shortest path between two nodes in a network, i.e. the path between the two nodes which contains the minimal number of edges.

Homophily: the tendency for people to form relationships with those who are similar to them, either in terms of status or value (e.g. beliefs).

Hub: a node in a network with a significantly higher degree than many or most other nodes in that network.

Implicit edge/connection: an edge between two people which is not explicit in the wills, but rather is an implicit connection derived through close-reading and/or additional sources.

Implicit network: the base network (testator-legatee edges) with implicit edges added.

In-degree: the number of times a node is mentioned in all wills (other than their own) in the dataset.

Inferred edge/connection: a probabilistic connection between two people on the basis of the strength of each of their relationships with a mutually connected third person.

Inferred network: the implicit network with inferred edges added.

Intransitive: a triad (i.e. a group of three people) in which A is connected to both B and C but there is no connection between B and C.

Network centrality: a range of measures used to determine how central a node is within a network and thus its structural significance.

Network diameter: the longest distance between any two nodes in a network, defined as the number of edges between the two nodes.

Node: an entity within a network, in this case an individual or institution.

Normalised: a betweenness score which is represented as a number between 0 and 1, used to allow for comparison of betweenness in networks of different sizes.

One-mode: a network in which all the nodes are of one type, i.e. all individuals or all institutions.

Out-degree: the number of individuals or institutions named in a person's will.

Path: a sequence of adjacent edges connecting any two nodes. Paths may be of varying length, the length being the number of edges making up the path; the shortest possible path length is therefore one.

Pendant: a node which is connected to a network by only one edge.

Reciprocal: an edge which, in a directed network, travels in both directions; in this case, instances in which two testators each name the other in their will.

Resident: anyone living within the selected geographical boundary for whom a will is made or proved between 1st January 1520 and 31st December 1540. No distinction is made between freemen/women (those included in the Freeman's Register); foreigners (those resident within the city but not registered as freemen - a majority of lesser craftsmen, traders, apprentices, the poor etc); or aliens (non-resident, and therefore unlikely to feature in the wills).

Robust: a network is robust if it remains intact (i.e. does not fragment) following the removal of key nodes.

Scale-free: the distribution of edges within a network such that most nodes have very few connections (low degree), with only a small number having many connections (high degree).

Shortest path: see Geodesic Path.

Small-world network: a network characterised by a high average clustering co-efficient and short path lengths.

Social Network Analysis (SNA): the study of social networks, with a particular focus on the connections between nodes (in this case people or places) in the network, through the use of analytic measures to investigate network-structure and the structural roles of particular nodes or categories of node.

Sociocentric: the study of all nodes and their edges within a particular group, and the network's aggregate structure (as opposed to an egocentric study which looks at the networks of particular individuals (egos)).

Structural equivalence: nodes in a network which occupy precisely the same structural position, i.e. the same edges with the same other nodes. Structural equivalence is extremely unlikely to occur in real-world data.

Structural similarity: nodes in a network which occupy a similar structural position to one another, but do not meet the definition of structural equivalence.

Supervisor: a person or persons appointed by the testator to oversee his/her executors and to hold them to account if they do not handle the estate as stipulated. In the York wills, where a supervisor is appointed, they are usually a trusted individual of relatively high status and generally non-familial.

Tie: see Edge.

Transitive triad: a triad (i.e. a group of three people) in which A is connected to both B and C and B and C are also connected to one another.

Transitivity: the theory that if A knows both B and C, then there is a significant likelihood that B will also know C.

Triad: a group of three people, typically represented as a triangle which can either be closed (i.e. three-sided, see Transitive) or unclosed (i.e. two-sided, see Intransitive).

Two-mode: see Bipartite.

Undirected: a network in which edges are *between* A and B rather than *from* A to B or B to A.

Unweighted: a network in which all edges have the same significance, having no weight, strength, or value allocated to them.

Variant: an alternative number of points given to a relationship during the data-weighting process, where geographical distance makes the standard points-value inappropriate.

Weighted: a network in which each edge is given a value denoting its strength, or weight. In this case edges are weighted to denote the strength of relationship between two nodes, 1 being the weakest relationship (e.g. between a geographically distant tenant and landlord) and 9 being the strongest (e.g. between spouses).