1   STARTING POINTS

Part One: Social Network Analysis, Prosopography, and History

In 1998, Charles Wetherell argued in the International Review of Social History that Social Network Analysis offered 'real potential' for historians, potential which had hitherto been almost completely ignored. Nearly two decades later, while the sociological field of SNA has grown apace, and software for analysing social networks has continued to become more sophisticated, Wetherell's call has largely gone unanswered by historians. Wetherell's call-to-arms was about the potential for SNA to offer new approaches to the study of kinship and village communities for social historians.[1] Already in 1998, however, Wetherell lamented that the kinds of social historians who used quantitative methods were a small minority, and this situation has hardly changed in the interim. Moreover, in 1996, Wetherell had teamed up with Barry Wellman to argue in the journal History of the Family that network studies offered important new ways of conceptualizing communities (Wellman and Wetherell 1996). While it is certainly true that a general appreciation for networks, loosely defined, has greatly influenced the study of history, this has usually taken place under the aegis of those methods of interpretation which are conventional for historians, especially in medieval history. Most humanities scholars retain a certain reticence about quantitative data and sociological, anthropological, and mathematical theory, combined with a healthy concern about how far we can push our always-problematic source material.[2] In any event, the few examples of SNA touching on medieval history prior to recent years were the results of happy coincidences in which individuals managed to break free from the 'small worlds' of their disciplines (an SNA concept). What is more, these innovators were often social scientists working in historical studies rather than more traditionally defined historians. As social network theory makes clear, however, many brave innovators do not succeed in getting their innovations accepted and followed more broadly. That is the role of the 'opinion leaders'. The good news is that in the recent past several such hard-working and influential figures have made great strides in putting Historical SNA on the map.

---

[1] It is arguably in this area that Historical SNA has yielded the most fruit. The study of kinship and village communities has long been a field of great interests for historians, sociologists and anthropologists. Most of the work in this area has focused on the early modern period and the long nineteenth century.

[2] On this, see also the comments by Isabelle Rosé in her 2011 article, at pages 200-203.

Some of these SNA opinion leaders have gathered under the umbrella of an organisation called Historical Network Research. The first three Historical Network Research conferences, held at Hamburg in 2013, at Ghent in 2014 and at Lisbon in 2015, stand as a testament to the growing popularity of network approaches to historical topics. Further, they allow a handy thumbnail sketch of the field of HSNA. The full programmes of the conferences can be found at http://historicalnetworkresearch.org/hnr-conferences/. The conferences have attracted speakers from a broad swathe of nations, including Belgium, Netherlands, Luxembourg, Germany, France, Spain, Portugal, United States, United Kingdom, Ireland, Austria, Switzerland, Italy, Denmark, Finland, Norway, Poland, Croatia, Russia, Ukraine, Romania, Greece, and Colombia. The number of institutional departments and disciplines from which the speakers have been drawn reveal something of the remarkable yet quite dispersed nature of the field of HSNA. They include Archaeology, Classics, Communications, Computational Linguistics, Computer and Information Science, Economics, History, Ancient History, History of Art and Architecture, History of Medicine, History of Science, Physics, Political Science, Religious Studies, and Sociology. A wide range of historical periods have been represented at these three conferences, from the ancient world to contemporary society. A number of different subjects and themes have been profitably explored. Among the most fruitful seams have been intellectual and scientific networks, networks of marriage and kinship, social and political elites in various contexts, networks of traders, merchants, sailors, migrants, settlers, and so forth, urban networks, and networks of religious and other beliefs. Medieval topics have included social structure in Norman Sicily, 11th-century monastic reform, book circulation in the ninth century, Anselm of Canterbury, Old Norse sagas, and 16th-century politics in the Low Countries. The conferences give a sense of a field of academic endeavour that is young and fresh: the lion's share of the papers have been given by postdoctoral researchers or PhD students. Some of these have been part of collaborative research projects reflecting centres of activity in HSNA, such as the University of Ghent's Centre for Digital Humanities. While there have been a number of excellent papers on ancient, medieval and early modern topics, the impetus and the momentum seems often to focus on the period since 1800. Historical SNA's opinion leaders themselves mainly work on modern and contemporary questions. Christophe Verbruggen of U. Ghent works on transnational intellectual and cultural history around 1900. Claire Lemercier, a historical sociologist based at Sciences-Po in Paris, specialises in 19th-century French economic history. Martin Stark of Social and Economic Sciences at the University of Hamburg has worked on 19th-century social history. Marten Düring of the University of Luxembourg writes about networks of Jews in the Nazi Holocaust. Nick Crossley, professor of Sociology at the University of

Manchester, works on punk music communities in 1970s Britain. The relative scarcity of established academics working on pre-modern historical topics, especially in the faculties of Humanities, is noteworthy, although a few significant exceptions will be mentioned in greater detail below. In general, historical SNA has so far found most institutional support in faculties and schools of social, political and economic sciences. This is partly an indication, in my opinion, of the general move by the broader discipline of History away from quantitative methods since the 1980s, noting the exception of departments of Social and Economic History in the United Kingdom. As the remarkable and continuing success of the Historical Network Research conferences has shown, there are no shortage of green sprouts popping through the fertile topsoil of historical studies. The extent to which their humanist colleagues will pick the fruits of their labour largely remains to be seen.

Medieval History and Social Network Analysis

Various scholars have applied the concepts or methods of Social Network Analysis to the study of medieval Europe since SNA started to come into its own in the 1970s. For the most part, these studies have been relatively isolated, although in more recent years this has begun to change. The earliest example of such an isolated innovation which I have found is Richard M. Smith's 'Kin and Neighbors in a Thirteenth-Century Suffolk Community', published in the Journal of Family History in 1979 (Smith 1979). Smith, a population historian based in the Geography department at Cambridge, was aware of some of the concepts and methods behind Social Network Analysis, but it is clear that this understanding was provided solely by John A. Barnes (1918-2010), who was Professor of Sociology at Cambridge from 1969 to 1982, and had been a student of Max Gluckman of the 'Manchester school' of anthropologists. Barnes's 1954 study of a Norwegian island parish was seminal for the development of social network analysis (Barnes 1954). Richard Smith wanted to test a hypothesis about whether kinship or community were more important to the lives of residents in the manor of Redgrave in Suffolk in the 1280s. The detailed records of the manorial court there allowed him a sophisticated approach to the question, and he applied various SNA concepts to the task, apparently without the use of any computer software. This included creating formulas for various network densities as well as several tables laying out numbers for what he called 'Star and Zonal Multiplexities'. 'Star' refers to actors who are adjacent to ego while 'multiplexity' refers to the existence of ties in a variety of distinct fields or settings. Smith wanted to ask whether networks were denser at different socioeconomic levels and in four geographical

zones. The results, however, were interesting but ultimately inconclusive, which may account for why Smith seems to have abandoned SNA approaches in his later work.

In her 1984 article 'The tie that binds: peasant marriages and families in late medieval England', Judith M. Bennett, at the time an Associate Professor of History at the University of North Carolina, used SNA techniques to examine the social worlds of two prominent families in the village of Brigstock, Northants, in the early fourteenth century (Bennett 1984). Like Smith, Bennett used local court records, from which she constructed personal networks for 31 individuals, categorising interactions along the lines of giving or receiving of assistance or of land, of acting jointly or engaging in a dispute. Bennett's network analysis allowed her to make some important points about how marriages changed social relationships in village society. Bennett explicitly thanked Richard Smith for his suggestions, and mentioned his article, as well as a 1979 book-length treatment of another English village in the early modern period, as examples of two works of English history to have adopted the SNA model (Wrighton and Levine 1979). All three studies treated the subject of family and community relations at the village level, and were an outgrowth of the larger 1960s-1970s project of social and economic history. I have been unable to find any historical work on the middle ages produced in the decade or so after 1984, although this is not to say that none ever existed. If the trail did run cold at this point, it may have been due to the turn away from the preoccupations of the 1960s-70s social history.

The next major advance touching on the middle ages came not from historians but from sociologists. In Renaissance Florence, John F. Padgett and Christopher Ansell found a rich seam of data where historians had already prepared the ground. The result was one of the most well-known and influential historical SNA studies yet produced, Padgett and Ansell's 'Robust Action and the Rise of the Medici, 1400-1434', appearing in 1993 in the American Journal of Sociology. Padgett, a Professor of Political Science at the University of Chicago, and Ansell, a political scientist based at UC Berkeley, are not themselves medieval historians but were able to build on the work of a large number of historians and social scientists on the excellent dataset surviving from Renaissance Florence. Crucially, they took advantage of the prosopographical work of Dale Kent in The Rise of the Medici (1978). The evidence was rich enough to allow analysis of various different kinds of networks, for example, marriage, economic, 'political' and friendship networks of 92 elite families in 1400s Florence. Using block model analysis, Padgett and Ansell succeeded in demonstrating how the Medicis controlled the conduits of power by placing themselves at the nexus of these various parties (the 'blocks'), in multiple contexts. All business had to flow through Cosimo de Medici because of the way the network was structured.

Padgett has returned to Renaissance Florence in 2006 and 2011. 'Robust action' is an example of how SNA can be used in a remarkably effective way to demonstrate elite power dynamics in medieval Europe, but sadly there are very few places with the richness of sources and of scholarly endeavour that would allow it to be replicated.

Padgett and Ansell's study was part of a wider renewal of interest in elites happening in the Humanities and Social Sciences in the 1990s. This trend is also evident in Christine Carpenter's 1994 article, 'Gentry and Community in Medieval England'. Carpenter used social network concepts as a way out of several intractable problems around trying to identify communities at the county level. Wary of lending the evidence a 'spurious mathematical precision', however, Carpenter rejected the deployment of tables and sociograms (Carpenter 1994, p. 365). She did make good use of a number of SNA theoretical concepts, nevertheless, including network density, brokerage, and effective versus extended networks (p. 366). Carpenter's network analysis used charters and dealt with gentry society in Staffordshire. In the article, the personal network of Philip Chetwynd of Ingestre (d. 1307) was reconstructed and analysed (pp. 369-374). At the time of writing, the study was 'still in its early stages', but she apparently never published any more of the results (pp. 369, 374). Her University of Cambridge web profile does not mention an interest in social networks nor even include the 1994 article (http://www.hist.cam.ac.uk/directory/mcc1000@cam.ac.uk). Moreover, other historians studying medieval English gentry have failed to pick up the baton of historical SNA. In her 2006 article entitled 'The social networks of the Buckinghamshire gentry in the thirteenth century', Anne Polden makes reference to Carpenter's 'computer aided network analysis' (Polden 2006, p. 373). Polden analysed twenty gentry families in Bucks, using charter evidence to consider the geographical range and social status of their contacts. Despite acknowledging Carpenter's influence, Polden did not follow her in the use of SNA concepts like brokerage, opting for a more traditional analytical regime. This tendency to reject or ignore the methods and concepts of SNA by mainstream historians has been widespread, even as interest in networks as models or metaphors has grown steadily. A 2016 monograph by Kathryn Reyerson of the University of Minnesota (https://cla.umn.edu/about/directory/profile/reyer001), Women's Networks in Medieval France: Gender and Community in Montpellier 1300-1350 is a good case in point. There, Reyerson explains her decision to opt-out of SNA: 'While acknowledging the usefulness of social network analysis for studying society', she writes, 'given the problems of medieval data, I have chosen to privilege individuals, particularly Agnes, and their stories as a means of

discovering linkages, a more informal term than networks that is perhaps better suited to medieval social and economic history' (Reyerson 2016, xxiii).

Interest in elites has found expression through the study of correspondence as well as record sources. Margaret Mullett of Queens University Belfast brought SNA to the study of a medieval letter collection in 1997, with her monograph Theophylact of Ochrid: Reading the Letters of a Byzantine Archbishop. The letter collection, dating from around 1090 to around 1100, was fertile ground for the reconstruction of a 'complex network of friends, colleagues, patrons and clients within Byzantine Bulgaria' https://www.routledge.com/Theophylact-of-Ochrid-Reading-the-Letters-of-a-Byzantine-Archbishop/Mullett/p/book/9780860785491) Mullett also wrote an introduction in 2005 to a special issue of the Revue Belge de Philologie et D'Histoire which published three articles by young scholars who use SNA on medieval letters and narrative sources (Mullett, 2005). Julian Haseldine of the University of Hull has also used social network analysis in his work on medieval friendship. (http://www2.hull.ac.uk/fass/history/our-staff/julian-haseldine.aspx). Haseldine published an article, 'Friendship networks in medieval Europe: New models of a political relationship', in the inaugural issue of Amity: the Journal of Friendship Studies in 2013, wherein he carefully considers the thorny methodological issues involved in studying medieval friendship, proposing a provisional model for future work. Haseldine holds up Mullett's 1997 study as an example of what is possible, but notes the limitations inherent in the genre (Haseldine 2013, p. 84). As his 2014 position paper (available for download at http://www2.hull.ac.uk/fass/history/our-staff/julian-haseldine.aspx) lays out, Haseldine is currently working on a database which will incorporate SNA techniques.

Work on monastic networks has proceeded apace in continental Europe as well. Isabelle Rosé, through her work on the aristocratic networks around Odo of Cluny, abbot of Cluny (926-942), has demonstrated that it is possible to put social network analysis and theory profitably to work in the early Middle Ages. Rosé's project has been to develop a new form of biography based on the idea of an itinerary – a series of distinct events – as opposed to a narrative. SNA offered her the possibility of exploring Odo's social capital at different points in his life. Rosé's excellent disposition of this, published in the Spanish journal Redes in 2011, lays out her method in exact detail as well as how her network analysis allowed a reassessment of Odo's biography. Rosé used three types of sources – diplomatic acts, personal letters, and narratives, and constructed a database in MS Excel of each link between two actors, as well as details on date, source, and the nature of the relationship. She then created a node table and link table to enter into Netdraw. These had fields which allowed various attributes to be

displayed visually. These included status, familial group, and, for the links, the nature of the relationships. Using this, Rosé produced 63 annual graphs, from 879 to 942, which she then analysed in terms of the aristocratic networks around Odo's life (Rosé 2011, 214-24). Rosé's work certainly deserves to garner interest by students of what is known in France as the Haut Moyen Âge. Rosé has noted how extensively medievalists have taken to talking about networks in an imprecise and metaphorical way; her lengthy article was partially aimed at getting scholars like these to start thinking about SNA (Rosé 2011, 202-4). Koen Vanheule, a PhD student at Ghent since 2011, (http://research.flw.ugent.be/en/koen.vanheule) is an example of a younger scholar who has incorporated social network theory into his research on monastic reformers in the tenth and eleventh centuries. Vanheule uses personal networks based around abbots, monks, and aristocratic familiae as an alternative method of understanding change to conventional interpretations of reform (Vanheule).

Others have taken a more theoretical tack in the study of religion. In the early 2000s, medieval historian Andrew Roach teamed up with economist Paul Ormerod on two studies which sought to apply SNA concepts to historical themes. These took the approach that medieval heresy and Protestantism, respectively, spread through society according to the patterns of scale-free networks, a kind of network 'whose degree distribution follows a power law ... so that any part of the network has a similar structure to the whole (Wikipedia, 'Scale-free networks'). The first study, which is wholly qualitative, considers medieval heresy in the paradigm of a disease contagion. SNA has been particularly influential in the field of epidemiology, and this is a very interesting theoretical approach (Ormerod and Roach, 2004). The second study includes some quantitative analysis but does not involve any matrix-based SNA method (Ormerod and Roach, 2008).

The work mentioned so far has been mostly done in English or French, but a large body of work on SNA and the middle ages has built up in the German language. Among the most significant and influential of these have been Johannes Preiser-Kapeller and Robert Gramsch. Preiser-Kapeller, a lecturer at the University of Vienna, has conducted extensive research on long-distance networks of trade and migration in the Byzantine empire and its neighbours. These have relied heavily on social and spatial theory and often take into account other large themes, like religion and climate (http://rapp.univie.ac.at/project-team-members/johannes-preiser-kapeller/). His work ranges across many centuries: for example, he has examined the ego-networks around fourteenth- and fifteenth-century emperors and the social networks of participants in fourteenth-century ecclesiastical synods, Jewish trading networks between the sixth and eleventh centuries, and early-medieval competition and

conflict between Byzantium and the Arab Caliphate, particularly in Armenia. Preiser-Kapeller's approach, which emphasizes a strong geographical dimension to network analysis, he calls 'Entangled Worlds', itself the title of a conference exploring 'network analysis and complexity theory in historical and archaeological research' held at Vienna in April 2016. (http://www.dasanderemittelalter.net/conference-entangled-words/entangled-worlds-the-programme/). Preiser-Kapeller is an avid disseminator of his many lectures, papers, and publications on www.academia.edu and elsewhere (https://oeaw.academia.edu/JohannesPreiserKapeller/; https://oeaw.academia.edu/TopographiesofEntanglements), and is a major 'opinion leader' in Historical Network Research. Preiser-Kapeller has a forthcoming monograph in English called The Connected Empire. A Global History of Byzantium´s long 14th century (1282-1402). A number of scholars are now studying commercial networks. For example, in his monograph Der hansische Bergenhandel im Spätmittelalter (Cologne 2009) Mike Burkhardt uses SNA to cast light on the trading networks of the Hanseatic Bergen.

One speaker at the 'Entangled Worlds' conference was Robert Gramsch (now Gramsch-Stehfest), a lecturer at the University of Jena in Germany (http://www.histinst.uni-jena.de/Bereiche/Mittelalterliche+Geschichte/PD+Dr_+Robert+Gramsch_Stehfest.html). His subject is the Holy Roman Empire in the thirteenth century and he has published mostly in German (https://uni-osnabrueck.academia.edu/RobertGramsch). While Preiser-Kapeller has done much to push the envelope in terms of apply new theory and methodology to big historical questions, Gramsch has been most successful at incorporating SNA into a deeper, more focused historical study, in a way which bears fruit in terms of integrating with the traditional historiography. Gramsch created a dataset using a variety of historical sources for his study of the 'Empire as a network of princes' in the decade of Henry (VII)'s rule as king under his father, Emperor Frederick (II), which lasted from 1225 to 1235. This dataset include evidence of kinship, alliances, competition, conflicts and so forth between 68 different actors at the highest level of the Empire at this time. Gramsch's method has been to emphasise negative ties and conflicts as much as positive links between actors, and he has relied on Heider's theory about structural balance for his theoretical underpinnings. He formulated his own cluster detection algorithm based around structural balance (pers. comm.; Gramsch et al., 'Community Detection'). Gramsch created a series of sociograms and did cluster analysis on the 68 actors, discovering there were very few distinct clusters with high internal densities. This allowed Gramsch to challenge the traditional view that Henry (VII) was removed from power in 1235 by his father due to

his inefficacy in dealing with the princes. The network analysis revealed that there were two factions engaged in a number of conflicts across the Empire, and that Emperor Frederick and King Henry supported opposing factions. The emperor removed his son from the throne in an attempt to re-forge some unity in his empire (Gramsch, 2013; Gramsch, 'Conflicts'). This is an excellent example of social network techniques and ideas being applied to a specific historical question and producing results that the broader field of historians can engage with.

At the time of writing, in January 2017, it is possible to look back and realize that enough studies have accrued over the last decades to make the claim that all of the thematic fields of endeavour discussed above have now been represented in the area of medieval studies, even if, ironically, these have emerged from pockets of interest with little connective tissue between them. The studies highlighted above deal with the divergent issues of kinship, local communities, friendship, political ties and conflicts, geographical patterns of trade, migration and belief. We can add to this the history of science and intellectual networks. For example, Dominique Raynaud, who describes himself as 'a sociologist and historian of science who previously trained as an architect', has published on medieval science and the origins of perspective since the 1990s. In a 2012 monograph, Raynaud used the theory of network knowledge diffusion as well as 'advanced network analysis and modelling' to uncover cast light on the 'topography' of a knowledge network based in central Italy in the thirteenth and fourteenth centuries (Raynaud 2012).

Digital Prosopography and Social Network Analysis

At first glance, prosopography and social network analysis seem to be natural bedfellows. This is especially true of digital prosopography, given that the people, places, and other potential actors have already been structured in appropriate fields in databases. The marriage of these two fields of endeavour, however, has been gradual, although it could be argued that the two disciplines are fast becoming more mutually familiar. One decade ago, Katharine Keats-Rohan's influential handbook on the practice of prosopography included two contributions that sought to combine the two approaches. These two chapters also give a good thumbnail sketch of the direction this project has taken more broadly. One piece, by Shawn Graham and Giovanni Ruffini, proposed the application of SNA to Greco-Roman Prosopography (Graham and Ruffini, 2007). The second, by Christophe Verbruggen, suggested

combining SNA and prosopography in a more tightly-focused modern case study, in his case, Belgian literary journals between 1880 and 1914 (Verbruggen, 2007).

It is probably in the study of ancient history that social network analysis of prosopographies has made the most headway. Giovanni Ruffini's 2008 monograph, Social Networks in Byzantine Egypt is touted as 'the first book-length application of this method to the ancient world' (Ruffini, 2008). While Ruffini tapped the two best archives from sixth-century Egypt for his work, the story of digital humanities and the broader corpus of papyrus evidence is much bigger than this. KU Leuven's 'Trismegistos' web resource bills itself as 'an interdisciplinary portal of papyrological and epigraphical resources formerly Egypt and the Nile valley (800 BC-AD 800), now expanding to the Ancient World in general' (www.trismegistos.org). While Trismegistos is not a prosopography (http://www.trismegistos.org/ref/about_prosopography.php), its data is structured in such a way as to allow the extraction of source and person data for two-mode networks straightforward. Trismegistos 'includes almost half a million attestations of individuals in Greek and Egyptian texts between 800 BC and AD 800'. Yanne Broux has completed a prosopographical analysis of Greco-Egyptian naming practices which incorporates social network analysis (Broux 2015a, 2015b). Project member Silke Vanbesaelere has created a number of interactive Gephi visualizations for the Trismegistos website (http://www.trismegistos.org/network/index#menu). The work of all three scholars mentioned so far has relied on the same SNA methodology, which involves the creation of a two-mode network with written sources and persons/names, and then the production of a one-mode affiliation network from this, to show the intersection of the actors. This was also the method used in most of the SNA work on the PoMS database – that involving co-witnessing. Prosopographical work on the ancient and classical world is so advanced that the academics are now aiming to draw together a number of existing resources using new technology. (https://snapdrgn.net/). Further, it is becoming more common for scholars of the ancient world to consider social network techniques. Diane Harris Cline of The George Washington University has also been applying SNA to cuneiform tablets (The Amarna Letters) and has already made excellent use of SNA visualization techniques for various dimension of ancient Greek history (http://www.dianehcline.com/index.php/about/). Caroline Waerzeggers of the University of Leiden, in her study of First-Millenium-BC Babylonia, has used SNA in her study of cuneiform tablets (Waerzeggers 2014a, 2014b). Shawn Graham's study of the brick-making industry in imperial Rome incorporated SNA (Graham, 2006). Classical archaeologist Anna Collar, at the University of Aarhus, has explored the spread of religious ideas in the Roman Empire using network theories and methods (Collar

2011, 2013). As of January 2017, the Historical Network Research bibliography lists 90 publications on the topic of Ancient History, as compared to only 35 for Medieval History (http://historicalnetworkresearch.org/resources/bibliography/). Anne Herzberg, at Leipzig, is creating a prosopography of Memphis in Egypt based mainly on epigraphic sources. Her work follows a model whereby social network analysis is seen as a necessary follow-up to the production of the prosopographical database- necessary for the proper interpretation of the results (Herzberg 2015). We may be entering a phase whereby SNA is seen as a natural partner of digital prosopography, where its concepts and methods are seen as vital tools for any prosopographer.

Of the projects combining SNA and prosopography which deal with the ancient and classical world, Ruffini's Social Networks in Byzantine Egypt bears the most relevance to the work put forth in this current volume, so it merits some deeper examination (Ruffini 2008). Ruffini used the evidence of thousands of papyri from the sixth-century settlements of Oxyrhynchos and Aphrodito, building on a long tradition of prosopographical study of the ancient and late Antique Greek-speaking areas. Moreover, digital humanities has served the vast papyrus collections from Greco-Roman Egypt very well, with multiple projects based in Duke University, Heidelberg and Leuven, respectively providing unusually ample textual material for the ancient world. Ruffini's method combines prosopography with SNA: for each of the two settlements, he has one prosopographical chapter and one SNA chapter. The evidence for Oxyrhynchos highlights vertical links in society across a broader region and an emergent elite kinship-group (the Apions), while the evidence from Aphrodito is due to the chance survival of a single family's archive (that of Dioskoros), and shows very close multiplex horizontal relationships within a single village. For his network studies of each, however, Ruffini relied upon pre-existing printed reference sources. In the case of Oxyrhynchos, no complete prosopography had been created, so he instead conducted a topographical network analysis, based on a pre-existing register of about 600 place-names. For Aphrodito, Ruffini built his database on a 1938 prosopographical index of nearly 2,000 villagers created by V. A. Girgis (Girgis 1938).

The method used by Ruffini for Aphrodito is essentially the same as that used by the PoMS project for our co-witnessing studies. Ruffini created two-mode networks with individuals (or places) on one axis and documents (as events) on the other. Then, affiliation networks were produced in order to create valued data about the strength of ties between individuals. Ruffini then used UCINet to reveal the properties of the network and of individuals. Ruffini was able to highlight a few of the most central actors in the network and to shed light on important players who had previously been obscured by

scholarly focus on Dioskoros and his family. He also draws attention to groups with 'high tie strengths'. Ruffini examines the methodology in a critical light, testing the results by simulating change over time. While Ruffini emphasises the importance of multiplexity in the nature of connections between actors, he reveals very little about the roles played by these actors in the papyri themselves. This is possibly partially down to Ruffini using an old-style prosopography for his database, but there is not enough explanation of how historical players interacted in the sources.[3] There is no typology of the papyri or consideration of whether the sources were, for example, transactional versus narrative or epistolary. There is also no typology of the social roles played by the actors, as witnesses, parties to disputes, and so on. Needless to say, the network analysis presumes that different document types are comparable and that SNA of actors in a variety of roles (without any attempt to incorporate these) are equivalent. While the PoMS analysis relies on the same kind of affiliation networks, our case studies have been defined strictly according to type of document and the roles played by the historical actors. Ruffini is now an Associate Professor of Classical Studies at Fairfield University in Connecticut (https://www.fairfield.edu/lassochannel/academic/profile/index.lasso?id=295). Social network analysis has apparently been only a minor interest since 2008.[4]

That same year (2008), four mathematicians from France used a dataset based about 1000 'contracts' dating to 1250-1350 from ten villages in the seigneurie of Castelnau-Montratier in the Lot region of France. With this, they produced a two-mode network of 615 vertices and 4193, from which they produced a sociogram (Boulet et al, 2008, pp. 1264-65). As the title of the article from the journal Neurocomputing suggests ('Batch kernel SOM and related Laplacian methods for social network analysis'), this study was seemingly only interested in medieval history to the extent that it needed a dataset with which to explore its mathematical project. Historians Jonathan Jarrett and Rachel Stone have both subjected this work to healthy scrutiny (Jarrett 2008; Stone 2012). This work was part of a larger project called 'Graph-Comp' (http://graphcomp.univ-tlse2.fr/), which saw the mathematicians team up with medieval historians and digital information specialists at the Universities of Toulouse and Nantes. The database of notarial acts copied down in the eighteenth century is freely available online (http://graphcomp.univ-tlse2.fr/spip.php?article46). A 2007 paper by the team demonstrated some basic cluster analysis, marking the links between groups involved in documents, what they called

---

[3] There are a couple of exceptions to this, a record of a dispute and a petition to the empress, explored on pages 168-72 and 177-9 respectively.

[4] He published a Social and Economic History of Medieval Nubia with OUP in 2012 and a A Prosopography of Byzantine Aphrodito the previous year.

'réseaux de sociabilité' ('networks of sociability'), as well as the evolution of these over time (Boulet et al, 2007). There has arguably not been enough critical questioning of the historical contexts and social phenomena reflected in the documents: the use of the term riches for individuals with high degree centrality, and the characterisation of a sub-graph as a communauté may give readers a false sense of historical setting to the network interpretation (Boulet et al, 2007, p. 8). A 2013 article in the Digital Medievalist revealed the final results of the project. Their 'Global Network Analysis' demonstrated a two-mode network with transactions and individuals using Gephi (Rossi et al., 2013, Figure 2). They then produced an affiliation network of the interactions of actors (Figure 3) out of which 34 clusters were identified, and central actors determined. In their 'Local Network Analysis', they examine degree and betweenness centrality figures. While this project showed that medieval record sources could be 'mined' for social networks, and identified key issues like the chronological issues inherent in datasets spanning centuries (which are explored further in this present volume), the model was more of an illustration of what is possible than a thorough-going historical analysis.

As part of the 'Making of Charlemagne's Europe 768-814' project, which ran from 2012 to 2014 (http://www.charlemagneseurope.ac.uk/), Rachel Stone examined the possibility of applying social network analysis to a major prosopographical database. This resource, like PoMS, uses a factoid-prosopography developed by John Bradley of Kings College London. Like PoMS, the Carolingian database used charters as its source material. Stone's 2013 IMC Leeds conference paper identified a number of methodological concerns. One of these was the difficulty for the prosopographer to identify individuals with non-unique simple names. Further, she identified a dearth of relationship factoids available. She also explored the methodology used by Ruffini in his study – affiliation networks based on appearing in the same document and highlighted the need to include the roles played by actors in the document in the creation of the dataset. Stone concluded that while the database could easily provide plenty of fodder for SNA work, producing meaningful graphs would be much more challenging. In the end, it was decided not to pursue the SNA route. While it is obviously possible to produce worthwhile small social networks dealing with the middle ages before about 1100, there are serious – possibly insurmountable – disincentives to producing social network analysis of digital prosopography, such as the Charlemagne project or the 'Prosopography of Anglo-Saxon England' (www.pase.ac.uk). The first is the problem of forgeries and the difficulties in establishing authenticity of charters from this period. The second, as Stone intimated, is that due to the frequent lack of surnames and/or by-names,

it is much harder to identify individual actors. Both of these problems decrease markedly when one is working with the twelfth century.

The 'ChartEx' project, funded by the Digging into Data programme from 2011 to 2013, explored a number of digital tools for working with medieval charters (https://diggingintodata.org/awards/2011/project/chartex). At the heart of the project were natural language processing and data mining, but SNA was also considered. Like PoMS, the 'ChartEx' tool breaks down charters into their components, but using a very different methodology. They did produced some sociograms using structured data taken from charters, and proposed a novel approach which took into account probabilities when seek to associate actors from multiple documents. Because this method was solely document-focused and did not involve creating a prosopographical database, the problem of generating a program to determine these probabilities while building up aggregates of documents ('record linkage') was likely to present major hurdles. While their final report includes a section on 'reconstructing social networks' (pp. 34-37), there is no discussion of SNA concepts, and the two 'histograms' produced there seem to be purely illustrative.

There are various currently ongoing projects which seek to combine medieval prosopography and social network analysis. Nükhet Varlık of Rutgers University and Abdurrahman Atçıl of Queens College, CUNY, are producing a prosopography of sixteenth-century Ottoman medical elites to which they will apply SNA (http://globalmiddleages.org/project/prosopographical-study-sixteenth-century-ottoman-medical-elite). Hervin Fernández-Aceves, a doctoral student at the University of Leeds, is producing a relational database using twelfth-century charters, with the aim of better understanding the composition and structure of the South Italian aristocracy. His model is a variation on John Bradley's factoid prosopography design. He has produced sociograms in Gephi for both documents and actors, and has also made visualizations for relationships of kinship and legal interactions (Fernández-Aceves 2016). At Harvard University, the work of the massive China Biographical Database Project is ongoing, covering a vast spread in time from the third century BC through to the 20th century AD. Their methodology combined prospography, GIS mapping, and SNA. They have created a number of interesting sociograms in Pajek, exploring networks based on letter correspondence, ties of kinship, and geographical location (combining SNA with GIS) (http://projects.iq.harvard.edu/cbdb/social-networks).

Most prosopographies dealing with post-medieval periods aim at more tightly defined categories of people and tend to have less all-encompassing aims than medieval projects such as PASE, PBW, Charlemagne's Europe, and PoMS. The most profitable seam of endeavour in early modern historical

prosopography and SNA has been based around correspondence networks. The 'Early Modern Letters Online' (EMLO) project includes letters from over 19,000 people from the 16th, 17th, and 18th centuries (http://emlo.bodleian.ox.ac.uk/). The ongoing 'Cultures of Knowledge: Networking the Republic of Letters, 1550-1750' project, based in Oxford, which incorporates EMLO, has been groundbreaking in its analysis of the 'virtual communities' of scholars and intellectuals active in the early modern era (http://www.culturesofknowledge.org/). Connected to this is Stanford University's 'Mapping the Republic of Letters' project, which has created remarkable visualization exploring various dimensions of the corpus of letters in a geographical context (http://republicofletters.stanford.edu/). As part of the 'Cultures of Knowledge' project, Robin Buning of Huygens Institute of Netherlands History led a team which produced a model of prosopography and social network analysis for two historical figures, Samuel Hartlib (c.1600-1662) and John Amos Comenius (1592-1670). Martin Hadley of Oxford produced sociograms using the program R Studio Shiny, with a model that allows users to highlight the specific kinds of relationships that interests them (Buning, 2016). However, at this time, the work has been 'proof-of-concept' and 'experimental', and is not yet available to the wider public.

One other early modern project deserves special mention. The only person to have applied social network analysis to Scottish history, as far as I have been able to uncover, has been the historical sociologist Anna Mitschele, in a Columbia University PhD completed in 2013 (Mitschele, now Anna Kaiser, is currently based at the University of Mannheim, Germany.) Using the pre-existing online Survey of Scottish Witchcraft (http://www.shca.ed.ac.uk/Research/witches/), Mitschele produced a series of spatial analysis sociograms for several periods of increased witch-hunting activity in seventeenth-century Scotland (Mitschele 2013, 2014). She found that previous explanations of the geographical and chronological distribution of witch cases could not explain the seemingly haphazard pattern whereby nearly half of cases crossed parish boundaries. Mitschele postulated that local patterns of witch-hunting were defined not institutionally but by the witch-hunters themselves, upwardly mobile members of the gentry class who sought to make a name for themselves when vacancies in government service came available. She also used a Girvan-Newman cluster analysis on sociograms representing two-mode matrixes of prosecutors and parishes. Mitschele's work is highly creative and original and adds a great deal to our understanding of sixteenth-century society, so it says a lot that she conducted it completely outwith the academic framework of Scottish History as a discipline in Scotland or indeed in the UK altogether. Mitschele's career has taken place in Germany and the USA, within the discipline of sociology, her attention drawn to Scotland by the excellent online resources provided. Mitschele's

case is salutary and instructive of several trends – the ability of online primary source tools to stimulate excellent new research, the relevance of Scottish historical topics to broader historical and conceptual questions, but also the insularity and reticence of history as a discipline in the face of dynamic new viewpoints, methods, and challenges presented by the social sciences.

In the last five to ten years, there has been a growing development of a sense of Historical SNA as a distinct field, at least in Europe, broadly defined. Various new groups have helped fuel this growth. The international and interdisciplinary Connected Past group, whose by-line is 'People, Networks, and Complexity in Archaeology and History', has held several workshops and conferences since 2011 (http://connectedpast.net/). They published in 2016 a volume entitled The Connected Past. Challenges to Network Studies in Archaeology and History (Brughmans et all, 2016). The contents include several useful methodological essays, but also reveal the strong emphasis on archaeology espoused by the group. Most relevant to historians is Marten Düring's chapter, 'How Reliable are Centrality Measures for Data Collected from Fragmentary and Heterogeneous Historical Sources? A Case Study'. Its contents also demonstrate the important new advances that the combination of archaeology and SNA have offered for the study of the classical world. The work of Anna Collar, one of the group's leading members, is a good case in point. In 2011, she used the evidence of material culture to demonstrate how the cult of Jupiter Dolichenus was disseminated across Europe through Roman military networks (Collar, 2011). Issue number 135 of the journal Les Nouvelles de l'archéologie, which was dedicated entirely to the use of SNA in archaeology, further demonstrates this trend. The articles therein show a strong predilection for study of the eastern Mediterranean from the Bronze Age to the Roman period. This also included a piece by Collar and others involved in the Connected Past group on the state of SNA in archaeology and history (Collar et al, 2014).

One of the co-authors of that piece, Claire Lemercier, has been responsible for establishing a French spin-off group, called Réseaux et Histoire ('Networks and History'), or groupe RES-HIST (http://reshist.hypotheses.org/). The group has organised a number of workshops and their website publicises details about ongoing research in HSNA. One recent workshop, held in December 2016 at Tours, was on the topic of SNA in ancient and medieval history (http://reshist.hypotheses.org/1097). RES-HIST reveals a growing number of doctoral projects employing SNA with medieval topics. Laurent Nabias' thesis examines social capital, lineage, and networks of nobility in the Île-de-France between 1180 and 1437 (http://reshist.hypotheses.org/384; http://reshist.hypotheses.org/760). Anne-Laure Méril-Bellini delle Stelle examined the sociability of religious women in the thirteenth-century Low

Countries (http://reshist.hypotheses.org/687). Henri Simonneau has considered the networks and prosopography of heralds in Burgundy, 1386-1519 (http://reshist.hypotheses.org/368). Agnès Bellini-Martin looks at commercial and political networks of Florentines in Lyon around 1500 (http://reshist.hypotheses.org/114).

The group responsible for the Historical Network Research conferences explored in greater detail above, is based in Germany and the Low Countries, and is organized by Martin Düring (http://martenduering.com/), along with Linda von Keyserlingk, Martin Stark and Ulrich Eumann. They have been holding workshops since 2009 and annual Historical Network Research conferences since 2013, and are now launching a new Journal of Historical Network Research (http://historicalnetworkresearch.org/). This journal is specifically aimed at correcting the fact that 'much of the groundbreaking and recent research into historical networks in the English-speaking world has been carried out by historical sociologists, rather than social historians, and has thus remained mostly outside the sphere of traditional academic history departments' (http://historicalnetworkresearch.org/journal/). Groups like the Connected Past, Réseaux et Histoire (RES-HIST) and Historical Network Research (and there is a considerable amount of overlap of personnel in their activities) are now providing the framework for SNA to begin to make a mark on the discipline of History more broadly. As the work of Res-Hist shows, there is clearly space for medievalists within this framework. The opinion leaders in these groups have been working hard as ambassadors for the discipline of SNA. Realising that effective use of SNA by students of history has often been hampered by the high learning curve involved in tackling the software, these groups have offered workshops. The conferences, workshops, and now the journal are doing much to link up what has too often been the isolated nodes and 'small worlds' of interest in SNA, allowing people to become more 'embedded' in their own supportive network.

To conclude, the persistent theme in the relationship between Social Network Analysis and the Humanities, and the conventionally-defined discipline of History in particular, has been one of stops and starts, of real progress tempered by limited engagement from the broader discipline. None of this is to gainsay the refreshing and innovative interdisciplinarity which characterises the field. Historians do not own the study of the past: archaeologists and social scientists have just as much a right to engage with history. But the story of SNA and the broader, Humanities-oriented swathe of academic History, including lecturers, researchers, students and the broader community, has been one of lack of engagement, with perhaps some bafflement or resistance. The relationship of capital-H 'History' and

SNA has meant historians venturing onto the academic turf of social scientists, working profitably and fruitfully with them, but not often being able to adequately translate their new skills and findings into the language and theoretical world of the Humanities. Making nice illustrations with SNA software is relatively easy; taking the quantitative results and translating them into worthwhile historical conclusions which other historians will pick up and include in the continuing discourse has proven more challenging. What we hope to offer in this current volume is a sustained attempt to marry up the digital prosopography and SNA with various significant historical contexts and actors, one that is hopefully pregnant with future possibility, but one that is only a snapshot of the research journey. The end of the road is not yet clear.

References

Barnes, John (1954). 'Class and Committees in a Norwegian Island Parish', Human Relations, 7, pp. 39-58.

Bennett, Judith M. (1984), 'The tie that binds: peasant marriages and families in late medieval England', Journal of Interdisciplinary History 15, pp. 111-129

Bergs, Alexander (2005), Social Networks and Historical Sociolinguistics: Studies in Morphosyntactic Variation in the Paston Letters (1421-1503). Berlin.

Boulet, Romain, Bertrand Jouve, Fabrice Rossi, and Villa Nathalie (2008), 'Batch kernel SOM and related Laplacian methods for social network analysis', Neurocomputing 71, pp. 1257-73.

Boulet, R., F. Hautefeuille, B. Jouve, P. Kuntz, B. Le Goffic, F. Picarougne, N. Villa (2007), 'Sur l'analyse de réseaux de sociabilité de la société paysanne médiévale', Actes des journées MASHS 2007, Brest, France, 10-11 Mai 2007.

Broux, Y. (2015), Double Names in Roman Egypt: A Prosopography. Trismegistos Online Publications, 8.

Broux, Y. (2015), Double Names and Elite Strategy in Roman Egypt. Studia Hellenistica, 54. Leuven: Peeters.

Broux, Y. (2015), Graeco-Egyptian Naming Practices: A Network Perspective. Greek, Roman and Byzantine Studies, 55, 706-720, Names network perspective.pdf.

Brughmans, Tom; Collar, Anna; and Coward, Fiona (eds.) (2016), The Connected Past. Challenges to Network Studies in Archaeology and History. Oxford.

Buning, Robin (2016), 'Experimental Prosopographical Network Analysis and Visualization with "Early Modern Letters Online"', Poster, Digital Humanities Conference Benelux 2016, 9-10 June 2016, Belval, Luxembourg.

Burkhardt, Mike (2009), Der hansische Bergenhandel im Spätmittelalter. Cologne.

Burkhardt, Mike (2014), 'Networks as social structures in late medieval and early modern towns: a theoretical approach to historical network analysis', pp. 13-44 in Commercial Networks and European Cities: 1400-1800, ed. Andrea Caracausi and Christof Jeggle.

Carpenter, Christine (1994), 'Gentry and community in medieval England', Journal of British Studies, 33:4, pp. 340-380.

ChartEx Project White Paper (2014), 'ChartEx: Discovering Spatial and Temporal Descriptions and Relationships in Medieval Charters'. 12 Feb. 2014. http://diggingintodata.org/awards/2011/project/chartex

Collar, Anna (2011), 'Military Networks and the Cult of Jupiter Dolichenus', 217-45 in Von Kummu nach Telouch. Historische und archäologische Untersuchungen in Kommagene. Dolichener und Kommagenische Forschungen IV. Asia Minor Studien Band 64. Bonn.

Collar, Anna (2013), Religious Networks in the Roman Empire: The Spread of New Ideas. Cambridge.

Collar, Anna; Brughmans, Tom; Coward, Fiona; and Lemercier, Claire (2014), 'Analyser les réseaux du passé en archéologie et en histoire', Les Nouvelles de l'archéologie, 135, pp. 9-13.

Fernández-Alceves, Hervin (2016), 'The Uncharted Networks of a "Chartered" Territory: Diplomatic Evidence and Relational Sociology for the Norman Kingdom of Sicily', Entangled Worlds. Network analysis and complexity theory in historical and archaeological research conference, Österreichiste Akademie der Wissenschaften, Vienna, 13-16 April 2016. https://leeds.academia.edu/HervinFern%C3%A1ndezAceves/Conference-Presentations-and-Talks

Graham, Shawn (2006), EX FIGLINIS: The Network Dynamics of the Tiber Valley Brick Industry in the Hinterland of Rome BAR International Series 1468. John Hedges Ltd. Available at http://www.graeworks.net/2013/05/16/ex-figlinis-the-complex-dynamics-of-the-roman-brick-industry-in-the-tiber-valley-during-the-1st-to-3rd-centuries-ad/

Graham, Shawn, and Ruffini, Giovanni (2007), 'Network Analysis and Greco-Roman Prosopography', pp. 325-336 in K.S.B. Keats-Rohan, (ed.) Prosopography Approaches and Applications. A Handbook. Occasional Publications of the Unit for Prosopographical Research, Linacre College, Oxford.

Gramsch, Robert (2013), Das Reich als Netzwerk der Fürsten. Politische Strukturen unter dem Doppelkönigtum Friedrichs II. und Heinrichs (VII.) 1225-1235. Ostfildern, Germany.

Gramsch, Robert, with Silvio R. Dahmen and A.L.C. Bazzan (forthcoming), 'Community Detection in the Network of German Princes in 1225: a Case Study'. Pre-print available at https://arxiv.org/abs/1701.01434

Gramsch, Robert (forthcoming), 'Conflicts as a structure-forming force: the Reign of Henry (VII) (1225-1235) in network analytical perspective', in Mitsiou, E.; Popovic, M.; and Preiser-Kapeller, J. (eds), Multiplying Middle Ages. New methods and approaches for the study of the multiplicity of the Middle Ages in a global perspective. Vienna.

Haseldine, Julian (2013), 'Friendship Networks in Medieval Europe: New models of a political relationship', Amity. The Journal of Friendship Studies, 1:1, pp. 69-88.

Herzberg, Anne (2015) 'Prosopographia Memphitica: Individual Identities and Collective Biographies from a Royal Residence', DH Egypt 15: Itertumswissenschaften in a Digital Age: Egyptology, Papyrology and Beyond conference. Leipzig, 4.-6. November 2015.

Available at https://saw-leipzig.academia.edu/AnneHerzberg/Papers

Jarrett, Jonathan (2008), " 'Social networking gets medieval', does it? A historian's take on some recent research on computing in the humanities", http://tenthmedieval.wordpress.com/2008/06/05/social-networking-gets-medieval-does-it-a-historians-take-on-some-recent-research-on-computing-in-the-humanities/.

Lemercier, Claire (2005), 'Analyse de réseaux et histoire', Revue d'histoire modern et contemporaine, 52.2 (2005), pp. 88-112.

Lemercier, Claire; and Zalc, C. (2008), Méthodes quantitatives pour l'historien. Paris: Collections Repères.

Mitschele, Anna (2013), 'Identity and Social Structure in Early Modern Politics: How Opportunities induced Witch Trials in Scotland, 1563-1736', unpublished Columbia University PhD.

Mitschele, Anna (2014). 'Identity and Opportunity in Early Modern Politics: How Job Vacancies Induced Witch Persecutions in Scotland, 1563–1736', pp. 151-178 in G. Manzo, ed. Analytical Sociology: Actions and Networks. John Wiley & Sons.

Mullett, Margaret (1997), Theophylact of Ochrid: Reading the Letters of a Byzantine Archbishop. Vol. 2. Birmingham Byzantine and Ottoman Monographs. Aldershot: Variorum.

Mullett, Margaret (2005), 'Power, Relations and Networks in Medieval Europe. Introduction', Revue Belge de Philologie et D'Histoire, 83:2, pp. 255-59.

Ormerod, Paul, and Roach, Andrew (2004), 'The Medieval inquisition: scale-free networks and the suppression of heresy', Physica A, 339, pp. 645-52.

Ormerod, Paul, and Roach, Andrew (2008), 'Emergent Scale-Free Social Networks in History: Burning and the Rise of English Protestantism', Cultural Science, 1.

Padgett, John F. (2011), "Introduction to Marriage and Elite Structure in Renaissance Florence, 1282-1500." Redes. Revista Hispana Para El Análisis de Redes Sociales 21 (1). http://revista-redes.rediris.es/pdf-vol21/vol21_2e.pdf.

Padgett, John F. (2011), "Marriage and Elite Structure in Renaissance Florence, 1282-1500." Redes. Revista Hispana Para El Análisis de Redes Sociales 21 (1). http://revista-redes.rediris.es/pdf-vol21/vol21_3e.pdf.

Padgett, John F., and Christopher K. Ansell (1993), "Robust Action and the Rise of the Medici." The American Journal of Sociology 98 (6): 1259–1319.

Padgett, John F., and Paul D. McLean (2006). "Organizational Invention and Elite Transformation. The Birth of Partnership Systems in Renaissance Florence." American Journal of Sociology 111 (5): 1463–1568.

Polden, Anne (2006), 'The social networks of Buckinghamshire gentry in the thirteenth century', Journal of Medieval History, 32, pp. 371-94.

Preiser-Kapeller, J.; and Daim, F. (eds.) (2015), Harbours and Maritime Networks as Complex Adaptive Systems, Mainz: RGZM Tagungen.

Preiser-Kapeller, J. (2015a), 'Liquid Frontiers. A relational analysis of maritime Asia Minor as religious contact zone in the 13th-15th century', pp. 117-146 in A. Peacock; B. De Nicola; and S. Nur Yıldız (eds.) Islam and Christianity in Medieval Anatolia. Aldershot.

Preiser-Kapeller, J. (2015b), 'A Collapse of the Eastern Mediterranean? New results and theories on the interplay between climate and societies in Byzantium and the Near East, ca. 1000–1200 AD.', Jahrbuch der Österreichischen Byzantinistik 65, pp. 195-242.

Preiser-Kapeller, J. (forthcoming), The Connected Empire. A Global History of Byzantium´s long 14th century (1282-1402). Palgrave MacMillan.

Preiser-Kapeller, J. (forthcoming), 'Peaches to Samarkand. Long distance-connectivity, small worlds and socio-cultural dynamics across Afro-Eurasia, 300-800 CE' (pre-print online: http://oeaw.academia.edu/JohannesPreiserKapeller/Papers).

Preiser-Kapeller, J. (forthcoming), 'Aristocrats, mercenaries, clergymen and refugees: deliberate and forced mobility of Armenians in the early medieval Mediterranean and Near East (6th to 11th century)', in J. Preiser-Kapeller; L. Reinfandt; Y. Stouraitis (eds.), Migration History of the Medieval Afroeurasian Transition Zone, Studies in Global Migration History. (pre-print online: http://oeaw.academia.edu/JohannesPreiserKapeller/Talks).

Preiser-Kapeller, J. (forthcoming), 'Central Peripheries. Empires and Elites across Byzantine and Arab Frontiers in Comparison (700–900 CE)', in Drews, Wolfram (ed.), Die Interaktion von Herrschern und Eliten in imperialen Ordnungen.

Raynaud, Dominique (2014), Optics and the Rise of Perspective: A Study in Network Knowledge Diffusion

Reyerson, Kathryn (2016), Women's Networks in Medieval France: Gender and Community in Montpellier 1300-1350.

Rosé, Isabelle (2011), 'Reconstitution, representation graphique et analyse des réseaux de pouvoir au haut Moyen Âge. Approche des pratiques sociales de l'aristocratie à partir de l'exemple d'Odon de Cluny (†942)', Redes. Revista hispana para el análisis de redes sociales, 21.5, pp. 199-272.

Rossi, Fabrice, Nathalie Villa-Vialaneix, and Fabrice Hautefeuille (2013), 'Exploration of a Large Database of French Notarial Acts with Social Network Methods', Digital Medievalist 9.

Smith, R[ichard] M. (1979), 'Kin and Neighbors in a Thirteenth-Century Suffolk Community', Journal of Family History, 4, pp. 219-56

"(SNA)P | Standards for Networking Ancient Prosopographies." 2014. Accessed November 26. http://snapdrgn.net/archives/292.

Stone, Rachel (2012a), 'Medieval social networks, 1: concepts, intellectual networks and tools', https://magistraetmater.wordpress.com/2012/09/25/medieval-social-networks-1-concepts-intellectual-networks-and-tools-14878698/

Stone, Rachel (2012b), 'Medieval social networks, 2: charters and connections', https://magistraetmater.wordpress.com/2012/12/17/social-network-analysis-of-charters-who-is-connected-as-a-15330256/

Stone, Rachel (2013), 'Caught in Charlemagne's Net: Carolingian Charters and Social Network Analysis', unpublished paper, International Medieval Congress, University of Leeds, 2 July 2013.

Vanheule, Koen, 'Competing networks as instigators of institutional change: toward a new understanding of monastic reforms (Lotharingia, eleventh century)' https://ugent.academia.edu/KoenVanheule

Verbruggen, Christophe (2007), 'Literary Strategy During Flanders' Golden Decades (1880-1914): Combining Social Network Analysis and Prosopography', pp. 579-601 in KSB Keats-Rohan (ed.), Prosopography Approaches and Applications: A Handbook. Oxford Unit for Prosopographical Research.

Waerzeggers, Caroline (2014), 'Social Network Analysis of Cuneiform Archives', pp 207-233 in Documentary Sources in Ancient Near Eastern and Greco-Roman Economic History, ed. Heather D. Baker and Michael Jursa. Oxford.

Wellman, Barry, and Wetherell, Charles (1996), 'Social Network Analysis of Historical Communities: Some Questions from the Present for the Past', History of the Family, 1, pp. 97-121.

Wetherell, Charles (1998), 'Historical Social Network Analysis', International Review of Social History, 43, Supplement, pp. 125-144.

Wrighton, Keith, and David Levine (1979), Poverty and Piety in an English village: Terling, 1525-1700. New York.

https://en.wikipedia.org/wiki/John_Arundel_Barnes

https://en.wikipedia.org/wiki/Manchester_school_(anthropology)

https://en.wikipedia.org/wiki/Scale-free_network

Part Two: Introduction to SNA Concepts (by Cornell Jackson)

This introduction to SNA concepts will start by defining social networks and social network analysis, followed by a discussion on the importance of the structural view social network analysis provides. Next will be a look at what research has discovered about the rules on how networks work. Part Two ends with how this impacts our understanding of Scottish medieval society and the ways it can be used to provide new perspectives. Social networks are defined and measured as connections among people, organisations, political entities (states and nations) and/or other units. Social network analysis is a theoretical perspective and a set of techniques used to understand these relationships (Valente 2010, p. 3). The science of social networks provides a distinct way of seeing the world because it is about individuals and groups and how the individuals become groups. (Christakis and Fowler 2010, p. 32).

The Importance of Social Networks

Social network analysts view society through its structure. The structural view says that the organisation of society and the relationships that form them are as important as the attributes of individuals in explaining what happens in society. Why is the structural view of society so important? Why are the relationships that form social networks so important? Valente (2010, pp 3-7) says that bonds matter because these influence a person's behaviour above and beyond the influence of his or her attributes. A person's attributes do influence who people know and spend time with – their social network. Valente quotes Borgatti et al. (2009): 'One of the most potent ideas in the social sciences is the notion that individuals are embedded in thick webs of social relations and interactions'. The reason that social networks are so important is because human beings are ultra-social animals that create social networks (Haidt, 2006). Syed (2010, p. 110) concurs by quoting Geoffrey Cohen: 'The need to belong, to associate, is among the most important human motives. We are almost certainly hardwired with a fundamental motivation to maintain these associations'. Christakis and Fowler (2010, p. 214) add that human beings just don't live in groups, they live in networks. Valente argues the traditional social science approach of using random sampling is not adequate for measuring network concepts because random sampling removes individuals from the social context that may influence their behaviour. Valente explains that one primary reason social network research has grown in recent

decades is that scholars have become dissatisfied with attributes theories of behaviour. Many attribute theories have not explained why some people do things (e.g. quit smoking) while others do not. Social network explanations have provided good explanations in these cases. Social network analysis concepts and techniques have found wide application across a number of scientific disciplines including anthropology, business, communication, computer science, economics, education, marketing, medicine, public health, political science, psychology and sociology to name a few.

Freeman (2004, p. 2) also believes that the unique contribution of social network analysis is its structural approach which looks at the social structure as a whole rather than focusing on the individual. For him, the social network approach is grounded in the intuitive notion that the patterning of social ties in which actors are embedded has important consequences for those actors. Network analysts, then, seek to uncover various kinds of patterns. And they try to determine the conditions under which those patterns arise and discover their consequences. Comparing the structural approach of social network analysis to the traditional random sampling approach of social science, Freeman (2004, p. 1) quotes Allen Barton, a Columbia University sociologist,

> For the last thirty years, empirical social research has been dominated by the sample survey. But as usually practiced, using random sampling of individuals, the survey is a sociological meat grinder, tearing the individual from his social context and guaranteeing that nobody in the study interacts with anyone else in it. It is a little like a biologist putting his experimental animals through a hamburger machine and looking at every hundredth cell through a microscope; anatomy and physiology get lost, structure and function disappear and one is left with cell biology..... If our aim is to understand people's behaviour rather than simply to record it, we want to know about primary groups, neighbourhoods, organizations, social circles and communities; about interaction, communication, role expectations and social control.

Key Social Network Analysis Concepts

Therefore, social network analysis allows one to take a holistic, structural view in addition to the traditional approaches. There are several key concepts of social network analysis being used in this research that need to be discussed.

Small worlds

The first is small world networks. This is defined as a network in which most people have few connections yet the overall distance between any two people in the network is shorter than expected by chance (Watts, 1999). Small world networks are characterised by local clustering which indicates dense pockets of interconnectivity. There are bridges, however, that connected these subgroups and these bridges enable people to connect to seemingly distant others by fewer steps than would occur in a random network (Valente, 2010, pp. 9-19).

Homophily

Homophily is the tendency for people to affiliate and associate with others like themselves. As a result, a person's social network tends to be a reflection of him or herself because people feel more comfortable being with people like themselves rather than with people who are different. Homophily helps to explain why the small world effect occurs. The set of people from which contacts are drawn are narrowed by homophily and the probability that two people have an acquaintance in common is much higher than random chance alone would dictate. Homophily also explains why new ideas and practices have difficulty in getting a foothold within most social networks because most people talk to others like themselves and usually hold similar attitudes, beliefs and practices and as a result avoid those who do not share their views slowing the spread of new ideas. However, homophily can also speed the diffusion of an idea. Once a new idea does gain a foothold in the social network, the trust generated by homophily causes it to spread quickly (Valente, 2010, pp. 9-19). The concept of homophily was developed by Almack (1922) who asked children to name those they would like to invite to a party and then compared the similarities between the choosers and the chosen to study the effect of homophily.

Sociometry

One of the key innovators in social network analysis was Jacob Moreno (1934). Moreno, along with Helen Hall Jennings, created sociometry, an experimental technique obtained by application of quantitative methods that inquire into the evolution and organization of groups and the position of

individuals within them (Freeman 2004, p. 37). His work's aim was to investigate how psychological well-being is related to the structural features of what he called social configurations. His major innovation was to devise the sociogram as a way of representing the formal properties of social configurations (Scott 2000, p. 9). The sociogram turned out to be one the most powerful innovations in social network analysis because it allowed the visualisation of social networks. Because human beings are so visually oriented, visualisation is an efficient way to present a lot of network data in a way that is easily understood.

Centrality

Another key concept is centrality which focuses on who is the most central player in the network. The reason centrality is important is that Alex Bavelas (1948) said that the degree to which a single individual dominates its communication network – the degree to which it was centralised – affected its efficiency, its morale and the perceived influence of each individual actor. Bavelas and the group around him developed a formal model, drew graph theoretic images of social structures, designed an experiment and collected experimental data on efficiency, morale and the recognition of leadership which showed that Bevelas had been correct. As a result, a formal model for centrality was developed (Freeman 2004, pp. 68-70). In the data analysis chapter there will be a focus on centrality to identify the central players in the network who would be probably be the best link for new information for the sari sellers taking part in this research.

Ego networks

The Manchester anthropologists were extremely influential in social network analysis in Britain, with their work focused on ego networks. Ego networks are networks that focus on one individual and the individual's connections including connections between the people connected to the individual. The Manchester Anthropologists include John Barnes, Elizabeth Bott, Max Gluckman, J. Clyde Mitchell and Sigfried Nadel. Alfred Reginald Radcliffe-Brown, who espoused the structural perspective in anthropology, was a great influence on the Manchester Anthropologists (Scott 2000, pp. 26-33; Freeman 2004, p. 105). Of all the Manchester anthropologists, Scott (2000, pp. 28-32) considered Mitchell the most important contributor of this tradition. Mitchell, an anthropologist, said that the pattern of interactions that people have among themselves is the sphere of network analysis. These

networks are built on a flow of information and the transfer of resources and services. Mitchell's focus was mainly on ego networks. Mitchell's major contribution was to translate graph theory and sociometry into a sociological framework. From this came the concepts of density, the completeness of the network and reachability which measures how easy it is for all people in a network to contact one another through a limited number of steps. This research will measure the density of networks collected.

Strength of Weak Ties and Structural Holes

There has been a debate in social network analysis about the benefits of how loosely or strongly connected a network is. Burt (2000) argues that a strongly interconnected network has what is called closure. The benefits of network closure are the advantages created by lowering the risk of cooperation and that it facilitates sanctions that make it easier for people in the network to trust one another. This is because network closure means safety, security and social cohesion for its members.

The advantage of more loosely connected networks is that these offer the opportunity for brokerage. Brokerage refers to ability of people to broker connections between disconnected network segments. Those who serve as brokers act as bridges for new information helping to diffuse innovation from one group to another. Burt (1992) called the spaces between the network segments structural holes. The benefit of brokerage across structural holes is that it increases the value of cooperation.

Burt based his analysis on the seminal work of Granovetter (1973). In this work, Granovetter argues for the strength of weak ties in networks. Before Granovetter, weak ties were seen as a source of alienation (Wirth, 1938). Granovetter showed that if you are in a part of the network that has a high degree of closure, everyone there tends to have the same information. Building a weak bridging tie over a structural hole gives access to new information. Since network closure tends to breed trust, this gives the opportunity for the person to become an opinion leader and help spread the new information in that part of the network because of the confidence closure breeds.

Networks Rules

Christakis and Fowler (2010, pp. 17-26) described five rules on networks discovered through research.

The First Rule

The first rule is that individuals shape their network. One example they give of how individuals shape their networks is homophily which was described above. Individuals also decide the structure of the network by deciding how many people they are connected to, influencing how densely interconnected their family and friends are and by controlling how central they are to the social network. Individuals also shape their networks through transitivity, which is the tendency where an individual has strong ties to two separate people; those two people will know each other thus forming a triangle. The importance of transitivity will be discussed in the theoretical framework.

The Second Rule

The second rule is that the network shapes us. The network shapes individuals because the number of social contacts can affect people, transitivity, or the lack of it, can affect individuals and how many contacts an individual's friends and family have can affect them. How an individual can be constrained by its network will be discussed in the theoretical framework and the discussion of the results.

The Third Rule

The third rule is that friends affect individuals. Due to the human tendency to influence and copy one another, friends help determine the content that flows across the network which affects the individual. This seems obvious and will be shown in the impact of the number of strong ties in the collected ego networks.

The Fourth Rule

The fourth rule is that our friends' friends' friends affects individuals. Two examples of this rule are described. First is hyper dyadic spread which is the tendency of effects to spread from person to person to person beyond an individual's direct social ties. The second example is Milgram's famous sidewalk experiment (Milgram et al, 1969). In this experiment, researchers would stop and look up at a window

and record how many other passers-by also looked up. The more researchers that looked up, the more passers-by that looked up. This illustrated the importance of a threshold in influencing a network.

The Fifth Rule

The fifth rule that the network has a life of its own, or to put it another way, a network is more than the sum of its parts. Christakis and Fowler give two reasons why the network has a life of its own. First, networks combine properties and functions that are neither controlled nor perceived by its members. They can only be understood by studying the whole network. Second, networks also have emergent properties. Emergent properties are new attributes of a whole that arise from the interaction and interconnection of the parts.

Influence on the Network

One question that comes up is how far does an individual's connections and influence reach into the social network? Christakis and Fowler (2010, pp. 26-30) give different answers to the question for connections and influence. For connections, they point to Milgram's famous six degrees of separation experiment. In this experiment (Travers and Milgram, 1969), Milgram gave a few hundred people who lived in Nebraska in the USA a letter addressed to a businessman in Boston more than 2300 kilometres to the east in the USA. These people were asked to send the letter to someone they knew personally. The goal was to get the letter to someone they thought would be more likely to have a personal relationship with the Boston businessman. The number of times the letter changed hands was tracked and it was found that on average it changed hands six times. Dodds, Muhamad and Watts (2003) repeated Milgram's experiment using e-mail instead of letters. This time 98,000 subjects were recruited. Each subject was randomly assigned a target from a list of eighteen targets in thirteen countries. The subjects sent an e-mail to someone the subject knew who might in turn know the targeted person. Again, it took roughly six steps to get the e-mail to the targeted person replicating Milgram's results. Therefore, Christakis and Fowler conclude that an individual reach extended six steps or degrees into their networks.

For influence, Christakis and Fowler conclude that the reach of an individual's influence is much shorter. They promulgate the three degrees of influence rule. This rule states that an individual's influence through the network gradually dissipates and ceases to have a noticeable effect on people beyond the social frontier that lies at three degrees of separation. They give three reasons for this. First is the

Intrinsic Decay Explanation, which says that influence eventually peters out as information loses it fidelity. Second is the Network Instability Explanation. This explanation says that links beyond three degrees have a tendency to become unstable as the network evolves. Third is the Evolutionary Purpose Explanation, which says that humans evolved in small groups in which everyone was connected to everyone else by three degrees which constrains influence going beyond three degrees.
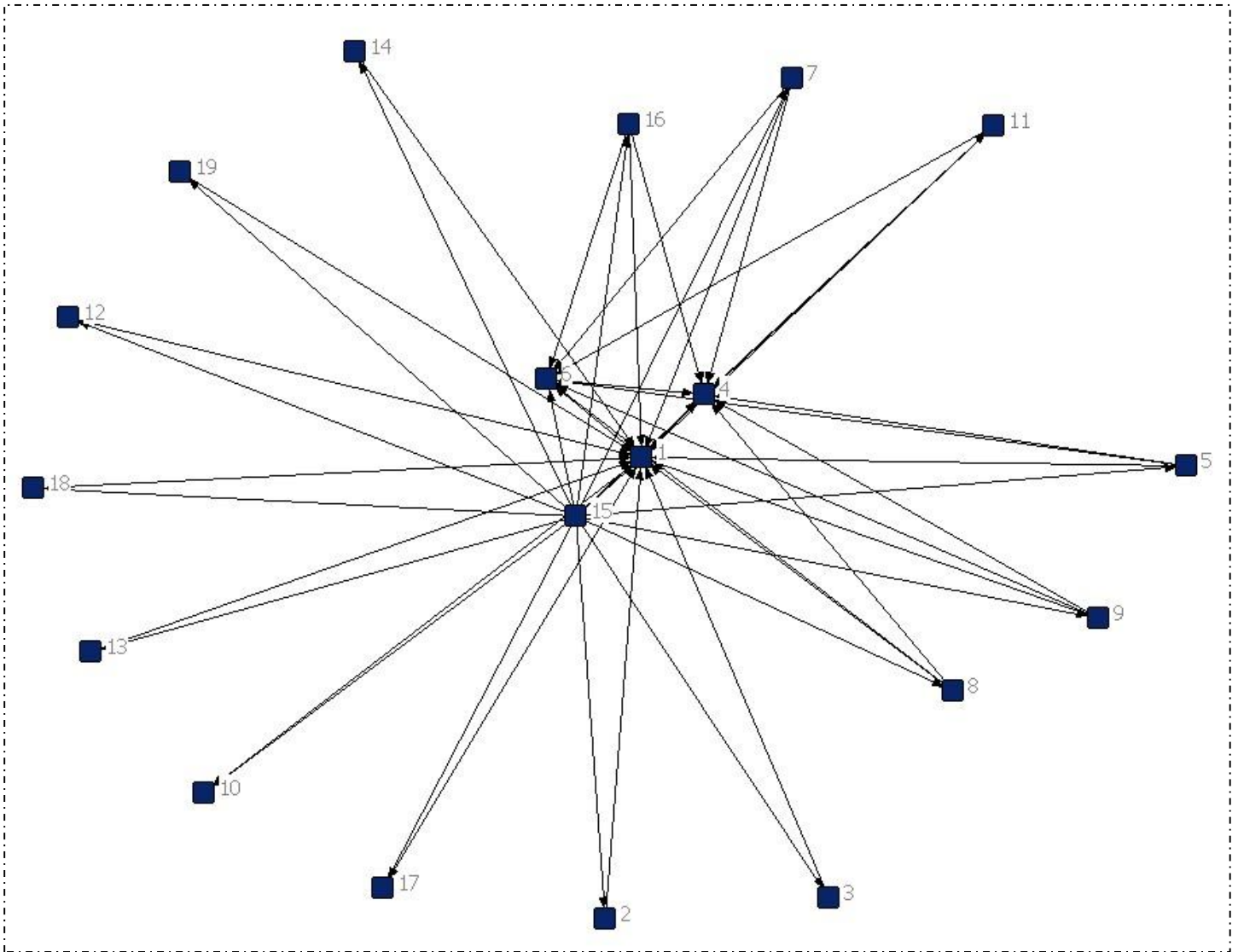
Visualisations

One of the key advantages of social network analysis is the ability to use software to visualise the network. Features not readily apparent looking at the numbers become very apparent when looking at the visualisation. The software used to do the network calculations was UCINET (Borgatti et al, 2002) and NetDraw (Borgatti, 2002) was used to visualise the network. NetDraw uses a spring-embedded algorithm where the edges in the network behaves as springs and does not like long lines.

Using examples collected during a field trip from a separate PhD research project in India, each respondent was asked to identify which members of the Self Help Group (SHG) who did the most work. SHGs are essentially microbanks owned by its members. In looking at the visualisation, it is important to note that direction is important. In this case, the base of the arrow is at the respondent and the arrowhead points to the people the respondent thinks are important. The more arrowheads a person has, the more important the person is within the SHG.
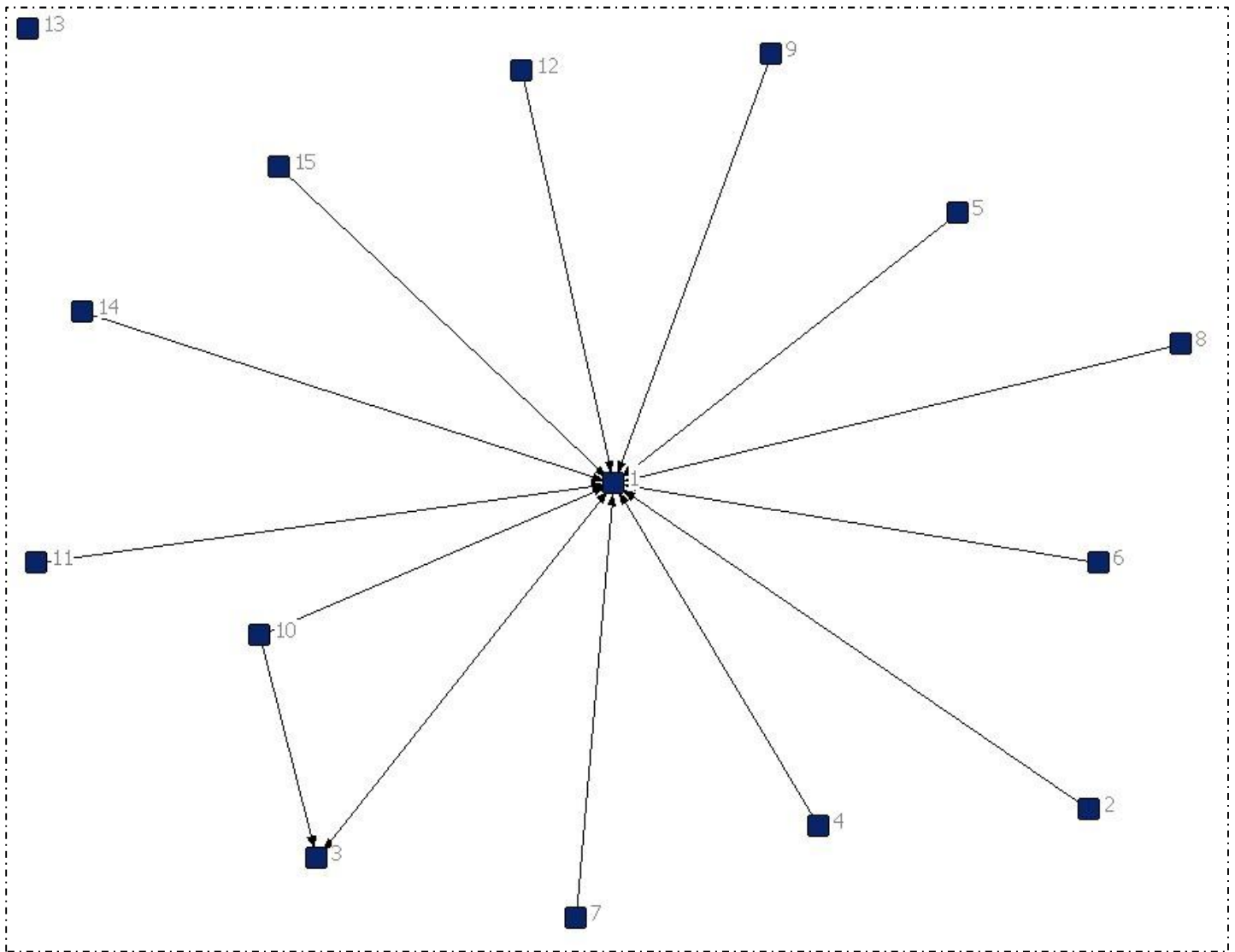
Figure 1.1. Male SHG: Who Does the Most Work?

In Figure 1 above is the visualisation of the answers for the male SHG and Figure 2 below is the visualisation for one of the female SHGs.

Figure 1.2. Female SHG: Who Does Most of the Work?

In Figure 1.1, most of the arrows point to the animator (SHG leader) and the two representatives (deputy SHG leaders). In Figure 1.2, almost all of the arrows point to the animator. In one sense, this is not surprising that the leaders would have the most arrows pointing at them. However, another way to interpret these is to say that if anything happened to the leader of the male SHG, there are two ready replacements. The female group, on the other hand, could be in considerable difficulty if their leader disappeared. These two figures show the power of visualisation in social network analysis.

Using Two-Mode Networks

There is a special type of network used in this research called two-mode networks. In these networks, there are two different sets of actors and all of the relationships are between sets and not within them. In our research, one set consisted of charters and the other set consisted of people who had witnessed these documents. Looking at the sociogram of this network, you would see lines from each charter to those who had witnessed it. However, using a software process, more useful data can be generated by creating what are called affiliation networks. The affiliation we are looking for is how often people witnessed charters together. The more often people witness charters together, the more probable they have a real social relationship. The software process sets up a matrix which holds the results of the calculations of the number of times two people have witnessed charters together.

Applying Social Network Analysis to Medieval Scottish History

What social network analysis gives is another perspective to view medieval Scottish history that is independent of the perspective given by traditional historical methods. It is important to understand that social network perspective is in addition to and not a replacement for the perspective given by traditional historical methods.

This is especially true of the structural elements of the networks. A social network analyst can identify a group from the network diagram who are working together over time that invites the questions what are they working on why are they working on this and what historical processes are keeping this group together? The network diagram identifies individuals who are extremely well connected and the question becomes why these people so well connected and what are the processes that generated these connections? Is it possible for the structure of the network to identify patterns What social network analysis gives is another perspective to view medieval Scottish history that is independent of the perspective given that could possibly identify what the historical data might look like?

The true power of social network analysis is this ability to provide new perspectives. The rest of our discussion will be describing what new perspectives were uncovered in our research.

References

Almack, John C. (1922), 'The Influence of Intelligence on the Selection of Associates', School and Society, 16, pp. 529-30.

Bavelas, Alex (1948), 'A Mathematical Model for Small Group Structures', Human Organization, 7, pp. 16-30.

Borgatti, S.P. (2002), Netdraw Network Visualization. Harvard, MA: Analytic Technologies.

Borgatti, S.P. and M. G. Everett and L. C. Freeman (2002), UCINET for Windows: Software for Social Network Analysis Harvard, MA: Analytic Technologies.

Borgatti, S. P. and A. Mehra, D.J. Brass and G. Labianca (2009), 'Network Analysis in the Social Sciences', Science, 323, pp. 892-95.

Christakis, Nicholas and James Fowler (2010), Connected: The Amazing Power of Social Networks and How They Shape our Lives. London: Harper Press.

Dodds, P.S. and Muhammad, R. and Watts, D.J. (2003), 'An Experimental Study of Search in Global Social Networks', Science, 301:5634, pp. 827-29.

Freeman, Linton C. (2004), The Development of Social Network Analysis: A Study in the Sociology of Science. Vancouver, BC: Empirical Press.

Haidt, Jonathan (2006), The Happiness Hypothesis: Finding Modern Truth in Ancient Wisdom. New York: Basic Books.

Milgram, Stanley and Leonard Bickman and Lawrence Berkowitz (1969) 'Note on the drawing power of crowds of different size', Journal of Personality and Social Psychology, 13:2, pp. 79–82.

Moreno, Jacob L. (1934), Who Shall Survive? Washington, DC: Nervous and Mental Health Publishing Company

Scott, John (2000), Social Network Analysis: A Handbook 2nd Edition London: Sage Publications Ltd.

Syed, Matthew (2010), Bounce: The myth of talent and the power of practice London: Fourth Estate.

Travers, Jeffrey and Stanley Milgram (1969), 'An Experimental Study of the Small World Problem', Sociometry, 32, pp. 425-443.

Valente, Thomas W. (2010), Social Networks and Health: Models, Methods and Applications Oxford: Oxford University Press.

Watts, D. (1999), Small Worlds: The Dynamics of Networks between Order and Randomness. Princeton, NJ: Princeton University Press.