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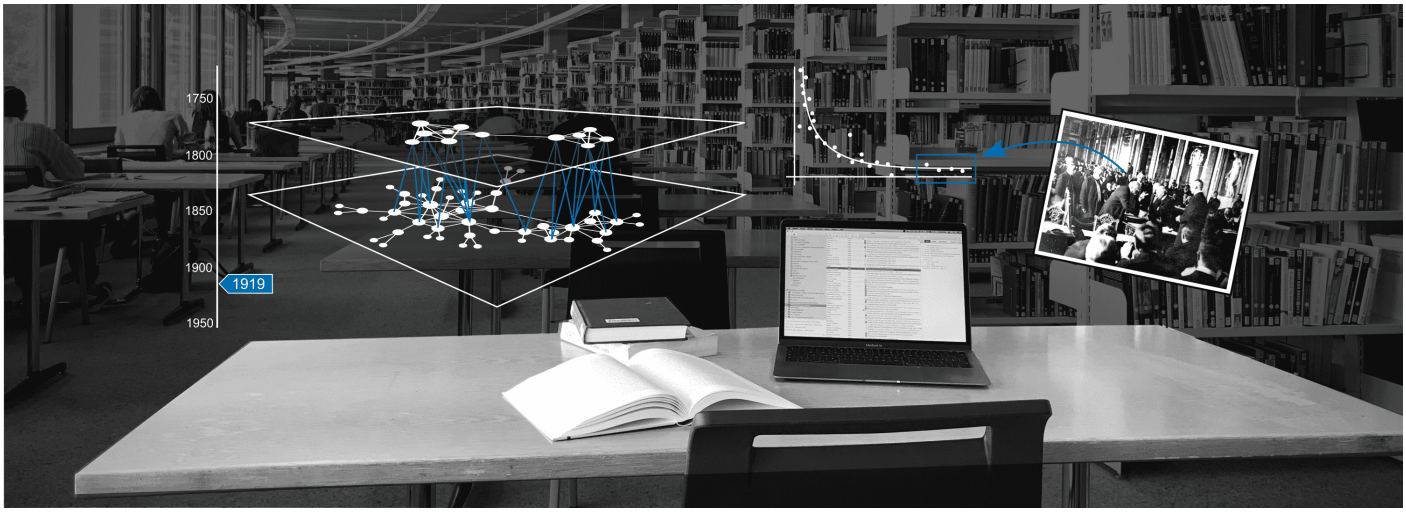

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The Journal of HISTORICAL NETWORK RESEARCH

CLÉMENT DUTREY

Distribution de l'information et stratégies relationnelles dans le corpus de correspondances amarniennes : approche par l'analyse de réseaux

Journal of Historical Network Research 6 (2021) 1–40

Keywords Amarna letters, network analysis, Amurru, Akhenaten, geopolitic

Abstract This study employs network analysis to investigate the relationships between the great kings of the Near East (Egypt, Mitanni, Hatti, Alashiya, Babylonia) and the mayors of the Syro-Palestinian region from the very end of Amenhotep III's reign to the beginning of the reign of Amenhotep IV-Akhenaten. Data are extracted from a sample of 83 letters from the el-Amarna corpus of correspondence discovered in Egypt (14th century B.C.). We focus on the distribution of information (actors and links) in the Amarna letters and how this distribution influences the shape of the Egyptian king's personal network. By means of a holistic approach, we highlight different groups of interactions and analyse their relational properties. We also show which type of interaction is predominant according to each group. Observations suggest that trade flows monopolised the attention of the great kings, who organised their close networks around these exchanges. On the other hand, the mayors of the Syro-Palestinian corridor are integrated into a network structured around war-related concerns. The study concludes by discussing possible developments based on this dataset.

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I. Introduction : Géopolitique et réseaux*

À l'époque d'el-Amarna (XIVe s. av. J.-C.), la géopolitique des grands ensembles proche-orientaux présente une configuration singulière, en net contraste avec ce que nous savons des périodes antérieures. Ainsi, la multitude des petits royaumes hourrites et sémitiques qui constellait la haute Mésopotamie a été unifiée en un puissant empire, celui du Mitanni/Hanigalbat (Carte 1). Plus à l'ouest, le royaume de Hatti s'étend de la plaine de Konya, au sud-ouest de l'Anatolie, jusqu'à Alep, en Syrie occidentale. L'ancrage territorial du Hatti hors de son berceau d'origine, l'Anatolie centrale, reste cependant fragile jusqu'à l'avènement de Šuppiluliuma Ier autour de l'année 1370, qui marque la phase d'apogée de l'empire. Dans le sud, les efforts des pharaons de la XVIIIe dynastie a permis une expansion territoriale continue et fulgurante depuis la reconquête du delta du Nil sous Ahmosis jusqu'à l'élévation d'une stèle frontière sur la rive de l'Euphrate par Thoutmosis Ier, entre la fin du XVIe et le début du XVe siècle. Cependant, le contrôle d'une aire géographique aussi vaste et hétérogène requiert un important effort militaire. Ainsi, à la fin du XVe siècle, juste avant le début de la période amarnienne, le découpage des territoires situés dans la zone tampon entre les deux empires n'a cessé de fluctuer sous l'impulsion des grandes forces de la région : l'Égypte, le Hatti et le Mitanni.

L'étude des rapports entre les différentes cours proche-orientales est une constante de l'historiographie de cette période. Les recherches récentes dans ce domaine tendent à mobiliser des cadres théoriques empruntés à l'anthropologie et aux Relations internationales[1] dans le but d'appréhender leur évolution à la fois à une échelle locale et régionale. Ces mouvements d'échelle sont justifiés par le système d'interdépendance dans lequel se trouvent pris les différents acteurs. Ainsi, les rapports de l'empire d'Égypte avec les nombreuses cités de la côte phénicienne ont été un facteur déterminant dans la construction de ses échanges avec les autres grands empires du nord (le Hatti et le Mitanni). Les jeux d'alliances et d'oppositions qui se nouent à cette échelle locale, celle des maires (en akkadien : *ḫazannu*) de Syrie et de Palestine, traduisent dans une certaine mesure, et à une plus large échelle, les luttes d'influence entre grandes puissances. Les fréquentes demandes de soutien militaire ou d'envoi de ressources adressées à la chancellerie égyptienne par les maires occupant les espaces frontaliers en vue de contenir les pressions exercées par les vassaux de la couronne hittite témoignent, en effet,

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1 Pour l'approche anthropologique, voir, par exemple, l'ouvrage de Pfoh, Emanuel. 2016. *Syria-Palestine in the late Bronze Age. An anthropology of politics and power,* Londres/New York : Routledge ; dans le domaine des Relations internationales : Liverani, Mario. 2001. *International relations in the Ancient Near East, 1600–1100 B.C.,* New York : Palgrave ; Westbrook, Raymond, et Cohen, Raymond (éd.). 2000. *Amarna diplomacy : the beginnings of international relations,* Baltimore/Londres : The Johns Hopkins University Press.

Carte 1 Le Proche-Orient c. 1350 av. n.è

d'une certaine forme de dépendance vis-à-vis du pouvoir central. À l'inverse, certains documents, en particulier des lettres envoyées par le pharaon à ses vassaux, montrent une volonté d'affermir une emprise territoriale chancelante en s'attachant les maires qui pourraient être tentés de passer un accord avec une puissance rivale : c'est notamment le cas d'Aziru, un chef amorrite sous obédience égyptienne, dont la sympathie manifeste pour l'Empire hittite finie par déclencher une réaction du pharaon à travers une lettre lourde de menaces[2]. Sur un plan méthodologique, la nécessité d'articuler l'étude des particularismes avec une vision d'ensemble des grandes forces à l'œuvre (contrôle de l'espace phénicien et cananéen par l'Égypte, opposition des empires du Hatti et du Mitanni, etc.) au travers d'ensembles impliquant parfois plusieurs centaines d'acteurs (maires, fonctionnaires égyptiens, grands rois, etc.) induit une importante difficulté. En réponse à cette difficulté, et dans la droite lignée des emprunts théoriques initiés ces dernières années, cette étude se propose de mobiliser l'analyse de réseaux pour appréhender les rapports entre les acteurs de la période amarnienne (deuxième moitié du XIVe siècle av. J.-C.). L'outil permet, en effet, de s'adapter avec souplesse aux changements d'échelles et d'intégrer dans une même analyse une grande quantité d'acteurs.

Dans le courant des années 70 du siècle dernier, l'analyse de réseaux a suscité un intérêt notable au sein des milieux académiques qui redécouvrent, dans le même temps, la sociologie de Georg Simmel (1858–1918)[3]. En posant la question des socialisations comme objet central de ses travaux, l'auteur allemand avait donné la priorité à l'étude des propriétés relationnelles sur un niveau que l'on qualifie parfois de « mésosociologique »[4] : à mi-chemin entre l'individu et la société prise dans son ensemble. L'objectif visait à s'affranchir dans une large mesure du déterminisme des structures et modèles posés a priori pour s'intéresser aux aspects organisationnels. De la théorie relationnelle de Simmel, l'analyse structurale contemporaine et l'étude des réseaux ont hérité une conception « dualiste » des structures sociales. Ce sont les interactions entre individus qui font émerger les structures perçues alors comme un cadre de contraintes et d'influences s'exerçant sur ces mêmes interactions[5]. Il s'agit là d'un des principes fondateurs de l'analyse de réseaux qui restitue sous la forme d'un maillage relationnel les interactions entre individus ou groupes d'individus, eux-mêmes assimilés à des points nodaux – ou nœud de relations.

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2 EA 162.

3 Cinalli, Manlio. 2009. « Analyse de réseaux », dans : Fillieule Olivier, Mathieu Lilian et Péchu Cécile (dir.). *Dictionnaire des mouvements sociaux,* Paris : Presses de sciences Po, col. Références, p. 31.

4 Mercklé, Pierre. 2004. *Sociologie des réseaux sociaux,* Paris : La Découverte, pp. 14–16.

5 Sur la théorie relationnelle de G. Simmel et l'influence d'autres pionniers (J. E. Barnes, E. Bott, J. S. Coleman, M. Granovetter, etc.) dans l'analyse structurale : Forsé Michel et Degenne Alain. 2004. *Les réseaux sociaux,* 2e éd., Paris : Armand Colin, pp. 6–11.

L'approche a largement bénéficié du développement du formalisme mathématique[6] et des logiciels de traitement de données[7] dans le dernier quart du XXe siècle. Leur diffusion à une large échelle a récemment trouvé une place dans les sciences historiques[8]. L'étude des correspondances ou des journaux intimes offre notamment un terrain fertile à l'analyse de réseaux et l'intérêt de faire dialoguer un formalisme fondé sur le comparatisme des profils relationnels avec une approche plus qualitative n'a pas échappé aux représentants de ce courant historiographique[9]. Dans la pratique, l'analyse de réseaux en histoire se heurte fréquemment au problème de la comparabilité des sources pour d'évidentes raisons de chronologie : la restitution d'une « image » des réseaux d'interactions à un instant donné peut difficilement intégrer les transformations constantes des propriétés relationnelles, l'apparition ou la disparition des acteurs, en bref, tout ce qui, sur une période de temps donnée, est soumis à un processus dynamique dont l'impact sur le tissu social ne saurait être négligé. La solution apportée par les recherches en matière « d'égo-documents »[10], notamment, consiste en un découpage par période des sources étudiées.

Dans le domaine de l'histoire ancienne, les études soutenues par l'analyse structurale et les mesures statistiques restent encore marginales[11]. Si certains *corpus* présentent les caractéristiques adaptées à ce genre d'approche – on en

6 Wasserman Stanley et Faust Katherine. 1994. *Social Network Analysis. Methods and Applications,* Cambridge : Cambridge University Press.

7 On ne compte plus les manuels relatifs aux différents logiciels d'analyse : Pajek, Ucinet, Gephi, R, etc. ; le manuel le plus utilisé dans cette étude est dédié au logiciel Ucinet : Borgatti P. Stephen, Everett G. Martin et Johnson C. Jeffrey. 2017. *Analysing Social Networks,* 2e éd., Londres : SAGE.

8 À ce sujet, voir la synthèse de Lemercier Claire. 2005. « Analyse de réseaux et histoire », *Revue d'Histoire Moderne et Contemporaine,* n° 52–2, pp. 88–112.

9 Les premiers essais dans ce sens datent des années 70 avec, notamment, l'ouvrage de Macfarlane, Alan. 1970. *The Family Life of Ralph Josselin, a Seventeenth-Century Clergyman : An Essay in Historical Antrhopology,* Cambridge : Cambridge University Press.

10 Beaurepaire Pierre-Yves et Taurisson Dominique, (éd.). 2003. *Les Ego-documents à l'heure de l'électronique. Nouvelles approches des espaces et réseaux relationnels,* Montpellier : Presses Universitaires de la Méditerranée.

11 Dans ce domaine, l'analyse de réseaux se mêle aujourd'hui aux expertises d'une multitude de terrains ; à titre d'aperçu, dans l'étude des religions : Collar, Anna. 2013. *Religious Networks in the Roman Empire : the Spread of News Ideas,* Cambridge : Cambridge University Press ; en archéologie : Graham, Shawn. 2006. *EX FIGLINIS. The Network Dynamics of the Tiber Valley Brick Industry in the Hinterland of Rome,* Oxford : British Archaeological Reports Oxford Ltd, International Series 1486 ; en prosopographie : Graham Shawn et Ruffini Giovanni. 2007. « Network Analysis and Greco-Roman Prosopography », dans : Keats-Rohan, Katharine, S. B., (éd.), *Prosopography. Approaches and Applications. A Handbook,* Oxford : Prosopographica et Genealogica 13. Étant donné que ce domaine est en pleine expansion, il est encore difficile d'obtenir une vue d'ensemble des études à l'œuvre ; on pourra cependant consulter, dans le domaine de l'archéologie : Camberlein, Claire. 2016. « Les réseaux en archéologie : approche historiographique et interdisciplinaire », *Archimède : Archéologie et Histoire Ancienne,* UMR 7044 – Ar-

trouve, notamment, dans le domaine du Proche-Orient ancien[12] –, il est vrai que l'aspect souvent fragmentaire des sources pose, de façon récurrente, le problème de la complétude du réseau. Ainsi, les limites des réseaux personnels sont souvent brouillées et leur importance, sur le plan quantitatif, est biaisée par la distribution de l'information, donnant aux approches comparatives un caractère hasardeux. Pour pallier ces difficultés, l'analyste se doit de porter une attention soutenue à la manière dont l'information est agencée dans les sources afin de dégager des grandes tendances à même d'orienter la lecture des textes. L'usage de l'analyse de réseaux en histoire ne doit donc pas être pensé comme une fin en soi, mais bien comme un outil ouvrant le dialogue vers une approche qualitative.

C'est dans cette logique que les archéologues Diane H. et Eric H. Cline ont publié, en 2015, une étude consacrée au corpus des correspondances amarniennes[13]. Daté du XIVe siècle av. J.-C., l'ensemble documentaire a été découvert dans les ruines de l'ancienne capitale d'Égypte, à el-Amarna. Il se compose de 382 tablettes d'argile, principalement des lettres, à destination d'Aménophis III (*v.* 1390–1353), puis de son successeur, Aménophis IV-Akhenaton (*v.* 1353–1336)[14]. Ces documents présentent des propriétés favorables à l'analyse structurale : réparties sur une courte période (entre 15 et 30 années selon les chronologies), les lettres d'el-Amarna révèlent un vaste réseau d'acteurs contemporains allant de l'Anatolie centrale, au nord, jusqu'à l'Égypte, en passant par l'ouest-syrien et l'ensemble du couloir syro-palestinien. L'essentiel du corpus provient des grandes cours royales proche-orientales (Hatti, Mitanni, Babylonie, Assyrie), ainsi que des principautés syro-palestiniennes sous contrôle égyptien. Le caractère fortement hiérarchisé du système dans lequel prennent place ces échanges est mis en

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chimède, pp. 127–34 ; et en Histoire, le compte rendu de Schaps David. 2010. « Review of Malkin Irad, *et al.,* (éd.). 2009. *Greek and Roman Networks in the Mediterranean,* Londres/New York : Routledge », *Scripta Classica Israelica,* XXIX, pp. 91–97.

12 Les études mobilisant l'analyse de réseaux dans ce domaine sont peu nombreuses. Il faut cependant souligner les travaux de Dulíková Veronika, Bárta Miroslav (éd.). 2020. *Addressing the dynamics of change in ancient Egypt : Complex network analysis,* Prague : Charles University, Faculty of Arts ; Juloux Vanessa (éd.), Gansell Amy et Di Ludovico Alessandro. 2018. *Cyberresearch on the Ancient Near East and Neighboring Regions : Case Studies on Archaeological Data, Objects, Texts, and Digital Archiving,* Digital Biblical Studies 2, Leiden et Boston : Brill ; Wagner Allon, Yuval Levavi, *et al.* 2013. « Quantitative Social Network Analysis (SNA) and the Study of Cuneiform Archives : A Test-case based on the Murašû Archive », *Akkadica,* 134, pp. 117–134 ; Brumfield, Sara. 2013. *Imperial Methods : Using Text Mining and Social Network Analysis to Detect Regional Strategies in the Akkadian Empire,* Los Angeles : PhD diss., University of California.

13 Cline Diane H. and Cline Eric H. 2015. « Text Messages, Tablets, and Social Networks : the ‹ Small World › of the Amarna Letters », dans : Mynářová, Jana, *et al.* (éd.), *There and Back Again – the Crossroads II,* Prague : Université Charles de Prague, pp. 17–42.

14 Les dates absolues des règnes pharaoniques pour l'époque d'el-Amarna ne peuvent être fixées avec certitude, nous les donnons à titre indicatif. D'après Hornung Erik, Krauss Rolf et Warbuton David A., (éd.). 2006. *Ancient Egyptian Chronology,* Boston et Leiden : Brill, p. 492.

exergue par l'usage d'un langage strictement normé : chaque acteur désigné dans les correspondances tient un rang qui induit l'usage de formules spécifiques. Une telle structuration pousse naturellement à considérer les acteurs en fonction de leur appartenance à tel ou tel groupe hiérarchique (le « club » des grands rois, les « vassaux », les messagers, les commissaires, etc.). L'étude de Diane et Eric Cline visait, notamment, à questionner la porosité et l'articulation de ces groupes au travers du modèle de *small-world*[15] développé par l'analyse de réseaux. Suivant ce modèle, les catégories discrètes – isolées et délimitées – traditionnellement mobilisées peuvent être assouplies en tenant compte de l'aspect fluide et mouvant de leurs limites : dans la logique de l'analyse de réseaux, les routes qui unissent Amarna à Babylone *carry the diplomats, the trade embassies, and the activities that tie people to each other in a social way. (…) the trade routes are thus also the conduits or flow for social ties ; they are the edges that link nodes.*

L'approche développée par Diane et Eric Cline est ancrée dans une perspective davantage holistique qui ne prend pas en considération les attributs associés aux connexions à l'échelle des réseaux personnels, c'est-à-dire, les différents types de liens pouvant unir les acteurs. Dans une optique légèrement différente, donc, ce travail se propose d'articuler l'approche structurale (les statistiques portant sur le réseau dans son ensemble) avec la prise en compte des modalités d'interactions et de connexions à l'échelle des réseaux personnels. Il s'agira également de porter une attention soutenue à la manière dont l'information est distribuée dans les sources. L'objectif de cette approche est double : établir un profil de l'archive permettant d'isoler les enjeux qui ont accaparé l'attention des expéditeurs et la manière dont l'information s'agence autour de ces enjeux, puis utiliser ce profil comme cadre de lecture aux stratégies et aux comportements adoptés par les acteurs. La construction du profil de l'archive doit reposer sur l'extraction des données nécessaires à l'analyse de réseaux (types de liens et d'acteurs), leur partitionnement et leur hiérarchisation, alors que l'analyse stratégique opère à une échelle plus restreinte, proche du réseau personnel et s'intéresse qualitativement à la manière dont les acteurs s'intègrent et interagissent dans le tissu social. Ce dernier point doit être directement relié à la notion de capital de ressources. En effet, dans la logique du réseau, la capacité des acteurs à capter les flux de ressources environnants peut être vue comme une donnée décisive quant à leur faculté à résoudre un problème donné. En accord avec ces objectifs, la constitution d'un échantillon répondant aux contraintes de chronologie et d'informations (ensembles d'acteurs contemporains/pas d'isolat) constitue la première étape de cette étude.

15 Selon la définition retenue par les auteurs, *a small world is a network of social relationships in place such that it took only few ‹ hops › for one individual to reach another, via connections with people who can provide short cuts because they know a lot of people. (In other words) Small World consists of dense clusters connected by a small number of bridges that are quantifiable.* » Cline D. H. and Cline E. H. « Text Messages, Tablets, and Social Networks… », pp. 33–34.

2. Méthodologie

On admet généralement que la période couverte par le dossier des correspondances amarniennes oscille entre quinze et trente années – tout dépend du temps accordé à la corégence d'Aménophis III/Aménophis IV (Akhenaton) et d'Aménophis IV/Smenkhkarê[16]. Sur ce laps de temps, le réseau des interactions amarniennes, tel qu'il est attesté à travers la correspondance diplomatique, a connu de profondes transformations encouragées par les bouleversements géopolitiques dans le nord-palestinien et en Syrie : les mouvements des troupes hourrites dans l'Amurru et dans l'Amqu, les campagnes syriennes de Šuppiluliuma, le roi hittite, ou encore, l'émergence progressive de l'Amurru comme entité politique autonome. La restitution d'une image « stable » des interactions entre acteurs paraît dès lors compromise si l'on considère la période amarnienne dans son entièreté. Si l'on procède par découpage périodique, on peut isoler des ensembles de sources concentrés sur un laps de temps « court » et faisant intervenir des groupes d'acteurs non isolés les uns des autres. Ce dernier point peut en fait être directement évacué à partir de la question chronologique. De fait, les travaux visant à restituer la séquence des évènements en chronologie relative s'appuient précisément sur la recherche de synchronismes et mettent donc en évidence les connexions entre groupes d'individus. Le choix de la période sélectionnée pour notre étude s'appuie sur le découpage chronologique habituellement retenu pour partitionner le dossier amarnien. La structure générale, définie en grande partie par Campbell dans les années 60 du siècle dernier[17], s'appuie sur la succession des règnes pharaoniques. La période que nous retenons ici s'étend de la fin du règne d'Aménophis III (de l'an XXXVIII) jusqu'au début du règne indépendant d'Akhenaton – soit une fenêtre d'environ huit années[18]. L'ensemble des lettres correspondant à cette période[19] a l'avantage d'être quantitativement plus important que la moyenne des autres périodes ; par ailleurs, elle permet l'identification d'un nombre remarquable d'acteurs (99). Parmi eux, on mentionnera Rib-Hadda, le maire de Byblos, dont les lettres occupent une large part du dossier et consti-

16 Parmi les quelques ouvrages de référence : Kitchen, Kenneth A. 1962. *Suppiluliuma and the Amarna Pharaohs ; a Study in Relative Chronology,* Liverpool : Liverpool University Press ; Campbell, Edward F. 1964. *The Chronology of the Amarna Letters,* Baltimore : The Johns Hopkins Press ; Redford, Donald B. 1967. *History and Chronology of the Eighteenth Dynasty of Egypt,* Toronto : University of Toronto Press ; Krauss, Rolf. 1978. *Das Ende der Amarnazeit : Beiträge zur Geschichte und Chronologie des Neuen Reiches,* Hildesheim : Hildesheimer ägyptologische Beiträge, 7.

17 Campbell, Edward F., *The Chronology of the Amarna Letters.* La structure générale du découpage opéré par Campbell reste toujours d'actualité bien qu'un certain nombre de publications soit venu depuis affiner notre compréhension de la chronologie des tablettes. Pour un résumé, on consultera : Moran, William. 1992. *Amarna letters,* Londres : The John Hopkins University Press, pp. 34–39.

18 *Ibid.,* pp. 134–137.

19 EA 1–5, 6, 17–24, 31–32, 34–39, 45, 46–48, 60–65, 68, 71–95, 97 (?), 131, 232, 237 (?), 242–45, 249, 252–254, 270 (?), 271, 275–76, 277 (?), 278, 285–86, 369.

tuent un point de repère utile dans la chronologie des évènements – on désignera à plusieurs reprises, et par commodité, la période associée comme « la première période Rib-Hadda » (RH1). Notons que la présence récurrente du maire de Byblos parmi les expéditeurs induit un biais non négligeable quant à l'information qu'il nous est possible d'extraire du groupe de tablettes sélectionné – nous y reviendrons par la suite.

L'élaboration d'un graphe des relations entre les acteurs et les mesures subséquentes reposent nécessairement sur la construction d'une base de données. Suivant le principe de l'analyse de réseaux, les données peuvent être classées en deux grandes catégories : les points *nodaux* représentent les acteurs et les *liens* signifient les connexions et interactions entre ces acteurs. Ceux-ci sont, pour l'essentiel, des individus. Toutefois, il est parfois possible d'isoler des entités non réductibles à un individu, qui interviennent de façon remarquable dans le réseau : une frange de la population de Byblos, par exemple, courtisée par Abdi-Aširta, qui menace de se révolter contre leur maire. De tels groupes sont alors désignés en accord avec les dénominations employées dans les sources : « les hommes d'Irqata », « les hommes de Byblos », « les troupes *habiru* » qui désignent, à certaines reprises, des bandes armées bien spécifiques, etc. Dans d'autres cas, les acteurs peuvent être des cités dont l'identité du dirigeant est inconnue ; on le précise alors dans le graphe (Fig. 1) et entre parenthèses (cité).

L'ensemble de ces données est issu d'une lecture minutieuse du groupe de tablettes sélectionné : à chaque fois qu'une connexion entre acteurs est relevée dans le texte, les informations sont stockées dans un fichier en colonnes. L'enregistrement qu'on a choisi d'adopter tient compte de tous les acteurs identifiables dans les correspondances : il arrive, en effet, qu'un acteur soit évoqué de manière trop succincte, sans qu'il soit possible d'établir précisément à qui l'expéditeur de la lettre fait référence. C'est le cas, notamment, de la désignation « pays d'Amurru » utilisée à plusieurs reprises par Rib-Hadda. Dans la perspective de l'auteur, l'expression renvoie à une pluralité d'individus dont on ne connaît pas les contours et qui entretient des relations dont la nature n'est pas toujours claire : des soutiens contraints ou volontaires d'Abdi-Aširta, le prince amorrite, mais également des éléments d'opposition. On considère qu'il n'est pas possible, dans ce cas, d'assimiler l'expression à un nœud de relations et on préfère donc, quand cela est possible, étudier séparément les acteurs constitutifs de cet ensemble afin de ne pas risquer de confondre dans un même niveau d'analyse des éléments de nature trop éloignée.

Insistons ici sur le fait que l'unité de base choisie pour l'élaboration du réseau est « l'acteur politique » et non l'individu. Par acteur politique, on entend une entité disposant de suffisamment d'autonomie pour se lier et/ou interagir avec d'autres entités, que ce soit de son propre chef ou sous la pression d'une contrainte, en vue de réaliser un objectif donné. De plus, on admettra qu'un acteur, pour être considéré comme tel, doit avoir un impact suffisant sur le réseau

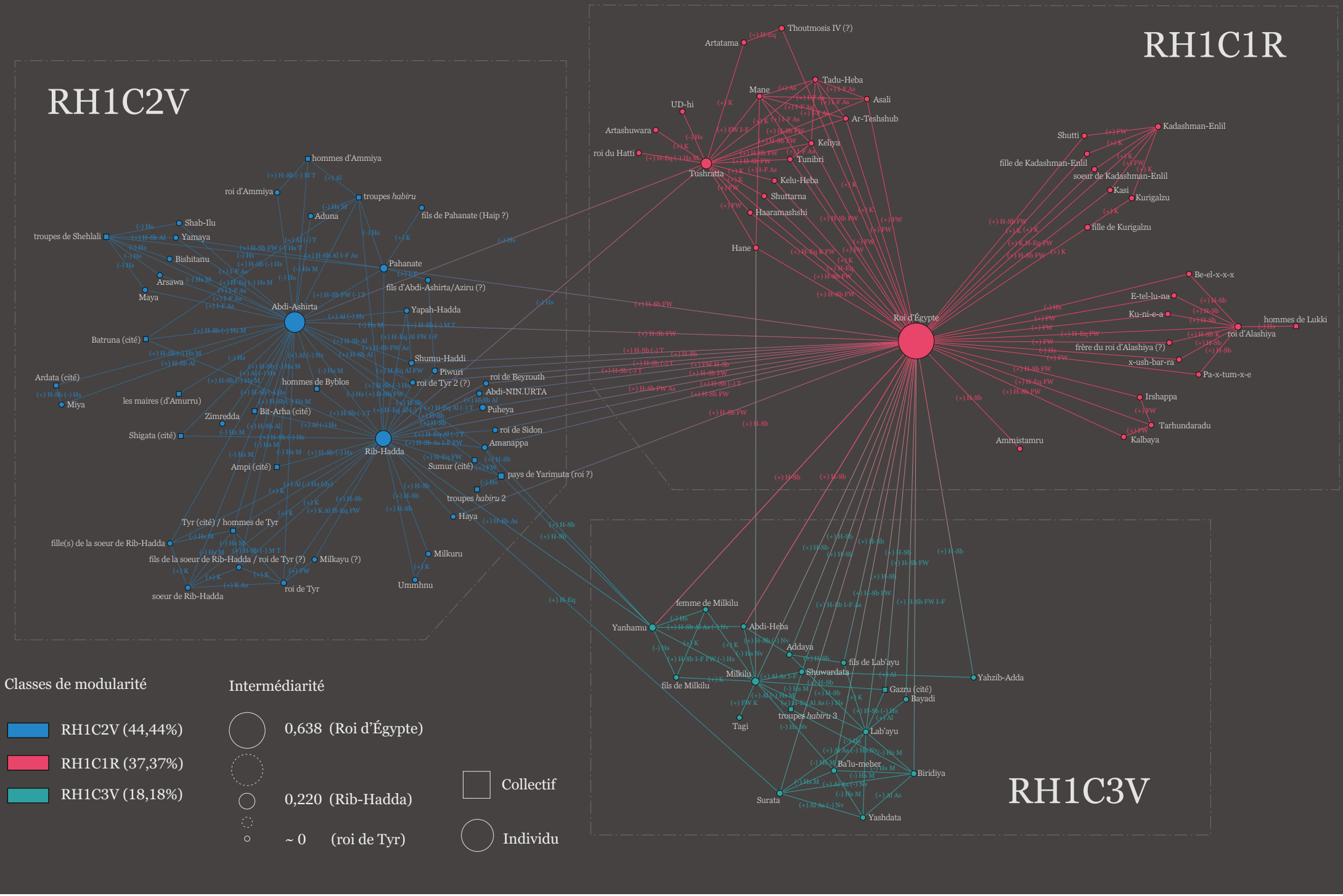


Fig. 1 Graphe des clusters de relations pour la période RH1

pour modifier l'environnement relationnel de ses contacts directs, et ainsi altérer ou renforcer leurs propres objectifs ; à ce titre, il doit présenter un certain nombre de caractéristiques permettant de l'identifier et de le différencier du reste de son environnement. La mention d'un messager sans plus d'indications constitue un simple élément intermédiaire, et a priori interchangeable, sans influence notable sur les objectifs de l'expéditeur qui en fait la mention : nous ne l'intégrons donc pas à l'analyse. A contrario, une épouse dont l'autonomie, et donc la capacité de prise de décision, peut être très limitée, constitue le marqueur d'une stratégie d'alliance matrimoniale. Il s'agit d'un élément parfaitement identifiable dans l'environnement relationnel qui influence notablement le lien entre les individus unis par son intermédiaire – son influence dans le réseau est suffisamment remarquable pour que nous l'admettions dans l'analyse. En accord avec la définition que nous venons de donner, la mention d'un collectif, comme une cité-État, peut être mis sur un même niveau d'analyse qu'un maire : les deux sont parfaitement identifiables, disposent d'une capacité d'action similaire et leur impact sur le réseau peut être considéré, dans la plupart des cas, comme sensiblement équivalent.

L'apparition de certains collectifs dans la documentation amarnienne présente, toutefois, des difficultés supplémentaires – mais non insurmontables – en termes d'analyse de réseaux. C'est le cas, notamment, des populations *habiru*. Dans les correspondances amarniennes, le terme *habiru* renvoie, le plus souvent, à un ensemble diffus et amorphe, synonyme de « rebelle à l'autorité égyptienne »[20]. À ce titre, il paraît difficile d'assimiler le groupe à une unité du réseau dont les contours doivent être bien définis. Néanmoins, en certaines occasions, les expéditeurs rapportent des interactions spécifiques impliquant un groupe de population *habiru*. Dans ce contexte en particulier, le collectif cesse d'être une évocation diffuse pour devenir un groupe homogène et cohérant, capable d'entreprendre des actions élaborées issues d'un processus décisionnel. Ainsi, certains groupes tissent des alliances avec des maires et d'autres s'impliquent militairement dans une campagne. L'analyse du contexte permet donc de préciser dans quelle mesure la mention du collectif correspond ou non à la définition de l'acteur politique. Étant donné que les groupes acteurs désignés sous un même terme (*habiru,* maires d'Amurru, etc.) ne sont pas assimilables entre eux, nous les numérotons en fonction de leur ordre d'apparition (*habiru* 1, 2,...). À titre informatif, et par souci de lisibilité, on distingue les groupes de différentes natures dans la légende du graphe (Fig. 1).

20 Sur les bandes de *habiru,* on consultera : Waterhouse, S. Douglas. 2001. « Who are the Habiru of the Amarna Letters ? » *Journal of the Adventist Theological Society,* vol. 12, pp. 31–42 ; Na'aman, Nadav. 1986, « Habiru and Hebrew : The Transfer of a Social Term to the Literary Sphere », *Journal of Near Eastern Studies,* 45, pp. 271–288 ; Bottero Jean. 1980. « Entre nomades et sédentaires : les Habiru », *Dialogues d'histoire ancienne,* 6, pp. 201–213 ; pour une liste des sources associée à ces populations : Bottero, Jean. 1954, « Le problème des Habiru à la 4e Rencontre Assyriologique Internationale », coll. : Cahiers de la Société Asiatique, vol. 12, Paris, pp. 15–21, 90.

L'objectif est ici de restituer une image des interactions telles qu'elles étaient connues par la chancellerie égyptienne au travers des sources. Bien entendu, ce tableau est tronqué, en raison des lacunes de la documentation puisque les archives de la chancellerie ne nous sont pas parvenues dans leur totalité. La découverte des tablettes amarniennes au cours de fouilles clandestines à la fin du XIX^{e} siècle nous interdit, en effet, d'apprécier le contexte archéologique et l'état de l'archive au moment de l'excavation. Ainsi, le nombre total de documents extrait reste, à ce jour, inconnu. Par ailleurs, l'ensemble des correspondances sélectionné pour l'étude a été produit, dans des proportions irrégulières, par un nombre conséquent d'expéditeurs (20) ; Rib-Hadda étant de loin l'auteur le plus prolifique, nous devons considérer que l'information accessible est fortement dépendante de la vision que le maire giblite avait du réseau d'interactions. En d'autres termes, l'échantillon considéré ne représente qu'une fraction biaisée de l'information que contenait l'archive complète – aujourd'hui perdue. Ce que nous sommes amenés à observer ne peut donc pas être considéré comme le « réseau complet » des interactions entre acteurs du système d'échange amarnien mais comme une part restreinte des contacts entretenus avec le roi d'Égypte, c'est-à-dire, de son « réseau personnel ». C'est pourquoi les interprétations des mesures d'ensemble du réseau ici considérées doivent être lues à la lumière de ces contraintes. En étudiant la distribution de l'information en fonction des différents expéditeurs (voir profil de l'archive), l'objectif est donc tout autant d'interroger les relations entre les acteurs que le rapport des historiens aux sources et les conclusions qu'il est légitime d'en tirer.

On remarque d'emblée, dans le corpus, un grand nombre d'occurrences associé à certains acteurs : Abdi-Aširta est, par exemple, mentionné dans 95 lettres réparties entre 5 expéditeurs, ce qui pourrait donner à penser que nous disposons d'une image *relativement* représentative de ce qui a capté l'attention des expéditeurs, et donc des individus les plus influents dans le réseau. La prise en compte des catégories traditionnellement mobilisées pour situer les acteurs (princes, rois, maires, messagers, épouses…) ne se fera qu'au niveau de l'analyse textuelle des sources. À l'échelle du réseau, le rôle des acteurs peut être évalué, dans une certaine mesure, en fonction de leur position (centre-périphérie)[21] et du type de lien qu'ils entretiennent avec les autres membres : à titre d'exemple, l'épouse du maire de Tyr et sœur de Rib-Hadda, le maire de Byblos, occupe une position périphérique dans le réseau des correspondances du secteur nord palestinien et entretient, principalement, des liens de parenté avec son entourage (Fig. 1) ; elle apparaît comme le marqueur d'une stratégie d'alliance matrimoniale entre les cours tyrienne et giblite.

21 Dans le cadre de cette étude nous nous limiterons à une lecture topologique et n'utiliserons pas les outils de décomposition k-shell/k-core.

En ce qui concerne l'enregistrement des liens, on a, tout d'abord, procédé à un relevé systématique, suivi d'une description complète des informations disponibles sur les relations enregistrées. En fonction des récurrences observées, on a établi une typologie des connexions répondant à un critère quantitatif : dans chaque catégorie, il faut un nombre suffisant de relations pour être significatif dans les différents stades de l'analyse (pas de type de liens uniques). Douze catégories ont ainsi été définies et réparties en deux grands groupes : les relations « positives » (+) qui englobent la plupart des échanges pacifiques et apparaissent structurantes dans la stabilité du réseau (hiérarchie, parenté, etc.) ; les relations « négatives » (–)[22] qui s'apparentent davantage à des facteurs d'instabilités (liens d'hostilité, confrontation armée, etc.) – un exemple des données tirées de la tablette EA 68 est donné en annexe.

Les relations entre individus ont ensuite été insérées dans un fichier lisible par le logiciel de visualisation Gephi[23].

Une fois les données enregistrées et mises en forme, on visualise plus aisément la manière dont l'information est répartie dans la séquence des tablettes en fonction de leur provenance et on peut ainsi construire un profil de l'archive.

22 Sur l'analyse des graphes signés (liens négatifs et positifs), on peut consulter le célèbre article de Leskovec Jure, Huttenlocher Daniel, Kleinberg Jon. 2010. « Signed networks in social media », dans : *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* Association for Computing Machinery, New York, pp. 1361–1370.

23 Les statistiques générales des réseaux sont tirées du logiciel Gephi. Pour des mesures plus spécifiques on utilise le logiciel UCINET. Pour passer d'un format de fichier adapté à Gephi vers UCINET, on construit les matrices adjacentes des graphes : dans le cas d'un graphe simple non orienté (*c.-à-d.,* pas de boucle sur un même sommet et des liens non orientés), il s'agit de matrices carrées et symétriques où les acteurs sont disposés sur la première ligne et la première colonne – pour 99 acteurs, on obtient un tableau de $99^2 = 9\,801$ entrées. Les relations sont signifiées par un 1 dans les cellules correspondantes, alors que l'absence de relation est marquée par un 0. Le passage du fichier en colonnes formaté pour Gephi à la matrice adjacente est assuré par un script développé en Python.

Ctgr. (+/–)	Abb.	Types de lien	Description
+	**H**	*Liens de hiérarchie*	Subordination (Sb) ou égaux (Eq)
+	**H – Sb**	*Subordination*	Un supérieur et son subordonné
+	**H – Eq**	*Égaux*	Rang équivalent
+	**As**	*Assistance*	Aide ponctuelle accordée par un partenaire
+	**K**	*Parenté*	Relations de parenté
+	**FW**	*Flux*	Échange de biens et/ou d'informations dans la durée
+	**Al**	*Alliance*	Engagement mutuel d'aide en cas de guerre
+	**I – F**	*Relation informelle*	Relations non formelles (marques affectives, faveurs)
–	**Hs**	*Hostilité*	Relation négative dans la durée
–	**M**	*Confrontation armée*	Affrontement ponctuel
–	**T**	*Trahison/révolte*	Rupture d'engagement/révolte
–	**Nv**	*Confrontation « non violente »*	Délation, accusation, rapport d'activité sur un partenaire hostile

Tab. 1 Typologie des relations

3. Profil de l'archive

La séquence correspondant à la « première période Rib-Hadda » comprend 83 tablettes[24] en provenance de 20 expéditeurs[25]. Sur ces 83 lettres, 69[26] apportent des informations exploitables (acteurs, connexions) en vue de la visualisation du réseau. Elles révèlent un ensemble de 99 acteurs connectés entre eux par 220 liens

24 EA 1–6, 17–24, 31–32, 34–39, 45, 46–48, 60–65, 68, 71–95, 97(?), 131, 232, 237(?), 242–245, 249, 252–254, 270(?), 271, 275–276, 277(?), 278, 285–286, 369.

25 Rib-Hadda : EA 68, 71–95, 131 (?) ; Tušratta : EA 17–23, 24 ; Abdi-Aširta : EA 60–65 ; le roi d'Alashiya : EA 34–39 ; Biridiya : EA 242–44, 245 (?) ; Amenhotep III : EA 1, 5, 369 ; Kadashman-Enlil : EA 2, 3 ; Lab'ayu : EA 252–54 ; Milkilu : EA 270 (?), 271 ; Baʿlu-meher : EA 249 ; le roi d'Égypte : EA 4, 31 ; Abdi-Heba : EA 285–86 ; Bayadi : EA 237 (?) ; Yapah-Hadda : EA 97 ; Tarhundaradu (?) : EA 32 ; Ammishtamru : EA 45 ; Burnaburiyash : EA 6 ; Surata : EA 232 ; Shuwardata : EA 278 ; Yahzib-Adda : EA 275–76, 277 (?).

26 On élimine notamment les tablettes trop fragmentaires ou présentant des redondances d'informations ; on utilisera : EA 1–3, 5, 17, 19–24, 31–32, 34–35, 37–39, 45, 47, 60, 62–65, 68, 71, 73–79, 81–95, 97, 131, 232, 237, 242–45, 249, 252–54, 270–71, 275–276, 278, 285–86, 369.

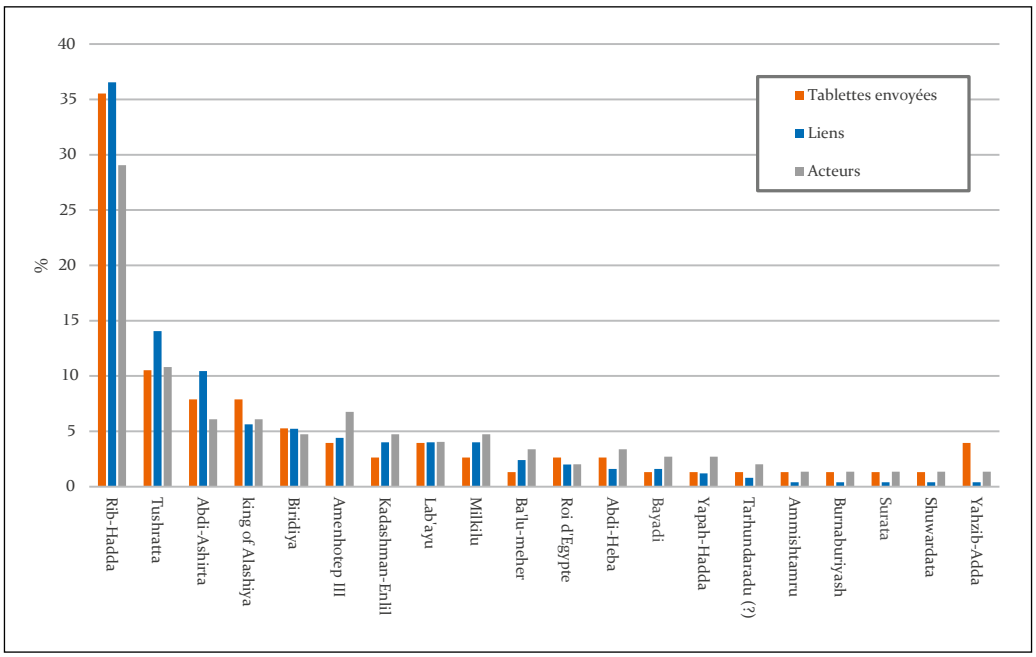


Fig. 2 Histogramme du nombre de tablettes expédiées et de la quantité d'informations en fonction des expéditeurs (%).

(tous types confondus). Le profil de l'archive montre une sur-représentation des lettres en provenance de Byblos (27), suivies de loin par celles de Tušratta du Mitanni (8) et d'Abdi-Aširta d'Amurru (6). On constate, par ailleurs, que la proportion d'informations délivrée par un expéditeur est directement corrélée au nombre de lettres expédiées. En effet, 36,8 % des connexions et 29,1 % des acteurs identifiés le sont d'après les lettres de Rib-Hadda (35,5 % des lettres de la séquence) ; en suivant, Tušratta et Abdi-Aširta nous donnent, respectivement, 14 % et 10,4 % des connexions et 10,8 % et 6,1 % des acteurs. À eux trois, ces expéditeurs fournissent donc plus de la moitié de l'information contenue dans la séquence (61,2 % des connexions et 46 % des acteurs). La figure 2 montre la proportion des liens et acteurs révélés par les différents expéditeurs mis en regard du nombre de tablettes expédiées.

Dans les grandes lignes, la reconstitution du réseau associée aux tablettes pour la période considérée repose donc sur l'information transmise par Rib-Hadda au roi d'Égypte – suivie par celle apportée par Tušratta et Abdi-Aširta. Cette information implique pour plus de moitié les relations « au premier degré » de l'expéditeur (ses liens directs) et permet, dans une moindre mesure, de relever ou déduire des connexions entre tiers – à titre d'exemple, lorsque Rib-Hadda rapporte l'assassinat du maire d'Ammiya par une faction de sa propre cité, il n'est pas possible de préciser la relation entre le maire assassiné et Rib-Hadda, il s'agit donc d'une connexion entre tiers (EA 73, 74, 81). Ainsi, sur les 43 acteurs identifiés dans

les lettres de Rib-Hadda, 30 (69,8 %) sont directement reliés à l'expéditeur. On trouve des résultats encore plus tranchés chez les autres correspondants principaux : 100 % des acteurs identifiés chez Tušratta et Abdi-Aširta sont, en effet, directement reliés à l'expéditeur. Le réseau amarnien apparaît donc comme une juxtaposition d'égo-réseaux des expéditeurs dont l'importance en termes quantitatifs (nombre d'acteurs et de connexions) est, comme on pouvait s'y attendre, fortement corrélée à la quantité de lettres échangées. On constate, de plus, que les acteurs possédant les degrés de connexion les plus élevés sont aussi ceux dont la participation au dossier de correspondance est la plus importante : degré égal à 33[27] pour Abdi-Aširta, 30 pour Rib-Hadda et 17 pour Tušratta. Le roi d'Égypte, quant à lui, que l'on assimile avec Aménophis III[28], a un degré égal à 53. La prévalence de l'ego-réseau d'Abdi-Aširta sur celui de Rib-Hadda, alors que ce dernier précède le prince amorrite quant à la quantité de lettres expédiées, suppose que les relations d'Abdi-Aširta sont connues d'expéditeurs tiers, ce que l'on établira par la suite.

La prise en compte de l'origine et de la distribution des informations permet d'établir, ici, un cadre de lecture pour le traitement des données.

4. Analyse du réseau et profils relationnels

Le prérequis indispensable au traitement des données réside dans leur partitionnement et leur hiérarchisation. Dans le panel d'outils fourni par l'analyse de réseaux, la visualisation permet d'isoler en un aperçu les différentes composantes de la structure étudiée. On utilise dans ce but l'algorithme de spatialisation ForceAtlas2 qui, comme l'a mis en évidence A. Noack, tend à faire émerger des communautés de nœuds fortement reliés entre eux[29] : les sommets s'éloignent les uns des autres suivant le modèle de répulsion des charges électriques ($F_r = k/d^2$ où k est un facteur d'échelle et d la distance entre deux sommets), alors que les nœuds liés entre eux sont soumis à une attraction tirée de la force de rappel d'un ressort ($F_a = -k.d$)[30]. Sans entrer dans les détails, on conçoit aisément que les groupes de plus grande densité (qui canalisent les interactions) vont s'agencer de manière à

27 En analyse de réseaux, le degré d'un nœud désigne le nombre de liens connectés à ce nœud.

28 Bien que l'incertitude demeure quant au destinataire de certaines tablettes, en particulier pour EA 18, 32, 34–39, 46–48, 237, 270, 285, 277, on désignera le ou les pharaons de cette période sous le terme de « roi d'Égypte ». L'acception recouvre ici un sens général équivalente au « pouvoir égyptien » qu'on assimile à un nœud unique dans le réseau.

29 Noack, Andreas. 2009. « Modularity clustering is force-directed layout », *Physical Review E,* 79, p. 2.

30 Tous les détails sur l'algorithme sont disponibles dans : Jacomy Mathieu, Tommaso Venturini, *et. al.* 2011. « ForceAtlas2, a continuous graph layout algorithm for handy network visualization », *Medialab center of research,* p. 560.

former des agrégats. On voit ainsi se dessiner (Fig. 1) trois ensembles distincts de nœuds ou *clusters*[31] qui concentrent, d'une part, la population des grands rois en lien avec le pharaon et leur proche entourage (RH1C1R[32]), d'autre part, les acteurs impliqués dans le conflit en Amurru qui gravitent autour de son principal instigateur, Abdi-Aširta, et de son opposant, Rib-Hadda (RH1C2V). On relève aussi un troisième ensemble, celui des *ḫazannu*[33] implantés au sud des possessions égyptiennes au Levant – Milkilu, Lab'ayu, Ba'lu-meher, etc. –, caractérisé notamment par la présence d'un fonctionnaire de haut rang, Yanḫamu, le flabellifère (*muṣallil*) du roi[34]. On notera que les ensembles ainsi constitués tiennent compte de tous les types de liens enregistrés. Ce que nous visualisons n'est pas le réseau complet des interactions définies en rapport avec une problématique – comme ce que les sociologues ont l'habitude de traiter lors d'une enquête sur une population donnée. Il émerge, cependant, des structures relativement cohérentes : leur construction repose sur l'information en lien avec les sujets qui ont focalisé l'attention des expéditeurs ; chaque *cluster* renvoie donc à une thématique dominante dans le groupe de correspondances qui lui est associé. Il suffit, pour s'en convaincre, de relever le type de liens prépondérants à l'intérieur de chacun des trois *clusters*[35] – ce qu'on visualise avec la figure 3.

Le cluster RH1C1R – le groupe dans lequel se concentrent les grands rois – se distingue tout de suite des groupes RH1C2V et RH1C3V – les groupes de « vassaux » – dont les profils présentent de fortes similitudes. L'analyse du groupe des grands rois nécessiterait de plus amples développements, mais nous nous contenterons ici de quelques remarques. On constate, tout d'abord, que les références à des liens d'hostilités (Hs) de même que les témoignages d'affrontements (M) y sont quasi absents. Ce qui participe à l'idée, bien établie aujourd'hui, selon laquelle les échanges entre grandes puissances forment un ensemble pacifié, dominé par les règles de la *diplomatie*[36]. L'essentiel des connexions dans le *cluster*

31 L'application d'un algorithme de Louvain sur l'ensemble du réseau a permis de définir trois « classes de modularité » (Fig. 1) qui correspondent exactement à l'identification « visuelle » des trois clusters.

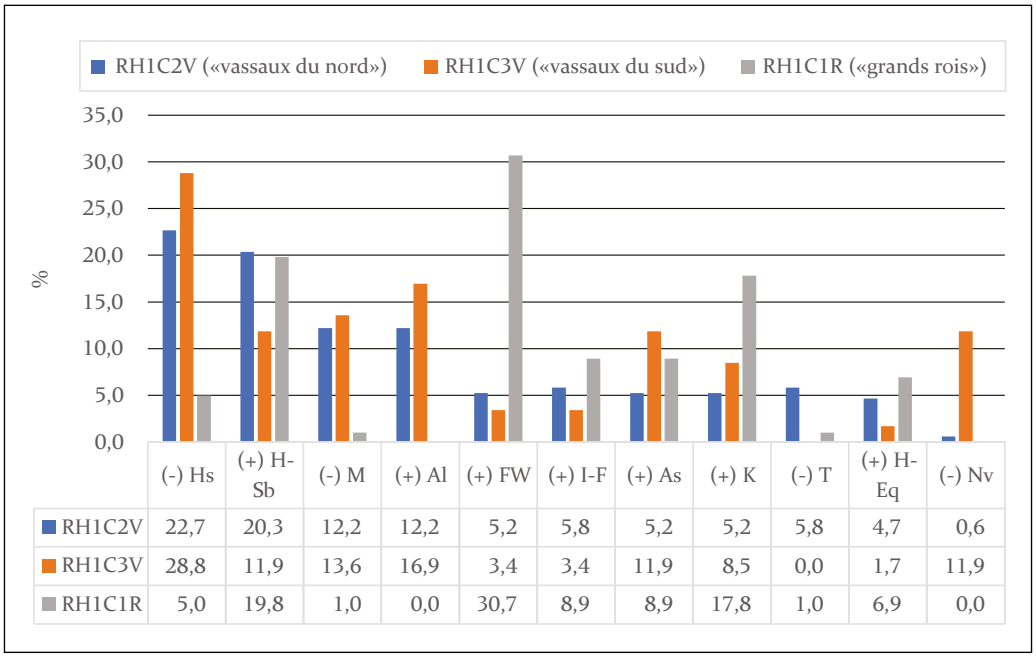
32 On étiquette les clusters RH1C1R, pour « Rib-Hadda première période, Cluster n°1, grands rois », RH1C2V, pour « Rib-Hadda première période, cluster n°2, vassaux » et RH1C3V.

33 Dans les correspondances amarniennes, les gouverneurs locaux sont fréquemment désignés par le terme *ḫazannu* (« maire »), ou encore *awilu* (« homme »), quelques fois *šarru* (« roi ») ou encore, d'après le mot égyptien, *wr* (« prince »).

34 Voir EA 106, l. 38 et Moran, William. 1987. *Les lettres d'el-Amarna,* Paris : Éditions du Cerf, p. 303, n° 8.

35 Les lettres dont on extrait les liens internes aux différents *clusters* sont, pour RH1C2V : EA 60, 62–65, 68, 71, 73–79, 81–95, 97, 131 ; RH1C3V : EA 85, 232, 237, 242–245, 249, 252–254, 270–271, 275–76, 278, 285–286, 369 ; RH1C1R : EA 1–3, 5, 17, 19–24, 31–32, 34–35, 37–39, 45.

36 Berridge, Geoffrey. 2000. « Amarna diplomacy : a full-fledged diplomatic system ? », dans : Westbrook, Raymond et Cohen, Raymond, *Amarna diplomacy, The beginnings of international relations,* pp. 212–213 ; sur l'équilibre des puissances et la régulation des



	(-) Hs	(+) H-Sb	(-) M	(+) Al	(+) FW	(+) I-F	(+) As	(+) K	(-) T	(+) H-Eq	(-) Nv
RH1C2V	22,7	20,3	12,2	12,2	5,2	5,8	5,2	5,2	5,8	4,7	0,6
RH1C3V	28,8	11,9	13,6	16,9	3,4	3,4	11,9	8,5	0,0	1,7	11,9
RH1C1R	5,0	19,8	1,0	0,0	30,7	8,9	8,9	17,8	1,0	6,9	0,0

Fig. 3 Histogramme des profils relationnels des clusters (%)

est distribué entre les liens de hiérarchies (H-Sb), les flux d'échanges (FW) et les relations de parenté (K). Les deux dernières catégories renvoient aux préoccupations dominantes du dossier de la correspondance « internationale » : l'octroi de dons à travers la pratique des cadeaux de salutations (*šulmanu*)[37], les négociations de mariage et la circulation des ressources via les dots[38]. Les liens de hiérarchie, quant à eux, mettent en évidence le groupe des messagers, quantitativement dominant dans le *cluster*. Leur rôle d'intermédiaire est souligné dans le

rapports entre les grandes cours proche-orientales : Cohen, Raymond. 1996. « On diplomacy in the ancient Near East : the Amarna letters », *Diplomacy & Statecraft* 2, pp. 245–270 ; Westbrook, Raymond, et Cohen, Raymond (éd.). 2000. *Amarna diplomacy : the beginnings of international relations,* Baltimore/Londres : The Johns Hopkins University Press ; l'ouvrage phare de Liverani, Mario. 1990. *Prestige and Interest, International Relations in the Near East ca. 1600–1100 B.C.*, Padoue : Sargon srl.

37 Voir Zaccagnini, Carlo. 1973. *Lo scambio dei doni del Vicino Oriente durante i secoli XV–XIII,* Orientis Antiqui Collectio – XI, Rome : Centro per le antichità e la storia dell'arte del vicino oriente ; dans la ligné de : Liverani, Mario. 1972. « Three Amarna essays », *Oriens Antiquus,* 11, pp. 297–317.

38 Voir, en particulier : Pintore, Franco. 1978. *Il Matrimonio Interdinastico nel Vicino Oriente durante i Secoli XV–XIII,* coll. Orientis Antiqui Collectio, vol. XIV, Rome : Centro per le antichità e la storia dell'arte del vicino oriente, p. 105 ; Michalowski, Piotr. 1975. « The Bride of Simanum », *Journal of the American Oriental Society,* 95, pp. 716–719 ; Schulman, Alan R. 1979. « Diplomatic Marriages in the Egyptian New Kingdom », *Journal of the Near Eastern Studies,* 38, pp. 177–193.

graphe (Fig. 1) par leur position comme point de jonction entre les grands rois. Il est intéressant de noter la manière dont le messager égyptien Mane est intégré dans le réseau mitannien à la différence de ses homologues cantonnés au rôle de vecteurs d'informations et de biens. Il s'agit là d'une singularité dans le dossier amarnien où un messager révèle des fonctions dépassant le cadre de simple communicant[39]. En effet, resté en poste plusieurs années à la cours hourrite, Mane a pu développer un réseau personnel englobant des membres de la famille royale, ainsi que des hauts dignitaires chargés de délivrer les messages à la cour égyptienne. Plus largement, le graphe montre que, durant la période considérée, les cours babylonienne, chypriote et mitanienne avaient une communication régulière avec l'Égypte. Le grand absent de ces échanges est, en revanche, le Hatti. Ce dernier point peut sans doute s'expliquer par des lacunes dans la documentation, mais nous savons par ailleurs que la communication entre Hattuša et Thèbes[40] s'était refroidie un peu avant la période amarnienne[41].

En ce qui concerne les groupes de « vassaux », les références à des liens d'hostilité (Hs) sont clairement majoritaires (22,7% dans RHIC2V et 28,8% pour RHIC3V). De même, les témoignages d'affrontements violents (M) entre acteurs occupent une part non négligeable de l'ensemble des connexions dans RHIC2V (12,2%) et RHIC3V (13,6%). La communication des groupes de « vassaux » est donc principalement dirigée vers l'aspect conflictuel des contextes qui leurs sont propres. Ainsi, en regroupant les liens, positifs comme négatifs, associés à ces conflits – que ce soient les relations d'alliance mobilisées contre un adversaire, les flux de ressources visant à supporter l'effort militaire et, plus largement, la plupart des relations négatives – on obtient environ 80% des interactions dans RHIC2V et 85% dans RHIC3V ; c'est donc au prisme des antagonismes internes aux groupes de « vassaux » qu'il nous faut étudier les profils relationnels.

Malgré de fortes similitudes, des propriétés distinctes émergent entre les deux *clusters* au regard des paramètres de formes et du spectre relationnel. En effet, sur le plan topologique, la partie du graphe associée à RHIC2V montre une ar-

39 Bryce, Trevor, R. 2003. *Letters of the Great Kings of the Ancient Near East : The Royal Correspondence of the Late Bronze Age,* New York et Londres : Routledge, p. 76.

40 L'installation de la cours à Akhetaton dut avoir lieu après l'an V d'Akhenaton. Un *terminus post quem* nous est fourni par les tablettes EA 17, 19–21 et 24–25, de quatre ou cinq ans antérieures à EA 23, datée par l'inscription en hiératique « an XXXVI, 4e mois de l'hiver » d'Aménophis III, voir Moran, William, *Les lettres d'el-Amarna,* p. 48 ; Campbell, Edward F, *The Chronology of the Amarna Letters,* p. 38 ; Starke, F. 1981. « Zur Deutung der Arzaụ̂ụ̂a-Briefstelle VBot 1, 25–27 », *Zeitschrift für Assyriologie,* vol. 71, n° 2, pp. 221–231, a notamment réfuté les arguments pour une date antérieure de la correspondance d'Arzaụ̂ụ̂a.

41 Freu, Jacques. 2005. *Suppiluliuma et la veuve du pharaon, Histoire d'un mariage manqué – Essai sur les relations égypto-hittites,* Paris : L'Harmattan, XXVIII–XXIX ; Sur la crise que traverse le royaume hittite à cette période : Bryce, Trevor. 1998. *The Kingdom of the Hittites,* Oxford : Oxford University Press, pp. 158–67.

chitecture polarisée autour d'Abdi-Aširta et de Rib-Hadda, alors que RH1C3V présente une structure quelconque, faiblement dominée par Milkilu (10 degrés) et Lab'ayu (9 degrés, pour un degré moyen de 3,667 dans le *cluster*). Cette différence doit être mise en regard du nombre d'expéditeurs attaché à chaque ensemble : le groupe des « vassaux du nord » est, en effet, dominé à 89 % par les lettres de Rib-Hadda, alors que l'information est répartie de manière plus homogène entre 9 expéditeurs[42] pour le groupe des « vassaux du sud ». Corrélé au fait que le *ḫazannu* de Gubla (Byblos) a consacré la quasi-entièreté de sa communication à alerter la chancellerie égyptienne sur la menace amorrite[43], c'est sans surprise que l'agencement du réseau met en avant le maire giblite et son principal opposant. Du côté des « vassaux du sud », la pluralité des expéditeurs n'est pas un facteur suffisant pour expliquer la structuration du graphe. La répartition des liens d'hostilité se fait de manière globalement uniforme dans le *cluster* sans qu'il soit possible de définir une convergence forte vers un sommet ou groupe de sommets spécifique. Par ailleurs, les évènements rapportés par les maires du sud n'ont pas l'ampleur des troubles signalés par Rib-Hadda : à la racine de l'émergence du royaume amorrite comme entité politique autonome prête à s'émanciper de la tutelle égyptienne[44]. L'ensemble témoigne donc d'oppositions diffuses, généralisées et davantage caractéristiques de rivalités d'échelle locale. L'analyse textuelle des lettres associées au *cluster*[45] conforte cette interprétation. Elle révèle, en effet, des comportements opportunistes peu favorables à la formation de groupes cohésifs. On peut prendre pour exemple les évènements rapportés en EA 243–45 qui s'agencent autour de la triade négative[46] Biridiya-Lab'ayu-Surata. D'après Biridiya de Meggido, Lab'ayu, le *ḫazannu* de Schechem a tenté d'exploiter à son avantage le retrait temporaire des troupes égyptiennes et un épisode d'épi-

42 Abdi-Heba : EA 285–86 ; le roi d'Égypte : EA 369 ; Ba'lu-meher : EA 249 ; Bayadi : EA 237 ; Biridiya : EA 242–44, 245 ; Lab'ayu : EA 252–54 ; Milkilu : EA 270–71 ; Rib-Hadda : EA 131 ; Šuwardata : EA 248. Sur la localisation précise des tablettes et de leur correspondant voir en particulier : Na'aman Nadav, Goren Yuval, Finkelstein Israel. 2004. *Inscribed in clay : provenance study of the Amarna tablets and other Near Eastern texts,* Tel Aviv : Emery and Claire Yass Publications in Archaeology.

43 EA 68, 71–79, 81–95, 131.

44 Sur l'émancipation d'Amurru : Benz, Brandon C. 2016. *The Land before the Kingdom of Israel : A History of the Southern Levant and the People who Populate It,* Winona Lake : Eisenbrauns, pp. 141–166 ; Liverani, Mario. 1965. « Implicazioni sociali nella politica di Abdi-Aširta di Amurru », *Rivista degli studi orientali,* 40.4, pp. 267–277 ; et, en particulier : Singer, Itamar. 1991. « A concise history of Amurru », dans : Izre'el, Shlomo, *Amurru Akkadian : a linguistic study,* vol. 2, [Series], Harvard Semitic Studies, vol. 41, pp. 135–195 ; Altman, Amnon. 1978. ‹ The revolutions in Byblos and Amurru during the Amarna Period and their Social Background ›, dans : Artzi, Pinhas, (éd.), *Bar-Ilan Studies in History,* vol. 1, Ramat-Gan.

45 EA 85, 237, 243, 244, 245, 249, 253, 254, 270, 271, 278, 285, 286, 369.

46 Les triades négatives ou déséquilibrées sont, dans la théorie de l'équilibre structural, « non rationnelles » – elles brisent la chaîne logique « les ennemis de mes amis sont mes ennemis » – dans un réseau, il s'agit généralement d'une instabilité : Mercklé, Pierre, *Sociologie des réseaux sociaux,* pp. 61–63.

démie dans la cité de Biridiya pour y mettre le siège (EA 243–244). En EA 245, la situation est renversée et Biridiya mène l'assaut au côté d'un de ses alliés, Yašdata (un autre *ḫazannu* ?), contre le maire de Schechem. Il est cependant devancé par Surata, le maire d'Akka, qui parvient à capturer Lab'ayu. Finalement, et contre l'usage voulant que le fauteur de trouble soit déporté en Égypte, Surata décide de livrer Lab'ayu à Ḫinnatuna (?) contre rançon (*badiú,* EA 245, l. 34–35) – devenant ainsi la cible d'une dénonciation de la part de Biridiya. Ce triple conflit d'intérêt témoigne de la pluralité des enjeux propres aux acteurs qui, semble-t-il, a favorisé une « inconstance » et une instabilité structurale des relations positives – donnant lieu a des déclarations parfois contradictoires. Ainsi, dans les tablettes EA 249 et 250, Ba'lu-UR.SAG (= Ba'lu-meher) dénonce les agissements de Milkilu, le maire de Gezer, qui, allié à Lab'ayu, « a (causé) la perte du pays du roi[47] ». A contrario, la tablette EA 254 de Lab'ayu rapporte l'hostilité de Milkilu à son encontre, tournant précisément autour de la prise de Gezer et, vraisemblablement, du partage du butin : « Lorsque je (Lab'ayu) suis entré dans Gazru, j'ai dit continuellement ‹ Tout ce qui est à moi, le roi le prend, mais où est, ce qui appartient à Milkilu ? › Je sais ce que fait Milkilu contre moi ![48] ». On notera par ailleurs que les maires asiatiques n'avaient pas le monopole des actes de prédation, comme en atteste la tentative d'extorsion du *muṣallil* Yanḫamu rapportée par Milkilu : « Que le roi connaisse les actes que Yanḫamu commet sans cesse contre moi (...) il veut de moi 2000 sicles d'argent, et il me dit : ‹ Donne-moi ta femme et tes fils, ou je te tuerai. ›[49]. »

Plus généralement, le rapport des maires avec la hiérarchie égyptienne module de manière significative le déroulé des conflits tel qu'il nous est rendu dans les sources. Le rôle des *rabi* dans l'arbitrage des litiges et l'encadrement des provinces a été abondamment décrit[50] ; nous nous limiterons à quelques remarques par une mise en parallèle des profils relationnels de RH1C2V et RH1C3V (Fig. 3). Le nombre de liens de hiérarchie (H-Sb) semble a priori corrélé aux relations maires-commissaires : dans le groupe des maires du sud, 6 des 7 liens hiérarchiques sont en effet de ce type. Sachant que ces liens sont presque toujours évoqués dans le cadre d'une demande d'assistance d'un « vassal » vers un grand, nous pourrions y voir un indicateur de la tendance des maires à solliciter leur hiérarchie. Pour RH1C2V, cependant, la proportion de liens maires-commissaires ne représente qu'une part de l'ensemble des relations de subordination (H-Sb), soit

47 EA 250, l. 48–54.
48 EA 254, l. 16–29.
49 EA 270, l. 9–21.
50 Parmi de nombreuses études : Mohammad, Abdul-Kader. 1959. « The administration of Syro-Palestine during the New Kingdom », dans : *Annales du Services des Antiquités de l'Égypte,* 56, pp. 105–137 ; Albright, William F. 1966. *The Amarna Letters from Palestine, Syria, the Philistines and Phoenicia,* Cambridge : Cambridge University Press, p. 7–12 ; Na'aman, Nadav. 1981. « Economic Aspects of the Egyptian Occupation of Canaan », *Israel Exploration Society,* 31, n° 3/4, pp. 172–185.

13,5% de la totalité des connexions. La différence avec le groupe des « vassaux » du sud (11,9%) n'est donc pas significative.

Le critère de relations antagonistes « non-violentes » (Nv – délation ou accusation) offre une meilleure piste de réflexion. Ce type de connexion est fréquemment révélé dans le cadre d'une accusation à destination du roi (parfois d'un *rabû*) porté par un maire à l'encontre d'un de ses pairs et s'inscrit donc fréquemment dans une triade. Notons que ces liens sont relevés lorsque le conflit entre deux acteurs reste cantonné à des accusations ou des dénonciations mais ne dégénèrent pas en affrontements. La faible valeur de cet indice dans RH1C2V (0,6%) ne signifie donc pas que les pratiques d'accusation y sont absentes, mais seulement qu'elles sont très souvent supplantées par de véritables conflits armés. A contrario, le taux nettement plus élevé (11,9%) pour RH1C3V tend à montrer que le procédé est, ici, vraisemblablement plus efficace dans la gestion des conflits. Ainsi, en EA 249, alors que les hommes de Ba'lu-UR.SAG « accomplissent leur service aux jours de Milkilu[51] », ce dernier les soumet à un traitement cruel : *ils ont été frappés !*[52] Ba'lu-UR.SAG saisit alors le roi afin d'être dégagé de ses obligations envers Milkilu. D'autre part, en EA 250, Ba'lu-UR.SAG dénonce les agissements des fils de Lab'ayu qui tentent de le recruter sous la menace : *fais la guerre (avec nous) (…) et si tu ne fais pas la guerre, alors nous serons tes ennemis*[53]. Ba'lu-UR.SAG veut ici de se prémunir contre un conflit direct en sollicitant l'intervention égyptienne. De nouveau, en EA 245, Biridiya accuse Surata d'avoir livré son ennemi capturé, Lab'ayu, à un autre maire contre rançon. On comprend sans peine que Biridiya aurait préféré voir son adversaire définitivement écarté par une déportation à la cour du roi afin de ne pas risquer une nouvelle attaque contre sa cité. Pour chacun de ces cas, les maires cananéens tentent de mobiliser l'intervention du roi dans la défense de leurs intérêts – ces intérêts sont ici, tous d'ordre sécuritaire. Il ne nous est pas donné de savoir dans quelle mesure le pouvoir central a répondu à ces sollicitations, bien qu'il soit coutume d'évoquer le désintérêt de l'Égypte pour les « affaires étrangères » à partir du règne d'Akhenaton[54]. Que les litiges et les conflits locaux soient remontés sous forme de plaintes à la cour montrent, cependant, que l'Égypte avait déjà fait la démonstration de sa capacité à imposer un arbitrage[55] et à châtier ceux qui ne respectaient pas un semblant d'ordre[56]. Dans le nord, toutefois, la situation paraît avoir été différente. Comme

51 EA 249, l. 4–10.
52 EA 249, l. 10–17.
53 EA 250, l. 15–27.
54 Vandersleyen, Claude. 1995. *L'Égypte et la vallée du Nil,* t. 2, Paris : Presse Universitaire de France, p. 465.
55 Sur les litiges soumis à l'arbitrage des commissaires, voir, par exemple, l'affaire opposant Yapah-Hadda et Rib-Hadda : EA 105.
56 Une stèle érigée à Karnak sous le règne d'Aménophis II nous apprend que la tribu de Khatithana (?), qui avait résisté au pharaon lors de ses campagnes asiatiques, se trouva entiè-

le montre la faiblesse de l'indice Nv, les nombreuses plaintes établies par Rib-Hadda à l'encontre d'Abdi-Aširta et de ses alliés n'ont pas suffi à empêcher la progression des Amorrites et les affrontements[57]. Plusieurs hypothèses peuvent être formulées pour expliquer cette différence. Les cités du sud étant nettement plus proches de la frontière égyptienne et de l'importante ville de garnison de Gaza[58], il est possible que les maires de cette région aient été soumis à un contrôle plus étroit de la part des fonctionnaires égyptiens. D'autre part, l'état de division interne alimenté par les rivalités semble avoir limité la menace que pouvaient représenter les acteurs de cette région. Il se pourrait, au contraire, que dans le nord, l'Égypte n'ait pas disposé localement des moyens pour faire face à l'émergence d'un pouvoir fort et organisé – comme en témoigne la prise de la ville de garnison de Ṣumur par les Amorrites[59] et les difficultés du commissaire Yanḫamu à faire reconnaître son autorité : « Vois, auparavant le commissaire de Ṣumur tranchait entre nous, mais maintenant aucun maire ne l'écoute ! »[60] Afin de cerner plus en détail les propriétés des oppositions internes à RH1C2V, il nous faut recourir à une analyse plus fine des caractéristiques structurales du graphe associé ; une attention toute particulière doit être prêtée à la manière dont l'information mobilisée est agencée dans les sources.

5. Le cluster des maires du nord

Comme évoqué précédemment, la reconstitution du réseau interne à RH1C2V dépend majoritairement des lettres de Rib-Hadda (27 tablettes), suivies de loin par Abdi-Aširta (6) et Yapah-Hadda, le maire de Beyrouth (1). Par ailleurs, quatre des lettres expédiées par Abdi-Aširta (EA 61, 63, 64, 65) sont soit trop fragmentaires, soit des accusés de réception qui n'apportent aucune information exploitable pour cette étude. Dans les deux tablettes restantes (EA 60 et 62) le prince

rement déportée : *ARE,* 308 ; des exemples d'actes punitifs sont également connus dans le *corpus* amarnien : EA 252, 254, 313. Les expéditions résultant en une déportation ou des exécutions sommaires des rebelles faisaient également partie de l'arsenal coercitif des Hittites : *CTH* 49 ; *PRU* IV, RS 17.132,17.140 (dossier II A) ; *CTH* 62 I ro., 12. Voir aussi : Hoffmeier, James K. 2004. « Aspects of egyptian foreign policy in the 18th dynasty in western Asia and Nubia », dans : Knoppers, Gary N. et Hirsch, Antoine, (éd.), *Egypt, Israel, and the ancient mediterranean world. Studies in honor of Donad B. Redforf,* Probleme der Ägyptologie 20, Leiden et Boston : Brill, 4.

57 EA 68, 71–95, 131.

58 Helck, Wolfgang. 1960. « Die ägyptische Verwaltung in den syrischen Besitzungen », dans : *Mitteilungen der Deutschen Orient-Gesellschaft zu Berlin,* 92, pp. 1–13 ; Liverani, Mario. 1963. *Introduzione alla storia dell'Asia anteriore antica,* Rome : Centro di Studi Semitici, pp. 221–222 ; de Vaux, Roland. 1968. « Le pays de Canaan », *Journal of the American Oriental Society,* 88, p. 27.

59 EA 62, 76.

60 EA 118, l. 45–56.

amorrite se présente sous le jour du défenseur des pays du roi face à la menace que font peser « les princes soumis au roi des troupes hourrites (Tušratta)[61] ». Si l'on admet, comme le fait Na'aman, que la présence d'Abdi-Aširta a Irqata (EA 62, l. 21–24) coïncide avec les évènements rapportés par Rib-Hadda en EA 75 et 88[62] qui précèdent la chute de la ville de garnison de Ṣumur, alors la correspondance d'Abdi-Aširta doit être située à une période où son entreprise de conquête est déjà bien avancée. Son action favorisée par la poussée des Hourrites dans le secteur sud-syrien[63] a sans doute déjà focalisé l'attention des maires cananéens et induit la production de rapports à destination de la chancellerie égyptienne – ce que vient étayer l'accusation portée par le pouvoir central à l'encontre d'Abdi-Aširta : « Tu es un ennemi de l'Égypte et tu as commis un crime contre les Égyptiens[64] ». Dès lors, l'objectif d'Abdi-Aširta doit être de limiter autant que possible le risque de représailles en entretenant l'image du serviteur loyal et en passant sous silence ses agissements compromettants ; quelques années plus tard, son fils applique avec succès une stratégie similaire du « gain de temps » pour se mettre en sécurité au moyen d'un traité conclu avec les Hittites[65].

Les informations fournies par le prince amorrite sont donc filtrées à dessein et ne donnent aucun renseignement quant à son réseau personnel. Pour accéder à ces données, il faut nous tourner vers les lettres en provenance de Byblos qui occupent la plus large part de ce dossier. L'objectif de Rib-Hadda est bien différent, si ce n'est opposé : sur les 27 lettres de la séquence, 23 contiennent des appels lancés au pharaon dans le but d'obtenir une aide militaire face à la pression amorrite[66]. Il s'agit donc pour le maire giblite de motiver l'intervention de sa hiérarchie dans le conflit en faisant la démonstration de la menace que représente Abdi-Aširta pour les possessions égyptiennes. De fréquents rapports faisant état de l'évolution de la situation accompagnent ainsi ses envois. Bien que le maire tende à appuyer de façon outrancière son importance dans la protection des intérêts égyptiens au Levant, nous n'avons pas de raison de douter de la véracité de ses rapports : le sort du maire dépend, en effet, de la prise au sérieux de sa communication et du déploiement de troupes que les informations transmises peuvent faciliter.

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61 EA 60, l. 13–19.

62 Na'aman Nadav, Goren Yuval, Finkelstein Israel. 2003. « The expansion of the kingdom of Amurru according to the petrographic investigation of the Amarna tablets », *Bulletin of the American schools of oriental research,* 329, p. 9 ; pour une restitution de la chronologie relative associée aux « vassaux du nord », voir : Campbell, Edward F., *The Chronology of the Amarna Letters,* p. 77–89.

63 EA 85, 86.

64 EA 62, l. 4–10.

65 *HDT,* n° 5, p. 37.

66 EA 71, 73–79, 81–94, 131.

Il nous faut ici noter que la distribution des correspondances parmi les expéditeurs du *cluster* induit un biais spécifique dans notre compréhension du conflit. L'essentiel des informations provenant du dossier de Gubla (Byblos) et ce dossier étant focalisé sur la menace amorrite, il ressort l'impression que la lutte a été dominée par l'antagonisme Rib-Hadda/Abdi-Aširta. Cet « effet de sources » participe, graphiquement, à la polarisation des sommets et des connexions autour des deux belligérants. Il serait pourtant malavisé de conclure que Byblos fut le principal élément de barrage à la progression amorrite. Si la ville paraît avoir été la dernière des grandes cités de la côte phénicienne à maintenir son allégeance, il n'est fait mention d'aucune tentative de contre-offensive. La stratégie déployée par Rib-Hadda vise, de toute évidence, à accroître et à maintenir une capacité de résistance suffisante jusqu'à obtenir l'aide tant espérée : « si le roi ne peut pas me sauver de ses ennemis, alors tous les pays se joindront à Abdi-Aširta[67] ». Il est possible, dans une certaine mesure, de restituer les modalités de la mise en application de cette stratégie par une analyse croisée des réseaux personnels de Rib-Hadda et d'Abdi-Aširta – les deux réseaux étant structuralement liés de par l'orientation de l'information sur laquelle repose leur élaboration (*cf. précédemment*). En juxtaposant, les graphes des relations « positives » (Fig. 4) et « négatives » (Fig. 5) des liens internes au *cluster,* nous obtenons une image de la capacité ou de l'intention des deux antagonistes à mobiliser des capitaux de ressources dans le conflit – principalement d'ordre militaire et économique ; dans une moindre mesure, nous pouvons visualiser l'action d'éléments tiers dont les agissements sont indépendants des prises de décisions des princes amorrite et giblite. Afin de tenir compte de l'action de tous les acteurs influents dans le conflit, nous intégrons à l'analyse deux éléments hors *cluster* : le roi d'Égypte et le haut fonctionnaire Yanḫamu.

Les statistiques générales des réseaux donnent une première série d'indicateurs quant aux propriétés des ensembles relationnels.

Tout d'abord, la mesure de densité correspond au rapport du nombre de connexions réalisées dans le graphe sur l'ensemble des connexions possibles ; dans le cas d'un graphe non orienté simple (*c.-à-d.* pas de boucle sur un même sommet), il s'agira de la somme des n premiers termes d'une suite arithmétique de raison 1 et de premier terme 0 ; soit, pour 47 sommets $S_n = 47 \times (47 - 1)/2 = 1081$ connexions potentielles. Comme le nombre de sommets est identique dans les deux graphes, le paramètre est donc le nombre de connexions. On constate que, dans les deux cas, la densité des liens est globalement faible (< 8 %), ce qui traduit des ensembles peu cohésifs. Le fait qu'elle soit de peu supérieure dans le graphe des relations positives (7,6 %) par rapport à celui des relations négatives (4,9 %) montre que les expéditeurs révèlent davantage les liens positifs du réseau. D'autre part, le nombre de composantes connexes, traduisant le nombre d'ensembles iso-

67 EA 79, l. 34–47.

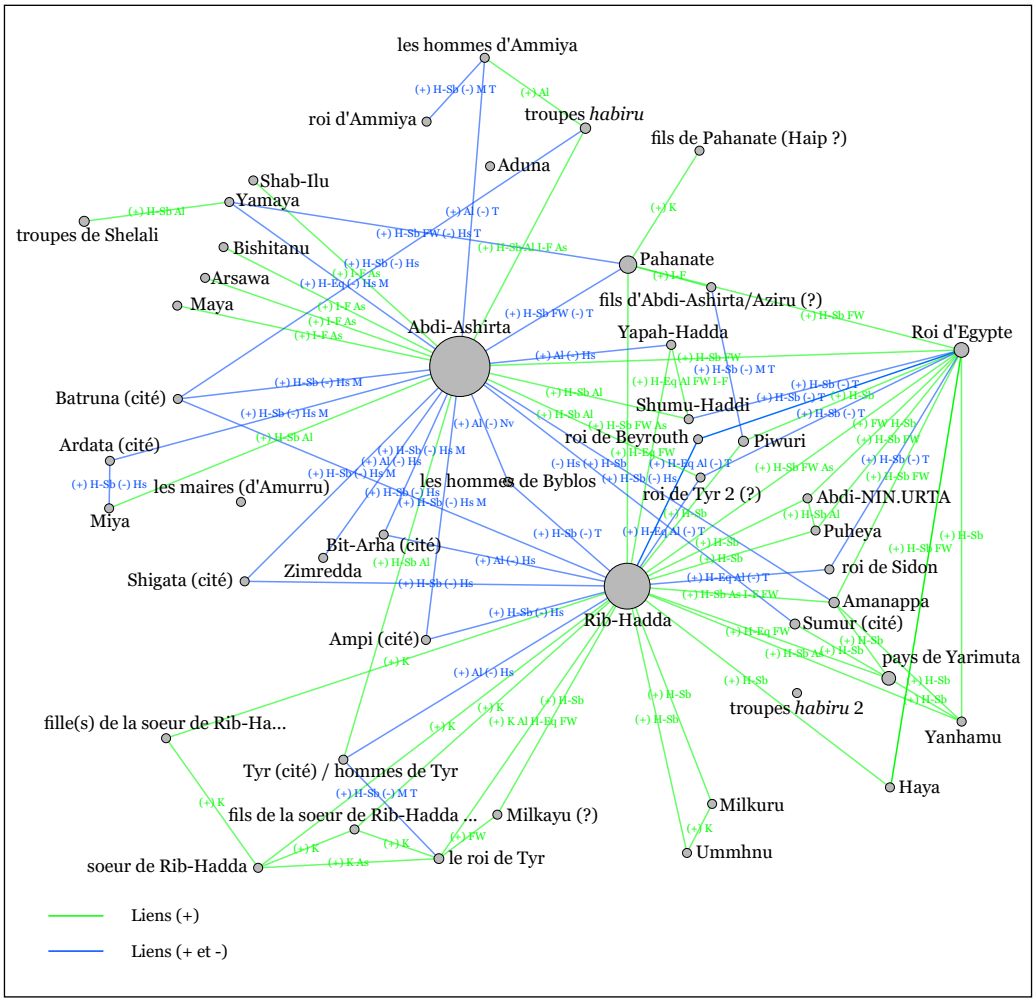

Fig. 4 Réseau (n° 1) des liens positifs (vert) et combinés (positifs et négatifs, bleu) du cluster RHI

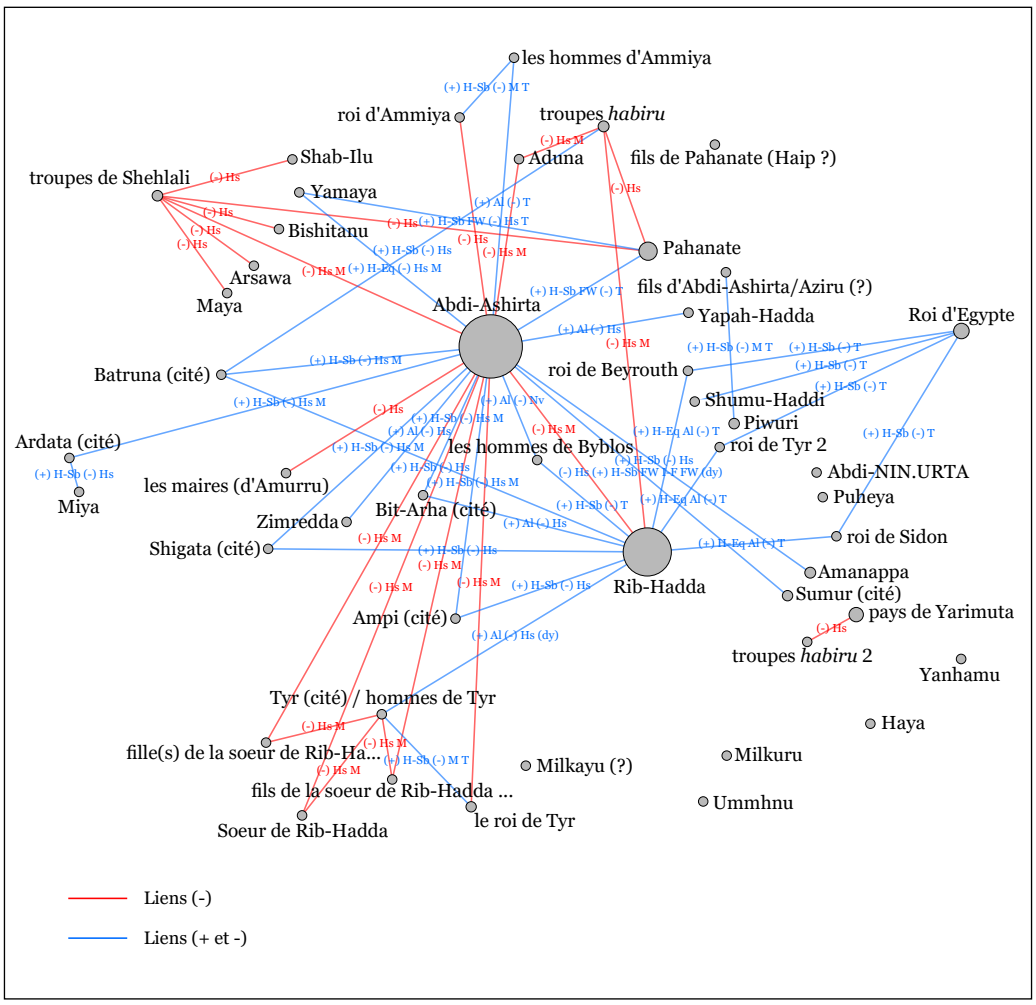

Fig. 5 Réseau (n° 2) des liens négatifs (rouges) et combinés (bleu) du cluster RH1C2V

	Réseau 1 (+ et combinés)	Réseau 2 (– et combinés)
*Ordre**	47	47
Liens	82	53
Degré moyen	3,489	2,255
Diamètre	5	6
Densité	0,076	0,049
Composantes connexes	4	11
Plus court chemin	2,358	2,526

* Le nombre de nœuds dans le réseau.

Tab. 2 Statistiques générales des réseaux

lés les uns des autres, est beaucoup plus important pour les liens négatifs que positifs ; autrement dit, les liens positifs unissent davantage de sommets que les connexions négatives – principalement, en raison du nombre important de relations de hiérarchie dans le réseau des liens positifs. Enfin, les diamètres (5 pour le réseau 1 contre 6 pour le réseau 2), de même que les moyennes de la longueur du chemin le plus court (2,358 pour le réseau 1 et 2,526 pour le réseau 2) n'offrent pas de différences significatives et témoignent donc davantage de la similitude des deux ensembles.

Du point de vue du réseau, la capacité des acteurs à mobiliser des ressources en vue d'un objectif donné réside dans leur façon d'exploiter le tissu relationnel environnant[68]. Afin d'évaluer de façon qualitative les ressources à disposition des acteurs et les stratégies qui en découlent, il nous faut chercher des régularités dans la manière dont les différents types de connexions s'agencent les uns par rapport aux autres : les relations d'assistance (As) s'établissent-elles plus facilement entre des acteurs impliqués dans des échanges à plus long terme (FW) ? Ou bien les liens d'alliances (Al) concernent-ils davantage des individus sur un même niveau hiérarchique (H-Eq) ? Quel type d'aide circule principalement dans le réseau ? L'analyse corrélative QAP (*Quadratic Assigment Procedure*) permet de délimiter un faisceau d'indices adapté à ces problématiques[69]. La procédure se distingue des méthodes classiques de régression en évacuant l'hypothèse d'indépendance

68 À ce sujet, voir l'article devenu classique : Nan, Lin. 1995. « Les ressources sociales : une théorie du capital social », *Revue française de sociologie,* vol. 36, n° 4, pp. 685–704.

69 Sur l'application de cette méthode : Yang Song, Keller Franziska B., Zheng Lu. 2017. *Social network analysis : methods and examples,* Londres : Sage, pp. 91–92 ; voir aussi : Borgatti, Stephen P., Everett, Martin G. et Johnson, Jeffrey C. 2017. *Analysing Social Network,* 2e éd., Londres : SAGE, pp. 144–148.

Couple de liens	As-FW	As – H-Sb	Hs-Al	T-FW	T-Al
Coef. r	0,228	0,204	0,121	0,121	0,227
p-value	0,002	0,001	0,022	0,020	0,001

Tab. 3 QAP corrélation des types de liens dans le cluster RH1C2V

des paramètres, inadaptée à l'analyse de réseaux sociaux[70]. Elle peut être déclinée en quatre étapes : pour chaque relation isolée selon sa typologie, on constitue une matrice adjacente. On choisit alors une variable correspondant un type de relation qu'on souhaite comparer avec une seconde matrice. L'application du test de Pearson donne un coefficient *r* de corrélation entre les deux matrices qu'on appelle aussi la corrélation « observée ». Le logiciel UCINET réitère la procédure en comparant la matrice de la variable sélectionnée avec un grand nombre de matrices (5000 itérations) aux propriétés identiques à celle de la seconde variable mais générées de manière aléatoire par permutation des lignes et colonnes. Les coefficients de corrélation obtenus sont ensuite comparés avec celui de l'observée et le logiciel fournit une *p-value* correspondant à la probabilité d'obtenir ce coefficient par le simple « hasard ». On a pour habitude de considérer qu'une *p-value* inférieure à 5% permet de rejeter l'hypothèse nulle – soit l'hypothèse selon laquelle il n'existe pas de relation entre les deux matrices.

Nous avons soumis chacune des onze matrices correspondantes aux différents types de liens à l'analyse. Nous ne relevons, ici, que les résultats pouvant éclairer et orienter la lecture des sources ; la corrélation obligée entre l'hostilité et les affrontements n'apportant, en effet, que peu d'informations.

En prenant pour première variable les relations d'assistance et pour seconde variable les flux (As-FW), il apparaît que ces deux connexions sont corrélées positivement. Ce constat peut suggérer une forme de réciprocité : les acteurs impliqués dans des flux d'échanges semblent être en mesure de mobiliser plus facilement l'intervention de leur partenaire. Le réseau personnel de Rib-Hadda montre, en effet, que les interventions ponctuelles visant à soutenir sa position face à Abdi-Aširta combinent des échanges de ressources établis sur la durée. Cependant, comme l'essentiel des soutiens reçus provient des commissaires du roi,

70 Les tests paramétriques standards qui comparent des valeurs observées avec une distribution théorique font l'hypothèse que les observations analysées sont indépendantes les unes des autres. Or cette hypothèse n'est pas vérifiée dans le cas des matrices adjacentes. En effet, comme le font remarquer les auteurs S. Borgatti, M. Everett et J. Johnson, si un nœud à une propriété particulière, comme étant très anti-social, il affectera l'ensemble des autres relations, introduisant un lien de dépendance entre les cellules de la ligne : *ibid.,* pp. 143–144.

les flux dont il est question rentrent dans un système d'obligations, celui d'informer et de livrer le tribut aux commissaires[71]. La masse des liens relevée n'est pas, ici, suffisante pour en tirer une règle générale. Le fait que les liens d'assistances impliquent, de préférence, une différence de rang (As – H-Sb) suggère que le *ḫazannu* de Gubla (Byblos) pouvait avoir des difficultés à mobiliser l'assistance de ses pairs ; ainsi, en EA 92 :

> « C'était un geste gracieux (...) que le roi ait écrit au roi de Beyrouth, au roi de Sidon, et au roi de Tyr, disant : ‹ Rib-Addi vous écrira en vue d'une troupe auxiliaire, et vous devez tous y aller ›. (...) j'ai donc envoyé mon messager, mais ils ne sont pas venus et ils n'ont pas envoyé leurs messagers pour nous saluer[72]. »

Par analogie avec les rivalités ayant court dans le sud, il se pourrait que les dissensions internes aient entravé la formation de groupes d'alliances cohésifs et organisés, capables de concurrencer la puissance amorrite[73]. Dans ce contexte, il est compréhensible que les maires, isolés, aient rechigné à manifester leur soutien envers Byblos, ce qui risquait de les faire ouvertement apparaître comme des ennemis d'Abdi-Aširta. L'annonce de la mort du maire d'Irqata par Rib-Hadda va, en effet, dans ce sens : « Les Habiru (= Abdi-Aširta) ont tué Aduna, le roi d'Irqata, mais il n'y a eu personne qui ait dit quoi que ce soit »[74]. Il s'agit là d'une illustration du principe de *bandwagoning* (« suivisme »), bien connu dans les Relations internationales[75], qui consiste, pour un groupe confronté à la menace d'une puissance émergente qu'il ne peut concurrencer, à renoncer à sa souveraineté en échange de la sécurité. Une remarque de Rib-Hadda à destination d'Amanappa en est, indirectement, le résumé : « S'ils (les Amorrites) entendent que les archers (du roi) s'avancent, ils abandonneront leurs villes et déserteront. Ne sais-tu pas toi-même que le pays d'Amurru suit le parti du plus fort ? »[76].

Malgré tout, une lecture plus générale des flux impliquant Rib-Hadda montre que la circulation des ressources en provenance des autres maires ne fut pas totalement absente du réseau d'interactions. En outre, une différenciation appa-

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71 Na'aman, Nadav, « Economic Aspects of the Egyptian Occupation of Canaan », pp. 172–185.

72 EA 92, l.29–40.

73 Un exemple de rivalité dans l'Amqu, a priori indépendant des troubles engendrés par Aziru, peut être observé en EA 179 : un maire (?) tente de récupérer la ville de Tubihu qui lui aurait été spolié par son « frère ».

74 EA 75, l. 25–29.

75 Sur la « Balance of powers theory » : Kaufman, Stuart J., *et al.* 2007. *The balance of power in world history,* Basingstoke : Palgrave Macmillan, pp. 1–21 ; sur l'articulation entre phénomène de compensation (*balancing*) et de « suivisme » (*bandwagoning*), on peut consulter : Sweeney, Kevin. 2004. « Jumping on the bandwagon : an interest-base explanation for great power alliances », *The Journal of Politics,* vol. 66, n° 2, pp. 428–449.

76 EA 73, l. 11–16.

raît quant à la nature de ces flux : les acteurs de rangs équivalents – le maire (?) de Bit-Arha (EA 83), le maire de Tyr (EA 77), et le pays (?) de Yarimuta[77] – sont impliqués dans l'envoi des céréales[78], alors que les relations de hiérarchie (Amanappa, Yanḫamu, le roi d'Égypte) sont mobilisées surtout pour l'aide militaire[79]. Dans le dossier des correspondances de Rib-Hadda, la hiérarchie égyptienne ne s'implique pas directement dans la distribution des céréales ; en revanche, la tablette EA 85 à destination d'Amanappa contient une demande du maire de Byblos au commissaire pour « que le grain, produit du pays de Ya[rmuta], soit livré à son serviteur, de même que [jadis] il était donné à Ṣumur »[80]. L'épisode laisse à penser que la circulation des ressources était contrôlée, au moins partiellement, par les fonctionnaires égyptiens qui pouvaient, au besoin, décider d'une réaffectation des circuits usuels. Il est à noter que la principale source d'approvisionnement en céréales pour Byblos a probablement été son propre territoire[81]. Le recours à un circuit externe qui survient généralement contre paiement[82] paraît avoir été une pratique de circonstance dont il est difficile d'évaluer la fréquence.

Les trois autres couples de liens corrélés (Hs-Al ; T-FW ; T-Al) associent entre eux des relations positives et négatives (liens en bleu dans les graphes). Ils s'inscrivent principalement dans un double processus à l'origine d'une modification profonde de l'équilibre des interactions dans le réseau. Il s'agit, d'une part, du ralliement ou de la soumission des maires et cités sous la pression amorrite et, d'autre part, de l'atrophie consécutive des relations d'alliances entre maires et de la perte des cités sous contrôle giblite. Dans une logique dyadique, nous visualisons, ici, l'accroissement des ressources militaires et économiques à disposition d'Abdi-Aširta et une réduction de la capacité d'action de Rib-Hadda. Ainsi, l'es-

77 Nous ne pouvons situer avec certitude le « pays de Yarimuta » dans les territoires égyptiens au Levant. En 1914, Poeble (1914 : 225–226) propose de le placer dans la plaine d'Antioche. En 1927, Dussaud rejette l'hypothèse sous l'argument que l'emplacement de Yarimuta se trouve plus vraisemblablement au sud de Byblos (1927 : 224). En 1987, Moran avance qu'il pourrait s'agir d'une cité côtière au sud de Beyrouth (1987 : 603). L'autre hypothèse soutenue par Albright et Niebuhr identifie Yarimuta avec le Delta du Nil (Albright 1940 : I : 31) ; pour un résumé des hypothèses relatives à ce toponyme Gordon, Cyrus H. et Rendsburg, Gary A., (éd.). 2002. *Eblaitica : Essays on the Ebla Archives and Eblaite Language,* vol. 4, Winona Lake, Indiana : Eisenbrauns, 70, n° 82, p. 83.

78 EA 83 suggère que Bit-Arha était impliquée dans le circuit assurant l'approvisionnement de Byblos ; de même, en EA 77, Rib-Hadda assure avoir envoyé un paiement pour des vivres à l'homme de Tyr.

79 Ce qui est le cas de la quasi-totalité des lettres de Rib-Hadda dans le dossier. Les demandes d'intervention sont régulièrement exprimées au travers de la formule consacrée (et de ses variantes) : « s'il n'y a pas d'archers cette année, alors il (Abdi-Aširta) sera fort pour toujours » (EA 93, l. 19–28).

80 EA 86, l. 31–40.

81 EA 85, 86.

82 Plusieurs exemples d'un paiement en vue d'obtenir des vivres coexistent dans le dossier giblite : à Tyr (EA 77), à Yarimuta (EA 74, 90) – le maire de Beyrouth, Yapah-Hadda est cité comme un intermédiaire dans cette dernière transaction (EA 85).

sentiel des relations d'alliance de Rib-Hadda correspond à des liens d'hostilité (Hs-Al) parfois accompagnés d'actes de trahison (Al-T), comme en EA 92 dans laquelle le roi de Tyr, de Sidon et de Beyrouth refusent de prêter main-forte à Rib-Hadda alors qu'ils en ont reçu l'ordre du roi. Quant au dernier couple (FW-T), celui-ci renvoie directement au double jeu mené par Abdi-Aširta et à sa stratégie du « gain de temps ». En effet, les envois d'informations (FW) à destination des *rabi* visent, très certainement, à brouiller les pistes quant aux véritables objectifs d'Abdi-Aširta. C'est ainsi qu'en EA 62, alors qu'Abdi-Aširta vient de s'introduire dans Ṣumur au mépris de l'autorité égyptienne, il écrit au commissaire Paḫanate : « Que mon seigneur écoute. Il n'y avait pas d'hommes dans Ṣumur pour la garder (...) Donc je suis moi-même accouru d'Irqat au secours, et je suis venu moi-même devant Ṣumur[83] ».

5.1 Interprétation

Ces différents éléments permettent d'expliquer dans une certaine mesure la stratégie déployée par le maire giblite. À l'instar de ses pairs, il ne disposait pas des moyens militaires nécessaires pour s'opposer à l'avancée amorrite. Une fois le conflit déclaré, le maire devait assurer une réponse face à deux problèmes qui menaçaient de précipiter la chute de sa cité : l'approvisionnement en vivres et la mobilisation d'une force capable de contrer Abdi-Aširta. Comme nous l'avons vu, le maire de Gubla semble ne pas avoir été en mesure de capter l'aide militaire nécessaire par le biais de la sollicitation directe du réseau de ses pairs. Afin de contourner le problème, Rib-Hadda a visiblement tenté d'exploiter ses contacts parmi les fonctionnaires égyptiens pour imposer le rassemblement d'une troupe de défense ; les directives prises par les commissaires n'eurent cependant pas l'effet escompté.

Du côté d'Abdi-Aširta, la mobilisation des forces nécessaires à son entreprise de conquête reposait sur deux principaux facteurs : la soumission volontaire des maires ou la mise en place d'un gouvernement favorable dans les cités récalcitrantes. Les ralliements des *ḫazannu* ont pu être motivés par la crainte de tomber aux mains d'Abdi-Aširta ou bien par les perspectives que pouvait offrir une alliance en termes de butin et de pillages[84]. Abdi-Aširta a également exploité le mécontentement des populations locales pour fomenter des révoltes et renverser ses opposants. Le procédé est étroitement lié à la question des vivres. En détruisant les récoltes et en bloquant les circuits d'approvisionnement, le prince amorrite pouvait espérer que les cités se rebellent d'elles-mêmes contre le gouvernement en place et finissent par se rallier à sa cause. Rib-Hadda a bien décrit le proces-

83 EA 62, l. 10–20.

84 Pas de témoignage direct de Rib-Hadda pour la période concernée ; les actes de pillages sont cependant bien documentés pour la période d'Aziru : EA 179, 185–86, 189.

sus dans plusieurs de ces lettres[85]. La mise en danger de son capital de ressources et les difficultés à mobiliser un circuit d'approvisionnement avec la collaboration des autres *ḫazannu* le poussa, une fois de plus, à faire appel à sa hiérarchie pour forcer l'envoi de denrées alimentaires. L'incapacité des commissaires à répondre positivement aux demandes du maire et à enrayer la progression amorrite met en évidence la fragilité de la stratégie déployée par Rib-Hadda. Les moyens mobilisés par le maire pour maintenir sa position reposaient presque exclusivement sur ses connexions avec les représentants de l'autorité égyptienne dont l'intervention se révéla peu efficace. Finalement, c'est vraisemblablement de la cour royale que fut prise la décision de dépêcher un contingent pour des raisons a priori étrangères aux nombreux appels à l'aide adressés par Rib-Hadda[86]. Bien que le maire réchappât du conflit initié par Abdi-Aširta, cet épisode met en lumière l'échec de sa stratégie. Quelques années plus tard, lorsqu'Aziru d'Amurru reprit à son compte la politique expansionniste de son père, l'impossibilité de Rib-Hadda à répondre efficacement à la menace le contraignit à s'exiler loin de sa cité. Il est vraisemblable qu'après quelque temps passé à l'abri à la cour de Beyrouth, le maire giblite finit par tomber entre les mains du fils de son ennemi[87].

6. Conclusion

L'usage de l'analyse de réseaux en histoire ancienne s'immisce doucement dans les différents champs de la discipline. Il est vrai que la richesse des ensembles documentaires tels que les correspondances amarniennes incite assez naturellement à adopter une approche qualitative qui pourrait sembler à l'opposé du processus d'abstraction qui sous-tend la « mise en réseau ». Cependant, le recours au formalisme peut s'avérer intéressant pour « dénaturaliser[88] » les données et les représentations qui en découlent : l'analyse de réseaux ne présuppose pas des catégories discrètes préalablement établies, mais fait émerger des ensembles relationnels de densités variables. On constate, par ailleurs, au travers de cette étude, que les groupes émergents (les *clusters*) présentent des similitudes avec les ensembles localisés géographiquement (les maires du nord, celui du sud) que Campbell définissait dans ses travaux en chronologie relative – bien que l'approche mobilisée soit différente. Il s'agit, en effet, des ensembles qui canalisent les interactions et pouvant donc servir de point de repère dans la chronologie des évènements. L'analyse comparative des profils relationnels des différents *clusters,*

85 La menace d'une révolte plane sur Byblos dès l'époque d'Abdi-Aširta (EA 77) mais ne semble pas avoir abouti ; ce n'est toutefois pas le cas sous la période d'Aziru où le maire giblite est emmené à réprimer un soulèvement dans le sang : EA 117, 125, 130, 136, 138

86 EA 101 ; sur le destin d'Abdi-Aširta : Altman, Amnon. 1977. « The fate of Abdi-Ashirta », *Ugarit-Forschungen,* 9, pp. 1–10.

87 EA 137–138, 162.

88 Suivant le terme employé par Lemercier, Claire, « Analyse de réseaux et histoire », p. 101.

mise en relation avec la distribution de l'information dans les correspondances et une approche plus qualitative de la documentation, a permis de cerner les principaux points d'intérêt des expéditeurs : alors que l'attention des maires du nord est clairement focalisée sur l'expansion du royaume amorrite, celle des maires du sud témoigne de rapports conflictuels généralisés ancrés dans un climat de rivalité endémique ; les correspondances des grands rois, au contraire, montrent un ensemble pacifié où les troubles régionaux sont occultés par les négociations matrimoniales et les échanges de présents. L'analyse plus poussée des relations à l'intérieur du *cluster* des maires du nord a permis de définir les stratégies adoptées par les principaux antagonistes visibles dans les sources : Abdi-Aširtra, le prince amorrite, et Rib-Hadda, le maire de Byblos. Les failles de la stratégie de résistance face à la pression amorrite déployée par Rib-Hadda apparaissent clairement au regard de son incapacité à mobiliser l'intervention de ses pairs, les autres maires de la région libanaise. De plus, sa relation de dépendance vis-à-vis d'une hiérarchie peu coopérative révèle une faille supplémentaire dans le fonctionnement de son réseau personnel. Les conséquences du conflit qui, quelques années après la mort d'Abdi-Aširta, eurent raison du maire giblite confortent l'hypothèse proposée. Bien que l'interprétation recoupe la plupart des arguments avancés sur le sujet, le recours à l'analyse de réseau offre ici une mise en perspective qui, nous l'espérons, aura montré l'utilité d'ouvrir un dialogue entre outils statistiques et approche historique des sources.

La présente étude a été pensée comme le préambule d'un projet de thèse de doctorat. Pour le seul jeu de données mobilisé ici, plusieurs développements ultérieurs sont envisageables ; par exemple, l'étude de la manière dont les différents clusters s'agencent les uns par rapport aux autres, en utilisant notamment la théorie des trous structuraux ; l'analyse approfondie du cluster des grands rois (RHIC1R) et de celui des maires du sud (RHIC3V). De même, le traitement du cluster des maires du nord (RHIC2V) pourrait être abordé sous un angle différent qui justifierait plus encore le recours à l'analyse de réseaux. En effet, la polarisation des relations autour des deux antagonistes (Rib-Hadda/Abdi-Aširta), dans le cluster, pourrait être contournée en supprimant ces sommets et en atténuant du même coup le biais relatif à la distribution de l'information reposant presque exclusivement sur la communication de Rib-Hadda focalisée sur les troubles en Amurru. De manière plus générale, la cartographie systématique des réseaux pour les différentes périodes de l'époque amarnienne permettrait d'intégrer une variable temporelle et d'analyser les mutations du tissu relationnel en corrélation avec l'évolution des contextes.

Appendice 1

Exemple des données relevées dans la tablette EA 68

Il s'agit ici de la première tablette envoyée par Rib-Hadda au roi d'Égypte. Les acteurs sont identifiés, une fois, en rouge.

> « [R]ib-Hadd[a di]t à son seigneur, [roi] de tous les pays, grand roi : Que la dame de Gubla accorde la puissance au roi mon seigneur. Je tombe aux pieds de mon seigneur, mon Soleil, 7 fois et 7 fois. Que le roi, mon seigneur, sache que Gubla, la servante loyale du roi est indemne. Toutefois, la guerre que me [font] les troupes ʿApiru est extrêmement rude, et donc que le roi, mon seigneur, ne ‹né›glige pas Ṣumur, de crainte que t[o]us ne se joignent aux troupes ʿApiru. Grâce au Commissaire du roi dans Ṣumur, Gubla est vivante. Paḫa[mna]ta, le Commissaire du roi qui est dans Ṣumur, connaît les difficultés : ma-na-rù (?) dans lesquelles se trouve Gubla. C'est du pays de Yarimmuta que nous avons obtenu des vivres. La gu[er]re [cont]re nous est extrêmement rude, et que donc le roi ne [né]glige pas ses [vi]lles. »

Le lien de hiérarchie (H-Sb) entre le roi d'Égypte et le maire de Byblos, Rib-Hadda, est révélé par la formule de prosternation en introduction. Le lien d'hostilité (Hs) entre Rib-Hadda et les troupes *habiru* (= ʿApiru) est clairement établi dans la tablette. On sait que cette relation antagoniste est installée dans la durée du fait de messages similaires en EA 71, 74, 75, 79, 82, 85, 87 et 94. L'expression utilisée par Rib-Hadda : « la guerre que me font les troupes ʿApiru est extrêmement rude » suppose des affrontements armés (M), ce que tend à appuyer EA 94 de Rib-Hadda : « Puisque c'est moi qui ait arrêté les ʿApiru, il y a des hostilités contre moi » ; ou encore, en EA 91 : « Je viens d'entendre qu'il (Abdi-Aširta) a rassemblé tous les ʿApiru pour tomber sur moi ». Une relation négative entre les troupes *habiru* et le commissaire Paḫanate (= Paḫa[mna]ta) semble également se dessiner. Ce que corrobore EA 62 envoyée par Abdi-Aširta qui mentionne l'hostilité de Pahanate à son égard : « Tu as parlé comme suit : ‹ Tu es un ennemi de l'Égypte › ». Or, dans les lettres de Rib-Hadda, les *habiru* sont systématiquement associés à Abdi-Aširta, on peut donc sans risque admettre une relation d'hostilité entre les *habiru* et le commissaire. Notons que l'expression « commissaire du roi » traduit immédiatement le lien de hiérarchie (H-Sb) entre Paḫanate (= Paḫa[mna]ta) et le roi d'Égypte. D'autre part, les vivres envoyés depuis le pays de Yarimuta le sont contre paiement (EA 74) et révèlent un flux d'échanges (FW) qui est installé dans la durée, comme en témoignent des références similaires en EA 74, 90. L'appel à témoignage lancé par Rib-Hadda au roi d'Égypte et qui engage le commissaire Paḫanate suggère un lien positif. De plus, l'affirmation selon laquelle « grâce au commissaire du roi (...) Gubla est vivante » laisse à penser que Paḫanate a pu ponctuellement prendre la défense (As) de Rib-Hadda dans le conflit, ce que vient étayer EA 85 de Rib-Hadda au roi : « Que le roi (...) donne des hommes pour garder sa ville, de peur qu'il (Abdi-Aširta) ne rassemble tous les ʿApiru et qu'ils *s'emparent* de [la ville]. (...) Lorsque le commissaire du

roi (Paḫanate) était avec nous, c'était à lui que nous écrivions (pour notre défense) ». Il va de soi que la relation entre Rib-Hadda et Paḫanate implique également un lien de hiérarchie (H-Sb). On obtient donc, pour EA 68, cinq acteurs (Rib-Hadda, le roi d'Égypte, les troupes *habiru,* Paḫanate, le pays de Yarimuta) et sept connexions (Rib-Hadda – Roi d'Égypte (H-Sb), Rib-Hadda – troupes *habiru* (Hs, M), Paḫanate – roi d'Égypte (H-Sb), Rib-Hadda – Paḫanate (As, H-Sb), Rib-Hadda – Pays de Yarimuta (FW)).

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A kinship network analysis of Palmyrene genealogies

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Abstract In this proof-of-concept study we investigate the potential and challenges of a formal network approach for the examination of 1st to 3rd century CE kinship networks in ancient Palmyra (in present-day Syria). The recent availability of a large, digitised archaeological dataset allows for a thorough reassessment of previously studied genealogies. By applying network and genealogical formal methods to these for the first time we can re-evaluate the genealogical completeness and gender bias in our sources, and scientifically explore the tendency for intermarriage within an extended Palmyrene family.

We combine archaeological information from funerary portraits in the exhaustive database created by the Palmyra Portrait Project with textual sources from funerary and public inscriptions, and critically evaluate the differences and limits of these sources for genealogical studies. Applying formal network and genealogical techniques to these datasets, as well as comparing five different case studies, allows us to draw attention to four key points: (1) our sources confirm a high degree of genealogical incompleteness and gender bias, which was already known from studies of Palmyrene society; (2) to evaluate whether the relinking index can enhance debates on endogamy and exogamy practices in Palmyra; (3) funerary and public inscriptions are highly complementary and reveal different genealogical structures; and (4) to assess the assumptions behind creating uncertain relationships in funerary cases and their effects on our results.

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This paper demonstrates a number of quantitative and qualitative approaches for understanding the limits of fragmentary archaeological and historical sources in this process, and it lays the foundation for formulating highly specified hypotheses about the structure of ancient Palmyrene kinship networks in future work.

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1. Introduction*

The public texts, funerary portraits and their inscriptions found in the desert city of Palmyra, famous for its tower tombs, hypogea (underground tombs) and temple tombs, document thousands of its ancient residents, as well as how they were related through kinship and other ties. But what was the structure of family networks in Palmyra, and how well do these diverse archaeological and written sources allow us to reconstruct them?

Previous studies have established genealogies for Palmyrene elite families, and combined insights drawn from inscriptions and portraits.[1] However, the recent creation of an exhaustive database by the Palmyra Portrait Project (PPP), directed by professor and Centre Director Rubina Raja, combined with the use of formal genealogical and network science techniques, allows for a thorough reassessment of our current knowledge of Palmyrene genealogies.

By applying, for the first time, a formal network analysis approach to genealogies derived from a combined corpus of Palmyrene portraits and inscriptions, we can highlight elements such as intermarriage in extended families, as well as generational and gender bias in our sources.[2]

To explore the diversity in which genealogical information might be represented in the data, we include five case studies, four based on funerary sources, and one based on public sources. We represent our datasets as genealogies, Ore graphs and p-graphs, and compare their structures using genealogical and network methods. We further propose two hypotheses to explore the impact of the missing parents in our sources and to increase the completeness of genealogies and generations. A discussion contextualising our quantitative results with Palmyrene history and data critique reveals the unique potential of this approach as well as the limits of our fragmentary sources for studying Palmyrene genealogies.

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1 Palmira Piersimoni, *The Palmyrene Prosopography* (London: University College London, 1995); Anna Sadurska and Adnan Bounni, *Les sculptures funéraires de Palmyre* (Rome: Giorgio Bretschneider Editore, 1994).

2 Here we use the term gender bias as it is used in the methodological literature to indicate the proportion of unknown men/women in sources. A more nuanced, contextualised discussion is provided in section 5.

2. Data collection

The data used in this study combined both archaeological and historical sources, in the form of funerary portraits and inscriptions, respectively. We drew on the genealogies presented in the studies by Anna Sadurska and Adnan Bounni (case studies 1 to 4) and by Palmira Piersimoni (case study 5), and expanded on these using the Palmyra Portrait Project (henceforth PPP) database.

The PPP aims to (1) compile a corpus of all known Palmyrene funerary portraits, (2) to digitalise the comprehensive photo archive of the Danish archaeologist Harald Ingholt, and (3) to produce text volumes to accompany the corpus, as well as a number of publications on various aspects of Palmyrene sculpture.[3] The corpus, which will be made accessible in an online database, currently contains information on almost 3,500 objects with 4,000 portraits. Each of the objects in the database is assigned an individual number and each portrait is designated by a letter (for example, a stele with father and daughter at the Ny Carlsberg Glyptotek[4] is assigned the object number NCG042, with the portrait of the daughter assigned the portrait letter A, and the portrait of the father assigned the portrait letter B). Information such as the current location of the object, its provenance, and context is recorded and compiled along with the full bibliography. Furthermore, the date of an object, and the age, attributes, and gender of a portrait is reassessed.

In spite of the high number of funerary inscriptions preserved from Palmyra, it is important to bear in mind that only a small fraction of the city's population, likely members of elite families, would have received the type of funeral that is reflected in our records. We have selected these case studies due to the fact that they were comparatively well-documented in existing literature and because they were in use over substantial periods of time. In sum, this entailed the risk that the family networks were not representative of the situation in Palmyra in general, but it nonetheless provided data that was well suited for the purpose of this article: to establish the potential usefulness of this methodological approach.

3 See for example Rubina Raja, "Compilation and digitisation of the Palmyrene corpus of funerary portraits," *Antiquity* 92, no. 365 (2018).

4 Ny Carlsberg Glyptotek (inv. no. I.N. 1029): Rubina Raja, *Catalogue: The Palmyra Collection, Ny Carlsberg Glyptotek* (Copenhagen: Ny Carlsberg Glyptotek, 2019a), 92–93, cat. 11.

2.1 Selected genealogies

In 1994, Sadurska and Bounni published the sculptures from hypogea that were kept at the Palmyra Museum (e.g. Fig. 1). They intended this as a holistic study of the finds from fifteen hypogea, integrating sculptural and epigraphic data with the excavation records. Their observations about family structures, genealogies, sculptural workshops, and use of funerary complexes are essential for understanding Palmyrene society. As we studied Palmyrene sculpture within the framework of the PPP, however, we noticed that it was possible to expand their analysis, elaborate on their results, and gain an even more nuanced image of Palmyrene families and the relationships between them. For this reason, we selected four case studies based on the following criteria: (1) the richest sculptural representations, namely funerary portraits; (2) epigraphic evidence accompanying most of the sculptural representations found in the tomb; (3) a textual and material record spanning for more than three generations; and (4) good documentation of find locations.

Funerary inscriptions, however, only represented one aspect of Palmyrene society. These inscriptions gave information on onomastics, family relations and sometimes tribal affiliation, but revealed little about activities in the public sphere. The city also had a rich record of public inscriptions in Palmyrene Aramaic and Greek, and a few exceptional inscriptions in Latin. To explore the potential to combine this material with that of the funerary sphere, case study 5 was based on the Palmyrene prosopography published by Palmira Piersimoni in 1995 which included every Palmyrene individual attested in inscriptions known until then.[5] From Piersimoni's work we selected the Firmôn family, which could be traced for eight generations between the early first century CE and the late second century CE.[6] In addition to its longevity, the family was chosen because the varied epigraphic record attesting it indicated their participation in caravan trade, acts of euergetism, membership in the priestly profession, and the purchase of funerary space in an established tomb, perhaps indicating upward social mobility.[7]

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5 Piersimoni, *The Palmyrene Prosopography.*

6 Piersimoni, *The Palmyrene Prosopography,* 563; also: Jósef Tadeusz Milik, *Dedicaces faites par des dieux (Palmyre, Hatra, Tyr) et des thiases Semiteques a l'epoque romaine* (Paris: Recherches d'epigraphie Proche-Orientale, 1972), 34–36.

7 In the case of the Firmôn family, we know that ID 9 in fig. 11 is known as the symposiarch of the priest of the temple of Bel: Harald Ingholt, "Inscription and Sculptures from Palmyra," *Berytus* 3 (1936): 89–91; Harald Ingholt, "Two unpublished tombs from the Southwest Necropolis of Palmyra, Syria, in *Near Eastern numismatics, iconography, epigraphy and history: studies in honor of George C. Miles,* ed. Dickran K. Kouymjian (Beirut: American University of Beirut, 1974), 45; Piersimoni, *The Palmyrene Prosopography,* 56. Moreover, ID 20 in fig. 11 is mentioned in an inscription on a tessera also depicting a priest, indicating that he was likely also a priest: Harald Ingholt, Henri Seyrig, and Jean Starcky, *Recueil des tessères de Palmyre* (Paris: Paul Geuthner, 1955), 111, cat. 851, pl. 41.

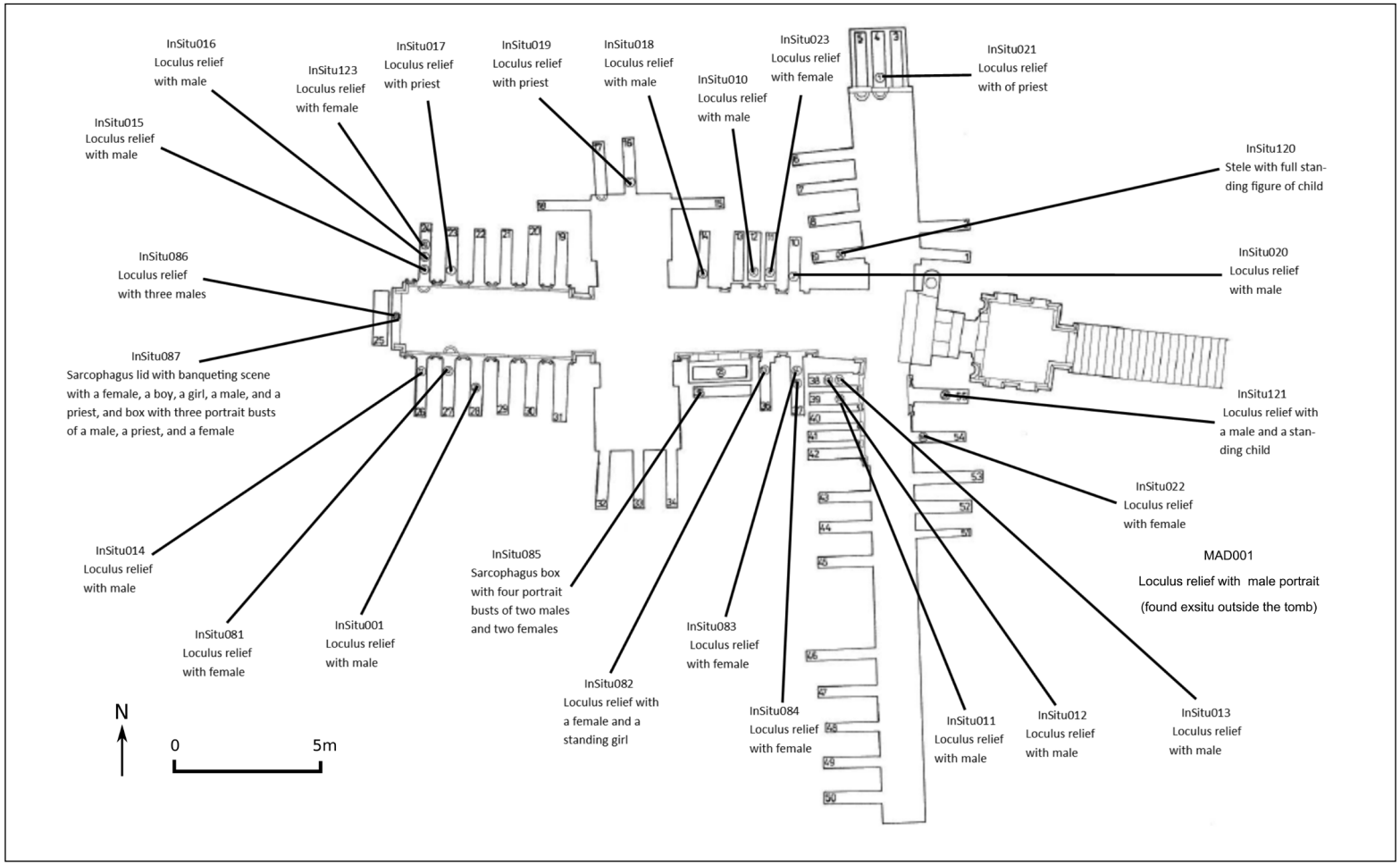

Fig. 1 The hypogeum of Artaban (case study 1). Note the corridor and location of the funerary portraits within them (ground plan adapted from Sadurska and Bounni 1994: plan IV).

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The public inscriptions also provided the opportunity to extend the network to external individuals with whom the family interacted (a potential that will be explored in future work). Piersimoni's genealogy was checked with the epigraphic editions cited in her study, as well as with the later published corpora of Aramaic and Greek texts from Palmyra.[8]

The following five case studies were selected and studied for this paper:

1) The hypogeum of Artaban, son of ʿOggâ[9]
2) The hypogeum of Bôlḥâ, son of Nebôšûri[10]
3) The hypogeum of Sassans and Mattai[11]
4) The hypogeum of Zebîdâ, son of ʿOgeilû[12]
5) The Firmôn family[13]

2.2 Collected data and format

From our sources we derived information about as many individuals as possible, as well as about the existence and nature of relationships between them. We additionally made assessments of the reliability of the collected information, and included these in the dataset. The dataset was stored as three spreadsheets per case study in order to import them into the genealogical network analysis software Puck:[14] (1) spreadsheet puck_relationships (genealogy information); (2) spreadsheet puck_individuals (additional information about all individuals); and (3) spreadsheet original_relationships (additional information about all collected relationships). The data was further prepared for genealogical and network analysis in the network analysis software Pajek[15] by storing it using the GEDCOM standard, with all additional information we collected about the individuals from both archaeological and historical sources stored as supplementary information in the same file. All spreadsheets and GEDCOM files created are available as a supplement to this paper (see online supplementary material). The following data was collected for each case study:

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8 Delbert R. Hillers and Eleonora Cussini, *Palmyrene Aramaic Text* (Baltimore and London: The Johns Hopkins University Press, 1996); Jean-Baptiste Yon, *Inscriptions Grecques et Latines de la Syrie: Palmyre,* vol. 17.1 (Beyrouth: Institut Français du Proche-Orient, 2012).

9 Sadurska and Bounni, *Les sculptures funéraires de Palmyre,* 23–40.

10 Sadurska and Bounni, *Les sculptures funéraires de Palmyre,* 70–90.

11 Sadurska and Bounni, *Les sculptures funéraires de Palmyre,* 41–69.

12 Sadurska and Bounni, *Les sculptures funéraires de Palmyre,* 91–101.

13 Piersimoni, *The Palmyrene Prosopography,* 563.

14 All genealogical analyses were performed using the open access software Puck: Klaus Hamberger, Michael Houseman, and Cyril Grange, "La Parenté Radiographiée," *L'Homme* 191 (2009).

15 Vladimir Batagelj and Andrej Mrvar, "Pajek, Program for Analysis and Visualization of Large Networks," accessed September 30 2019, http://mrvar.fdv.uni-lj.si/pajek/.

- Data collected about individuals (spreadsheet puck_individuals):
  - Individual_ID: unique ID for each individual.
  - Object_number: the object number in the PPP database.
  - Portrait_number: the portrait letter in the PPP database.
  - Without_portrait?: we had the choice of the values 'YES' and 'NO'; we chose YES if the individual was known only from an inscription, and not known through a portrait.
  - SB_number: the catalogue number in Sadurska and Bounni's publication.
  - Name: the name of the individual, when known.
  - Name_analysis: the name used in the analyses presented here, which included generically added and unknown names.
  - Date_SB_from and Date_SB_to: the proposed lower and upper date of the generation to which the individual belonged as published in the genealogies by Sadurska and Bounni.
  - Date_inscription: this was included when the portrait was dated by an inscription.
  - Date_from and Date_to: the date range proposed for this object in the PPP database.
  - Date_to_analysis: the upper date as known through any source, used for visualising networks.
  - Age: one of three hypothetical values: 0–15; 15–50; 50+. The Palmyrenes rarely indicated the age of the deceased in funerary inscriptions; therefore, the age of the depicted person was determined through iconographic features, such as specific attributes (for example grapes, birds, spindles) and facial features (receding hairlines and wrinkles).
  - Represents_age_at_death: we had the choice of the values 'YES' and 'NO'; in the cases where we have a portrait of a child with a parent we assumed that only the parent was buried, therefore we chose 'YES' for the parent and 'NO' for the child (i.e. he/she was not represented at the age of death).
  - Source_portrait and Source_inscription: we had the choice of the values 'YES' and 'NO'; we chose 'YES' if the individual was documented through a portrait/inscription.
  - Gender: male, female, unclear.
  - Priest?: we had the choice of the values 'YES' and 'NO'; we chose 'YES' if the individual was a priest. We decided that it was important to record priests, because priesthood in Palmyra was a marker of particular social status; it was often hereditary, and the evidence shows that it was also associated particularly with the elite.[16]
  - Profession_role: this was recorded only when we had indications of the individual's profession (for example, through attributes or an inscription).

16 See for example Rubina Raja, "Representations of priests in Palmyra: methodological considerations on the meaning of the representations of priesthood in Roman period Palmyra," *Religion in the Roman Empire* 2, no. 1 (2016); Rubina Raja, "Between Fash-

- Relationships (spreadsheet original_relationships):
  - Relationship_ID: unique identifier for each relationship.
  - Source_individual_ID and target_individual_ID: the pair of individuals between whom the relationship existed (from child to parent).
  - Nature: is son of, is daughter of, is married to, ...
  - Source_inscription, source_portrait and source_proximity: these three were our sources for judging the reliability of a relationship. We had the choice of the values 'YES' and 'NO'. We chose YES if a relationship was documented through an inscription and/or portrait or theory of proximity (e.g. the relationship A father of B was documented through an inscription only; the relationship between a parent C and child D on the same portrait without inscription was documented through a portrait only; the marriage relationship between E and F was a hypothesis by Sadurska and Bounni based on the physical proximity of their portraits in the tomb; the relationship G grandson of H was assumed because of use of the same name).
  - Reliability: we had the choice of values 0–3: solid evidence that this relationship definitely did NOT exist (selection of value 0). We considered a relationship improbable when the only source for it was physical proximity in the tomb (selection of value 1). The relationship could still exist, but we did not have enough evidence to support it. When a relationship was suggested by onomastic practices, and the portraits were located close to each other in the tomb, then we considered a relationship probable and likely correct (selection of value 2). When a relationship was documented

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ion Phenomena and Status Symbols: Contextualising the Dress of the So-Called 'Former Priests' of Palmyra," in *Textiles and Cult in the Mediterranean Area in the 1st millennium BC,* eds. Cecilie Brøns and Marie-Louise Nosch (Oxford: Oxbow, 2017a); Rubina Raja, "Networking beyond death: Priests and their family networks in Palmyra explored through the funerary sculpture," in *Sinews of Empire: Networks in the Roman Near East and Beyond,* eds. Eivind Heldaas Seland and Håkon Fiane Teigen (Oxford: Oxbow, 2017b); Rubina Raja, "Priesthood in Palmyra: Public Office or Social Status?," in *Palmyra: pearl of the desert,* ed. Rubina Raja (Aarhus: SUN-Tryk, Aarhus University, 2017c); Rubina Raja, "Præster i Palmyra: Et embede eller en social status?," in *Palmyra: ørknens perle,* ed. Rubina Raja (Aarhus: SUN-Tryk, Aarhus University, 2017d); Rubina Raja, "Representations of the So-Called "Former Priests" in Palmyrene Funerary Art: A Methodological Contribution and Commentary," *Topoi* 21, no. 1 (2017e); Rubina Raja, "To be or not to be depicted as a priest in Palmyra: A matter of representational spheres and societal values," in *Positions and Professions in Palmyra,* eds. Annette Højen Sørensen and Tracy Long (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2017f); Rubina Raja, "'You can leave your hat on': Priestly representations from Palmyra: between visual genre, religious importance and social status," in *Beyond Priesthood: Religious Entrepreneurs and Innovators in the Roman Empire,* eds. by Richard L. Gordon, Georgia Peitridou and Jörg Rüpke (Berlin: De Gruyter, 2017g); Rubina Raja, "It stays in the Family: Palmyrene Priestly representations and their Constellations," in *Women, children and the family in Palmyra,* eds. Signe Krag and Rubina Raja (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2019b).

through an inscription, and/or a portrait (i.e. solid evidence), we considered it correct (selection of value 3).

2.3 Data collection challenges

Collecting the data also meant re-evaluating the information published by Sadurska and Bounni and Piersimoni. The information on the totality of the contexts of the tombs was checked against the previous bibliography, while the dates proposed by the excavators were reassessed. During this process, we encountered challenges in assessing the following criteria used by the scholars for establishing relationships: proximity, and onomastics.

Proximity was used as a criterion for establishing a relationship when two individuals, identified through portraits (since no skeletal remains were preserved in most cases), were placed in adjacent burial niches. 'Adjacent', according to Sadurska and Bounni, meant either that both niches were in a single dug-out section of the tomb, therefore, one niche located over the other, or niches in neighbouring dug-out sections, thus divided only by a thin pillar (see Fig. 1). Without any inscriptions on the portraits, though, we considered proximity to be an indication of a possible relationship between the buried individuals.

Another indicator used by scholars to establish a relationship between two individuals was onomastics. We know that papponymy (i.e. the grandson is named after the grandfather) was a common practice in Palmyra. This led scholars to propose genealogies based on the reuse of names, and to hypothesise maternal relationships especially when the name of a woman's father was seen in the inscription of a man, where only his father is mentioned. Onomastics, however, were used in combination with other criteria, such as stylistic dating. So, for example, in a portrait dated between 150–170 CE, X was the daughter of Y, and in a portrait dated between 160–180 CE, Y was the son of Z, therefore X is the mother of Y, with grandfather and grandson sharing a name.[17] Of course, there was a relatively small pool of names to choose from in Palmyra; however, by focusing on individuals buried in the same tomb complex, we considered that reuse of names did indicate likely relationships between the individuals.

The last challenge faced in the data collection, as well as in the network analysis, was that not every individual of a family was represented through an inscription and/or a portrait in the public and the funerary sphere. Women, especially, are underrepresented in our inscriptions, although thanks to the work done by the PPP on the database, we can now see that portraits of women constitute almost 40% of all recorded Palmyrene portraits.[18] This gendered under-represen-

17 Piersimoni, *Palmyrene Prosopography,* 549–550.
18 Data taken from the PPP database (December 2019).

tation in inscriptions ('gender bias') means that in most cases we know the fathers but not the mothers of specific individuals; also, because women were usually recorded in the epigraphic record as daughters, we cannot be certain of their status as wives.

As we will show in the methodology section, we tried to address this issue by the creation of two networks, a primary and a secondary network.

3. Method

Summary: (1) to address some of the issues of missing or uncertain data, we focused on the largest connected component for each case study, creating a network with the collected genealogical data as is (referred to as **primary** network) and a *hypothesis* adding missing parents (referred to as **secondary** network); (2) the networks were represented as Ore graphs (using Puck) and p-graphs (using Pajek); (3) basic network statistics were derived (using Visone);[19] (4) genealogical statistics were derived (using Puck and Pajek).

3.1 Missing information and boundary specification

The incompleteness of the dataset meant that some of the information needed to make correct representations and analyses was missing. One crucial issue was our lack of information about all parents of known children. There are a number of cases where we knew one parent (typically the father) with multiple children but not the other parent(s). For example, for creating p-graphs, this posed the issue that we did not know whether these children had the same pair of parents or only shared one parent (in the case of studying remarriage, which was our main reason for using p-graphs, as stated below). A second issue was the uncertain nature of certain documented relationships. In some inscriptions, relationships between pairs of individuals were referenced but it was not clear whether this referred to a parent, marriage, sibling, or other relationship. A third issue was the uncertainty of the existence of a relationship. For example, in a few cases a kinship relationship was neither documented in an inscription or a portrait, but rather only through the presence of both individuals' names in close proximity in the same hypogeum (see section 2.3).

The incompleteness of the record necessarily influenced the boundary specification of our network analyses, and determined what analytical techniques could be applied to what network representations. To address these issues, we excluded relationships whose nature was unknown, highlighted the relationships whose existence was uncertain, and explored their impact on the results. We focused

19 Visone Project Team, "Visone v.2.16," accessed September 30, 2019, http://visone.info.

our analyses on the largest connected component of the genealogy derived from each hypogeum (i.e. the largest set of individuals that can be connected to each other).

There were more people buried in the hypogea than the people represented in the networks' largest components, and these included the portrait representations of individuals without an accompanying inscription. Furthermore, there were also reliefs with inscriptions depicting people who could not be linked to those of the main or extended families represented by the largest components. All these additional individuals could be among those "missing" family members that our hypotheses aimed to reintroduce. Future studies should further scrutinise the evidence for these additional individuals in light of the network structure and missing individuals revealed in this study, to explore whether they can be included into the genealogies.

We also have inscribed reliefs testifying to small sets of connected individuals that cannot be otherwise linked to the largest component. These may have been connected to the people in our largest components, although onomastics points to them being separate family units. Their presence in the family tomb may have indicated the use of the tomb by relations of the wife, perhaps indicating a degree of exogamy, or that the women who entered the husband's household then became his primary heiresses and used the husband's family tomb as their own.[20] Another hypothesis for their presence may have been the cession of part of the family tomb to a different, possibly unrelated, family, although this cannot be proven without a cession text.

1) The issue of missing parents was more difficult to deal with and required us to perform our analyses on the sources as well as two *hypothetical* versions of each network:
2) Using the dataset as it was to explore the sources. See the Ore graph and genealogical information of the **primary** network.
3) Adding a single missing partner (unrelated to other individuals) for each single parent and assuming each child had the same pair of parents (the chil-

20 Signe Krag, "Palmyrene funerary buildings and family burial patterns," in *Women, children and the family in Palmyra,* eds. Signe Krag and Rubina Raja (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2019), 50. We know of one woman, ʿAlâ, who is represented on two different portraits; one was likely placed in the tomb of her father and the other in the tomb of her husband. Both portraits carry the same inscription, although differently arranged, and mention the same year of death. (1) One portrait is now in the Ny Carlsberg Glyptotek (inv. no. I.N. 1079) and (2) the other is in the British Museum (inv. no. BM25695): Signe Krag, *Funerary Representations of Palmyrene Women from the First Century BC to the Third Century AD* (Turnhout: Brepols, 2018), 189, cat. 88–89; Raja, *Catalogue,* 70–71, cat. 3.

dren being siblings). This hypothetical version was referred to as the **secondary** network and was studied in detail through genealogical, Ore graph and p-graph representations.

4) Making the hypothetical assumption that single parents with multiple children remarried such that each child had a different pair of parents (the children being stepsiblings). This hypothesis was **only represented in the p-graph of the primary network** (a p-graph of the sources themselves could not be made without either formulating this hypothesis or the secondary hypothesis).

These *hypothetical* scenarios were designed in light of the proof-of-concept nature of this study: we initially aimed to explore the structure of the available information, as well as the theoretical extremes. A study of the sources themselves allowed us to explore the missing information within and the structure of the dataset as we know it. The first hypothesis allowed us to explore the scenario with a maximum number of nuclear families. The second hypothesis allowed us to explore a conservative hypothesis assuming a minimum number of nuclear families, and the implications of making this assumption on the network structure. A comparison between the structure of the two hypotheses also gave us an idea of the degree of missing information about women in the historical and archaeological record of Palmyra.

3.2 Network representation

Genealogies are most commonly represented as trees, in which parents are the roots and children are the shoots (this representation format was used in the studies by Sadurska and Bounni as well as by Piersimoni). To allow for different network analytical techniques to be applied we used two different representations (Fig. 2). We represented the genealogies as Ore graphs, which included all individuals as separate nodes connected by edges for marriage and arcs from parents to children (i.e. following the flow of time), as well as p-graphs (or parentage-graph[21]) in which couples and unmarried individuals were the nodes and arcs that flowed from children to parents (i.e. against the flow of time). Arcs in p-graphs were dotted if the descendent was female and solid if the descendant was male, and the arc itself was labelled by the individual who embodied the relationship. Thanks to both father and mother being directly connected to each of their children, the Ore graph allowed for an easy calculation of the length and direction of kinship relationships (e.g. how far-removed ancestors were from an individual). The p-graph as a representation was arguably less intuitive than the

21 Douglas R. White, and Paul Jorion, "Representing and Computing Kinship: A New Approach," *Current Anthropology* 33 (1992).

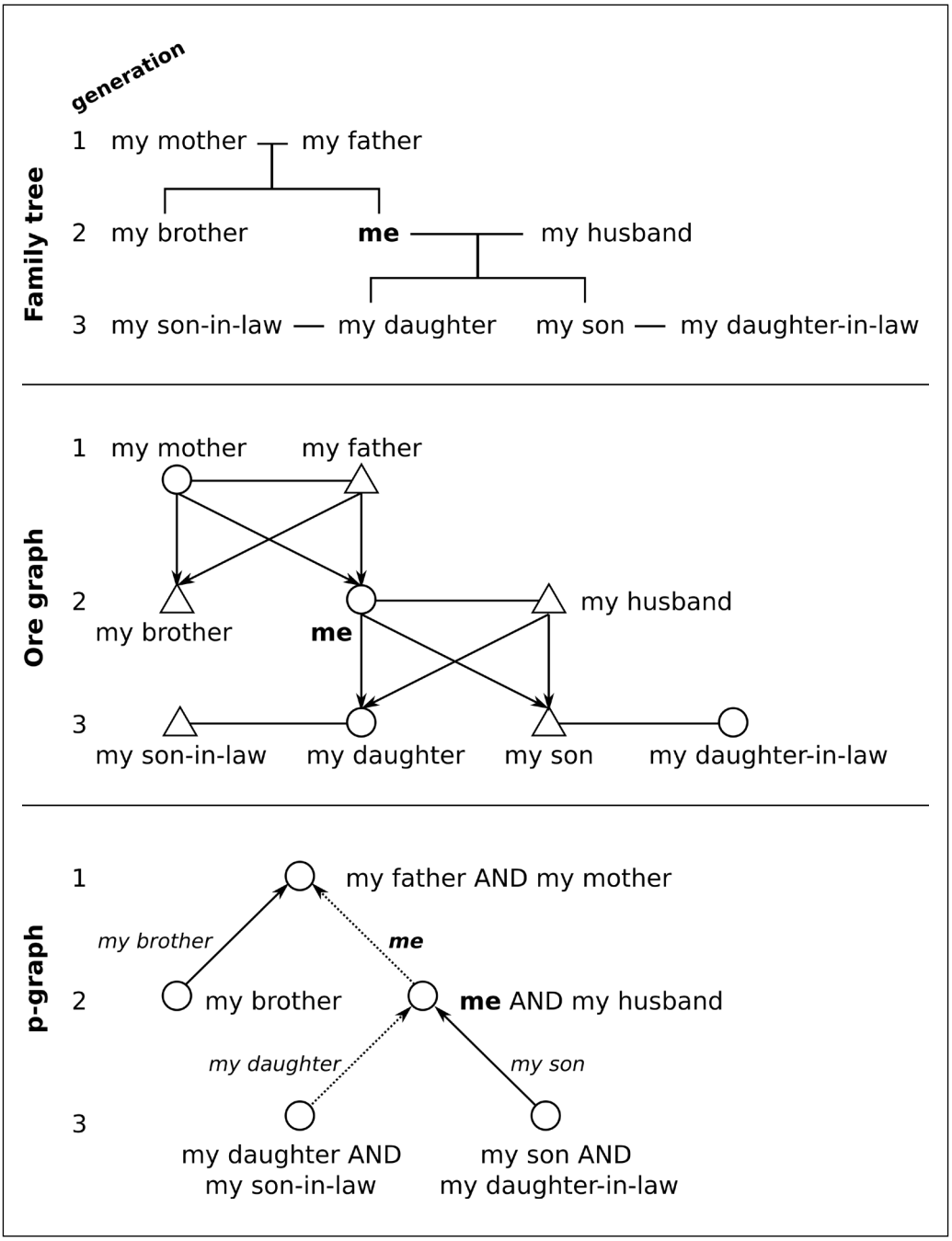

Fig. 2 Genealogical data are commonly represented as family trees (top), but here we use two network representations: Ore graphs (middle) represent women as circles, men as triangles, parent-to-child relationships as arrows and marriage relationships as edges; p-graphs (bottom) represent couples and single individuals as nodes, son-to-parents relationships as full arrows labelled by the son, and daughter-to-parents relationships as dotted arrows labelled by the daughter.

Ore graph, but it was more suitable for searching for relinking patterns in the kinship networks thanks to it being acyclic.[22]

3.3 Network analysis

From the connected components of the primary and secondary networks, we derived a number of network statistics. These helped describe the differences between the structure of the case studies' genealogies and the alternative Ore graph and p-graph network representations.

For the Ore graph, we calculated the number of nodes (individuals), the number of arcs (children), the number of edges (marriages), the average degree, the average in/outdegree, and the density. For the p-graph, we calculated the number of nodes (unmarried individuals and couples), the number of arcs (parents), the sources (number of first nodes), the sinks (number of last nodes), the average degree, average in/outdegree, the maximum indegree (maximum number of children), and the density.

3.4 Genealogical analysis

We derived a number of descriptive genealogical statistics that serve a dual purpose: they allowed for biases in the historical and archaeological records to be identified and for the limits of using this data for genealogical studies to be ascertained; they also revealed glimpses of the structure of past kinship relationships in Palmyra.

The simplest genealogical statistics included: the number of individuals, men, women, those with unknown gender, marriages, non-single men, non-single women, parent-child ties, multiple marriages (the number of individuals who had more than one marriage relationship), and the number of relationships whose existence was uncertain. In addition to these, we calculated more complex descriptive statistics revealing data patterns and network structures that spanned multiple generations. We explored the gender bias in the data by identifying the number of individuals for whom only a male (agnatic) or a female (uterine) ancestor was known at several generations' distance. We also identified the completeness of our genealogy by calculating the percentage of known ancestors by generation, again distinguishing between male and female ancestors.

A key statistic was the relinking index, which measured the tendency for marriages between members of the same extended family, which therefore rel-

22 Vladimir Batagelj and Andrej Mrvar, "Analysis of Kinship Relations with Pajek," *Social Science Computer Review* 26, no. 2 (May 3, 2008), https://doi.org/10.1177/0894439307299587.

ink diverging branches within the extended family (i.e. branches with a common ancestor within the genealogy). A high relinking index can be expected for communities in isolated locations with limited opportunities to marry into completely unrelated families, whereas such opportunities are more common in large cities, where we can expect a low relinking index. This measure is calculated on p-graphs because every semicycle (every closed path over directed relationships) constituted a relinking.[23] We also identified the number of first cousin marriages.

4. Results

The network and genealogical statistics for all case studies are presented in table 1. This section provides a brief technical description of key results, which will be interpreted and compared in the discussion section. The Ore graphs for the five case studies are shown in figures 3, 5, 7, 9, and 11, while the p-graphs are shown in figures 4, 6, 8, 10, and 12 (sections a and b show the primary and secondary networks, respectively). The gender bias and genealogical completeness per case study are shown in figures 13 and 14, respectively.

The genealogies derived from the five case studies varied in size from about 20 individuals in the case of Firmôn, to 71 individuals in the case of Bôlḥâ. Most included almost two centuries of kinship connections, covering a number of generations living in the first three centuries CE. The Hypogeum of Zebîdâ had the lowest, covering 5 generations over roughly 120 years. The Hypogeum of Artaban included 7 generations over roughly 180 years. The Hypogeum of Bôlḥâ included 8 generations over roughly 210 years, and the Hypogeum of Sassans included 9 generations, the highest number in this study, over roughly 140 years. The network of the Firmôn family was rather different to the other four, in that its very low number of 20 individuals were spread over no less than 8 generations, covering c. 180 years.

Although most individuals' gender was known, there was one case of an individual of unknown gender in the Artaban network, and four cases in the Zebîdâ network (constituting a rather high proportion of the total of 26 individuals). Potentially more problematic for studying kinship networks was the uncertainty inherent in the reconstruction of some relationships. No less than 16 out of 37 relationships (43%) were not entirely certain for the Zebîdâ case study. For the other three funerary case studies, these proportions were slightly lower (13/52 (25%); 19/94 (20%); 18/68 (26%)) and for the Firmôn network all 19 relationships were considered certain.

23 Batagelj and Mrvar, "Analysis of Kinship Relations with Pajek."

The number of marriages documented in the sources was extremely low, and certainly much lower than in reality (ranging from 1 in the Firmôn network to 9 in the Bôlḥâ network). Our hypothetical secondary network represented the minimum number of marriages that must have taken place in order to account for all known children (ranging from 12 in the Firmôn network to 35 in the Bôlḥâ network). Moreover, there were only two known cases of individuals marrying multiple times. The primary network's p-graph represented an alternative theoretical scenario in which all children with unknown parents had a distinct parent pair, thus including the maximum number of marriages of known individuals with known children. Comparing the number of nodes of the primary and secondary p-graphs revealed that there was a significant difference between these maximum and minimum marriages hypotheses. The exception was the Hypogeum of Zebîdâ whose primary and secondary p-graphs had the same number of nodes: only for this case study do we know all the siblings' parents.

Intermarriage within the extended family was very limited in our sources, as revealed by the relinking index. It was zero for Zebîdâ and Sassans, and very low for all other case studies. The secondary network typically had a higher relinking index than the primary. First cousin marriages were rare across all case studies, with one case each documented for Artaban, Bôlḥâ, and Firmôn.

The primary networks representing our sources revealed a very high degree of incompleteness: our sources lacked a high number of individuals from the studied genealogy (Fig. 14). The secondary hypothesis succeeded at increasing the completeness at the first generational level (i.e. the parents), but not at subsequent generational levels. Moreover, we saw that male ascendants were far more commonly represented at all generational levels than female ascendants (Fig. 13).

	Artaban		Bôlhâ		Sassans		Zebida		Firmon	
Genealogy										
Individuals	39	55	71	97	57	78	26	35	20	31
Men	27	29	56	58	41	43	13	13	18	18
Women	11	24	15	39	16	35	9	14	2	13
Gender unknown	1	2	0	0	0	0	4	8	0	0
Marriages	5	21	9	35	6	27	4	13	1	12
Non-single men	17	19	33	35	24	26	9	9	12	12
Non-single women	7	20	11	35	8	27	4	9	1	12
Parent-child ties	47	70	85	128	62	100	33	42	19	38
Multiple marriages	1	1	0	0	1	1	0	0	0	0
First cousin marriages	1	1	1	1	0	0	0	0	1	1
Uncertain relationships	13	13	19	19	18	18	16	16	0	0
Ore graph										
nodes (individuals)	39	55	71	97	57	78	26	35	20	31
arcs (children)	47	71	85	128	62	100	33	42	19	38
edges (marriages)	5	21	9	35	6	27	4	13	1	12
average degree	2,667	3,309	2,648	3,361	2,386	3,256	2,846	3,143	2	3,226
average in/out-degree	1,462	2,036	1,451	2,041	1,298	1,974	1,577	1,943	1,05	2
components	1	1	1	1	1	1	1	1	1	1
density	0,07	0,061	0,038	0,035	0,043	0,042	0,114	0,092	0,105	0,108

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	Artaban		Bôlhâ		Sassans		Zebida		Firmon	
P-graph										
nodes (unmarried individuals and couples)	42	35	79	62	69	52	22	22	27	19
arcs (parents)	41	36	79	64	66	51	21	21	27	19
Sources (number of first nodes)	14	14	28	28	25	25	9	9	8	8
Sinks (number of last nodes)	6	4	7	5	8	6	5	5	1	1
average degree	1,952	2,057	2	2,065	1,913	1,962	1,909	1,909	2	2
average in/out-degree	0,976	1,029	1	1,032	0,957	0,981	0,955	0,955	1	1
Max. indegree (number of children)	5	4	6	6	6	6	6	6	3	3
components	1	1	2	1	3	1	1	1	1	1
density	0,048	0,061	0,026	0,034	0,028	0,038	0,091	0,091	0,077	0,111
Size of Largest Component	42 (100%)	35 (100%)	75 (94.9%)	62 (100%)	51 (73.9%)	52 (100%)	22 (100%)	22 (100%)	27 (100%)	19 (100%)
Relinking Index	0	0,0714	0,0299	0,0566	0	0	0	0	0,0385	0,0556

Tab. 1 Genealogical, Ore graph and p-graph statistics for the primary (white) and secondary (grey) versions of each case study's largest component. Note that for the primary p-graph, we assumed the hypothesis that siblings with a single unknown parent were stepsiblings with distinct parent pairs (hence the higher number of nodes as compared to the secondary p-graphs).

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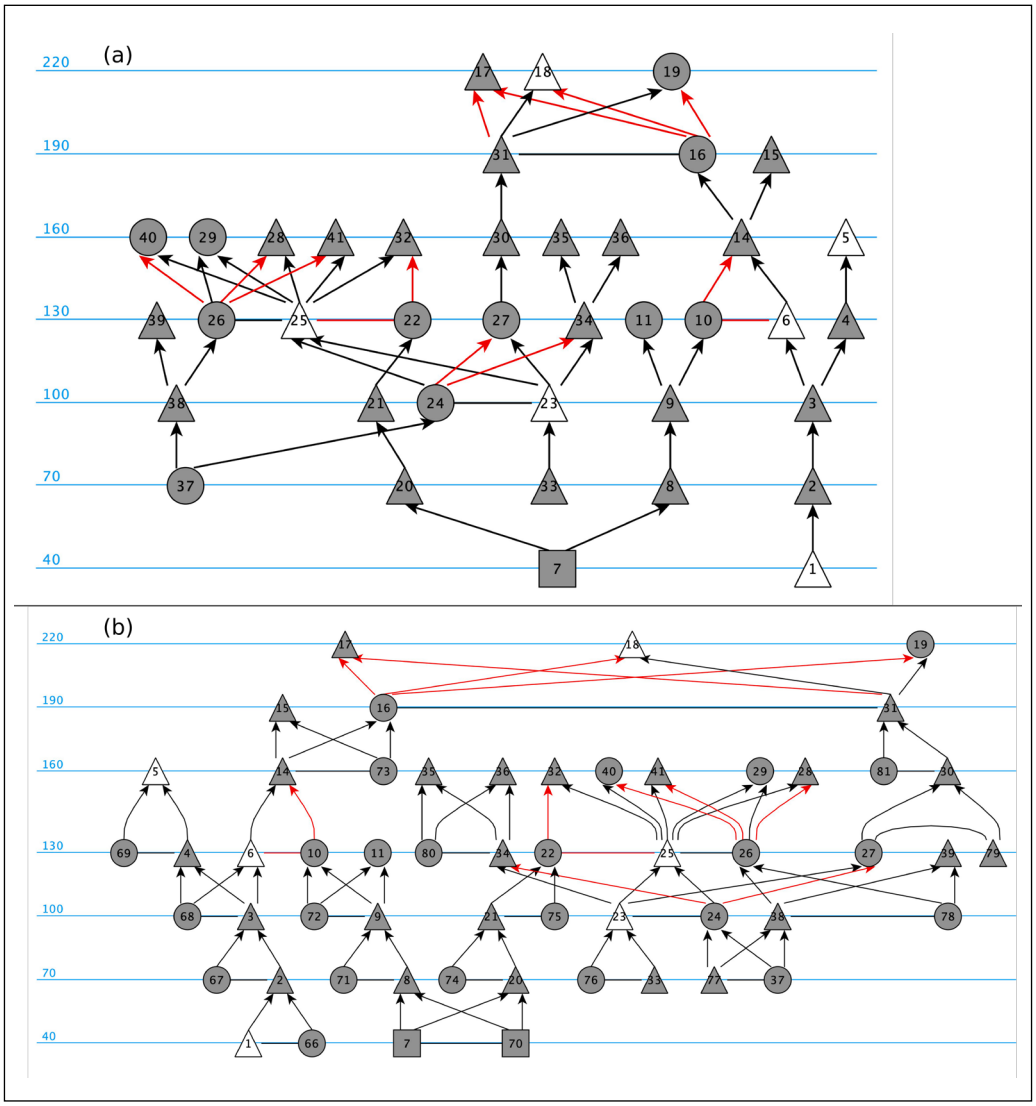

Fig. 3 Largest component of primary (a) and secondary (b) Ore graphs of the Hypogeum of Artaban. For this and all figures of Ore graphs below (Figs. 3, 5, 7, 9, 11): labels represent individual IDs, circles represent women, triangles represent men, squares represent individuals for whom the gender is unknown, white nodes represent priests, red lines represent relationships whose existence is uncertain, arrows represent parent-child relationships, undirected edges represent marriage. The y-axis represents years CE and individuals are placed according to the upper date known for them (this information is only used for representation and does not feature in the analysis).

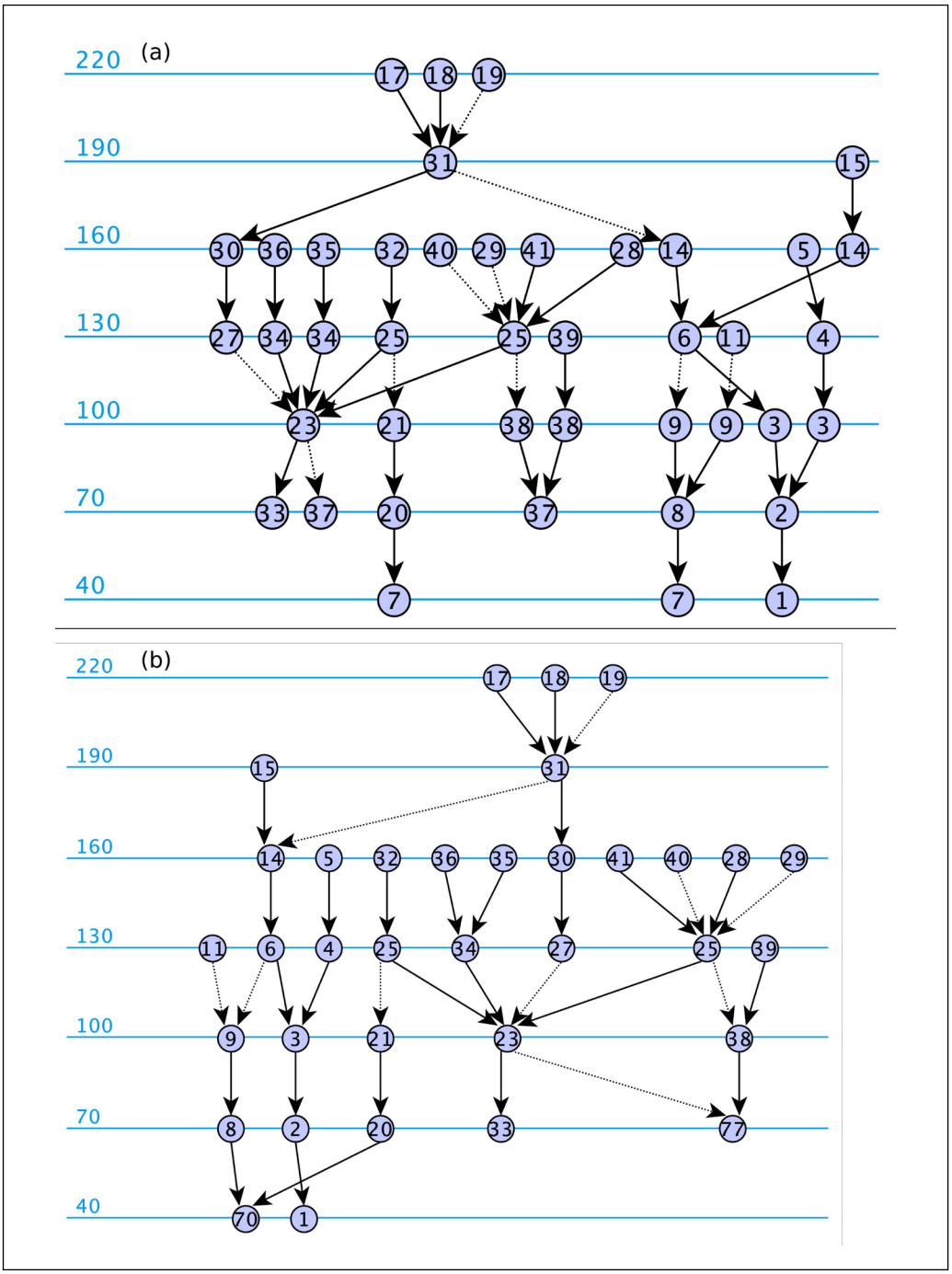

Fig. 4 Largest component of primary (a) and secondary (b) p-graphs of the Hypogeum of Artaban. In this and all p-graphs that follow (Figs. 4, 6, 8, 10, 12), "daughter of" relationships are represented by a dotted arrow and "son of" relationships by a solid arrow. Note how the secondary hypothesis reveals a degree of relinking, whereas the primary hypothesis does not.

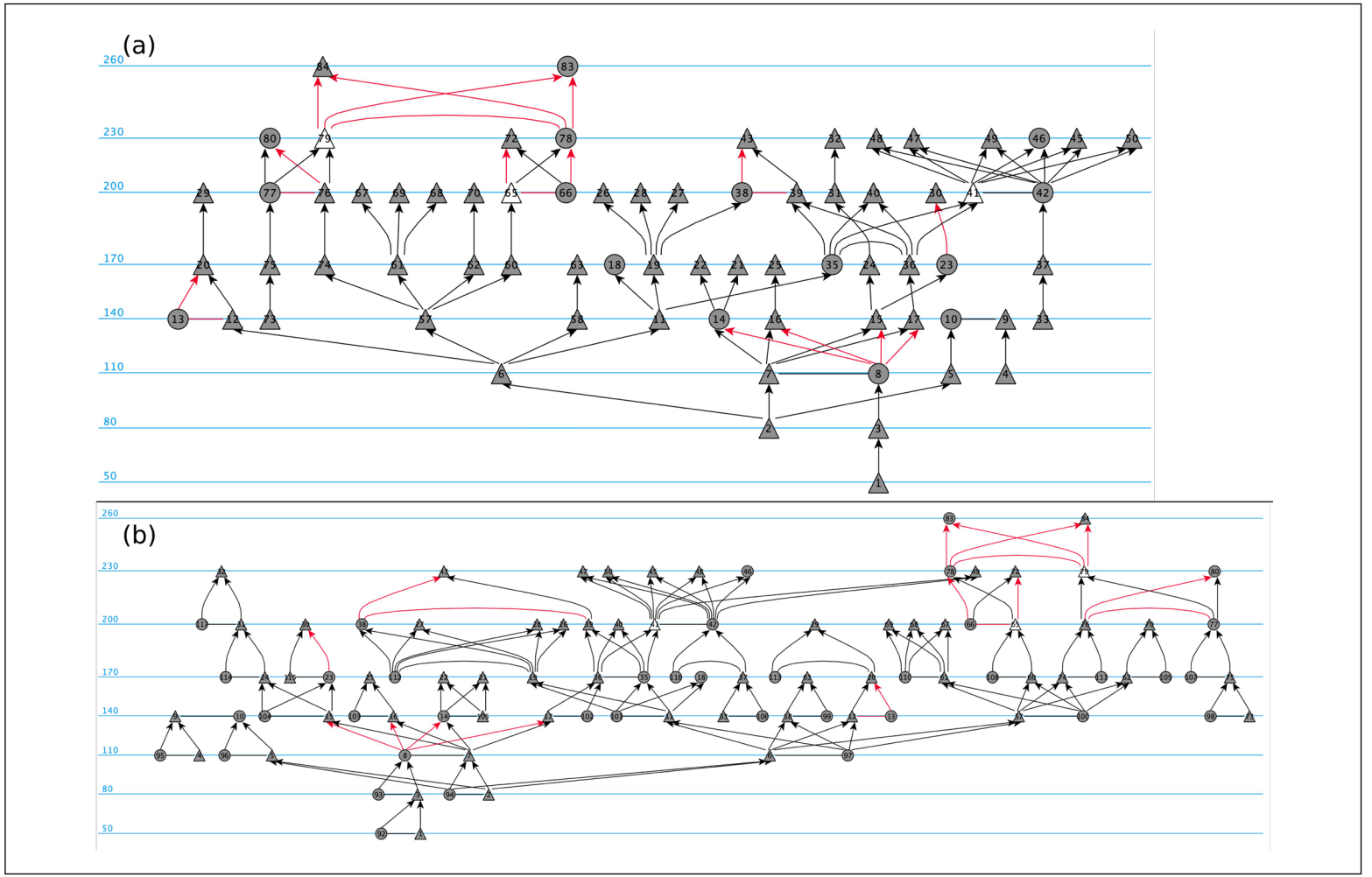

Fig. 5 Largest component of primary (a) and secondary (b) Ore graphs of the Hypogeum of Bôlḥâ.

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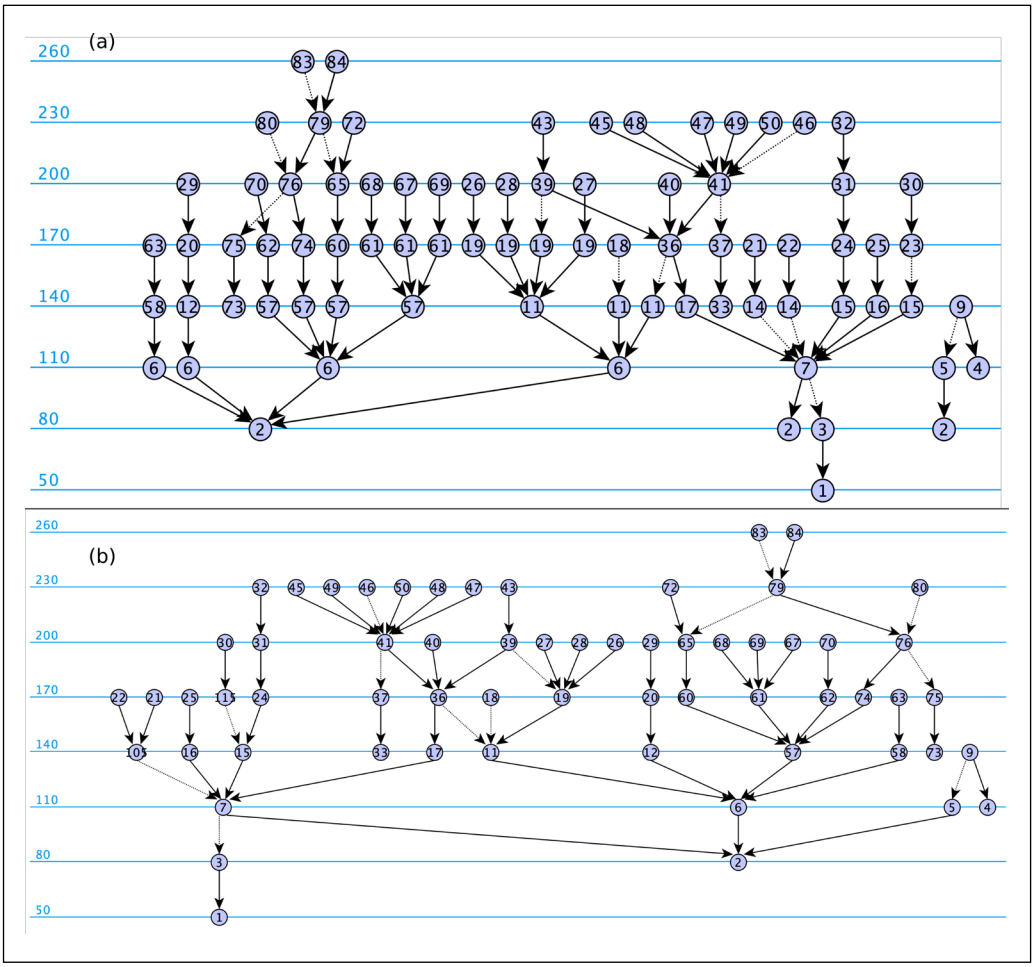

Fig. 6 Largest component of primary (a) and secondary (b) p-graphs of the Hypogeum of Bôlḥâ.

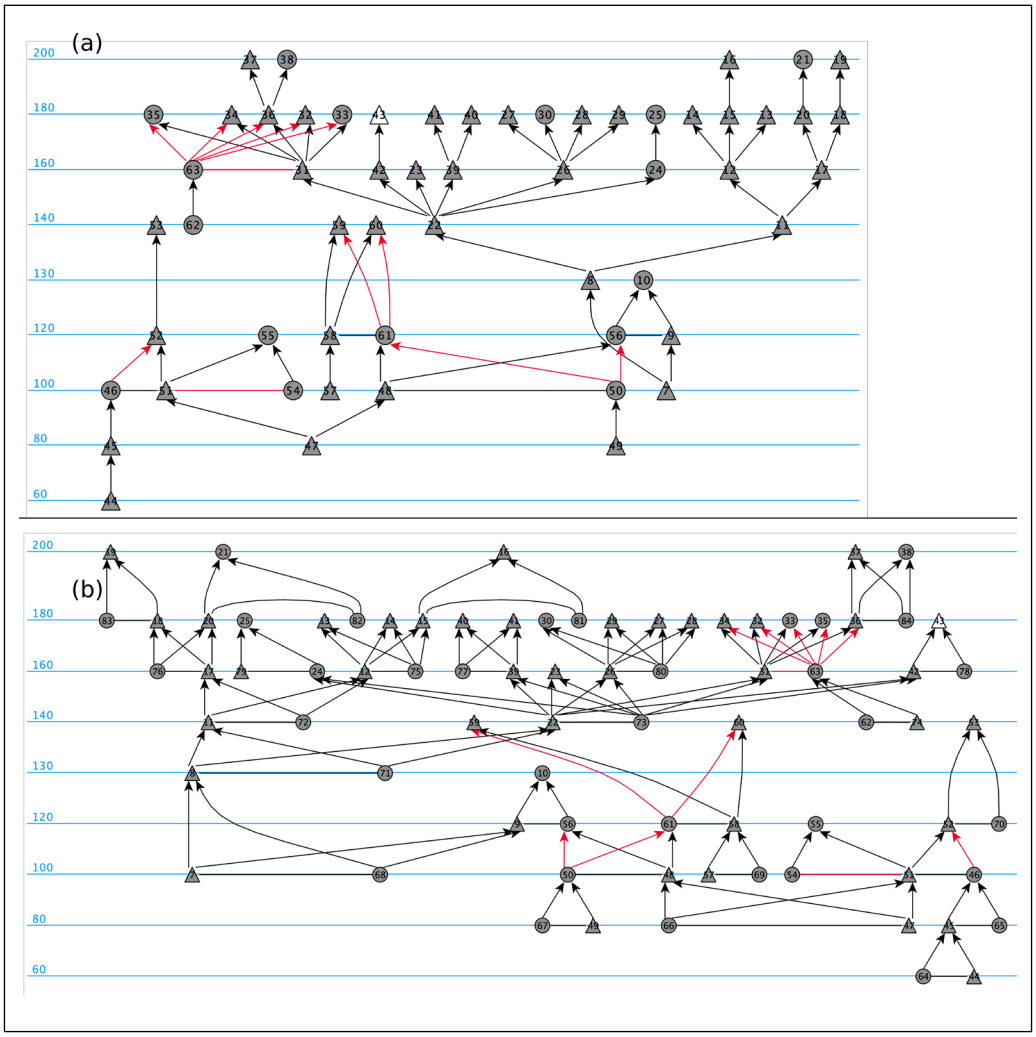

Fig. 7 Largest component of primary (a) and secondary (b) Ore graphs of the Hypogeum of Sassans.

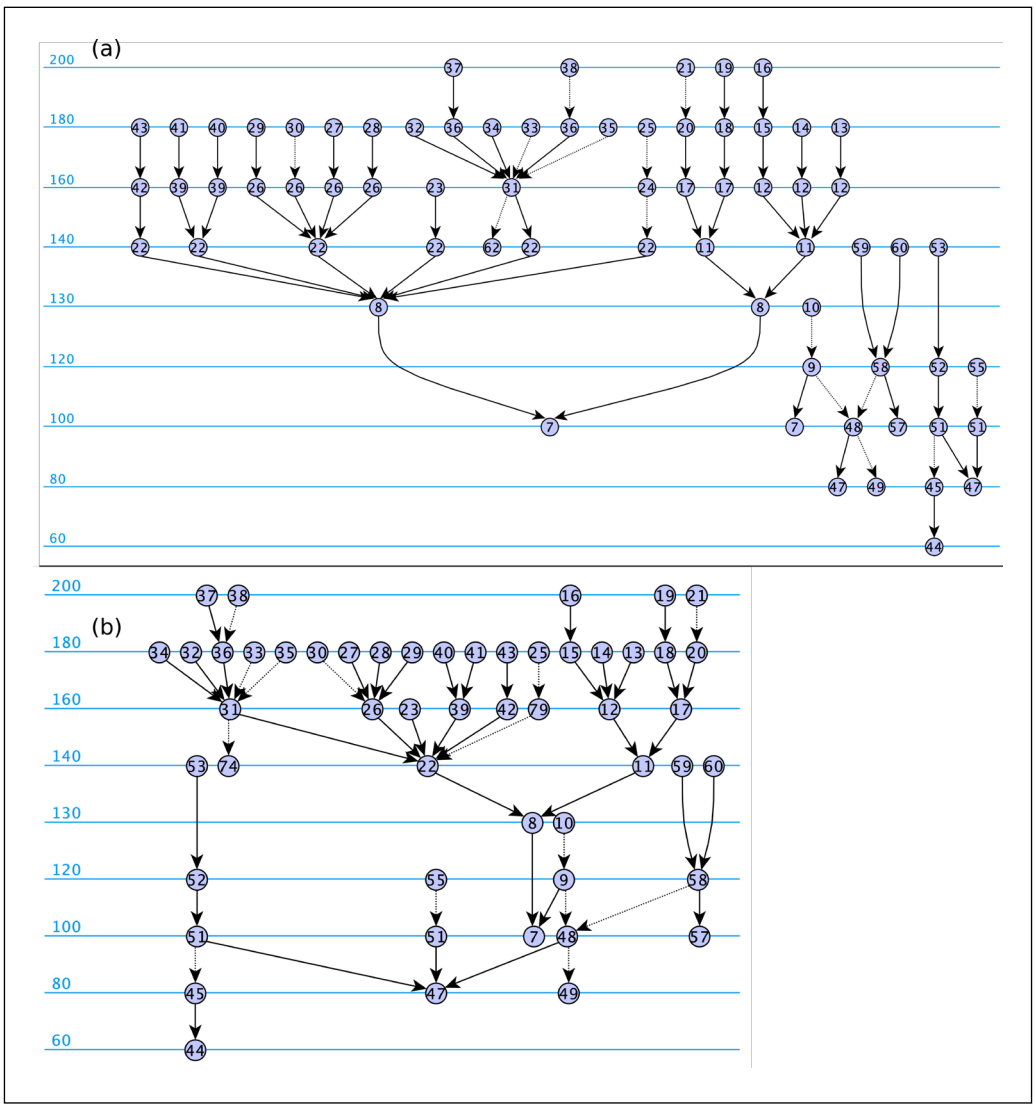

Fig. 8 Largest component of primary (a) and secondary (b) p-graphs of the Hypogeum of Sassans.

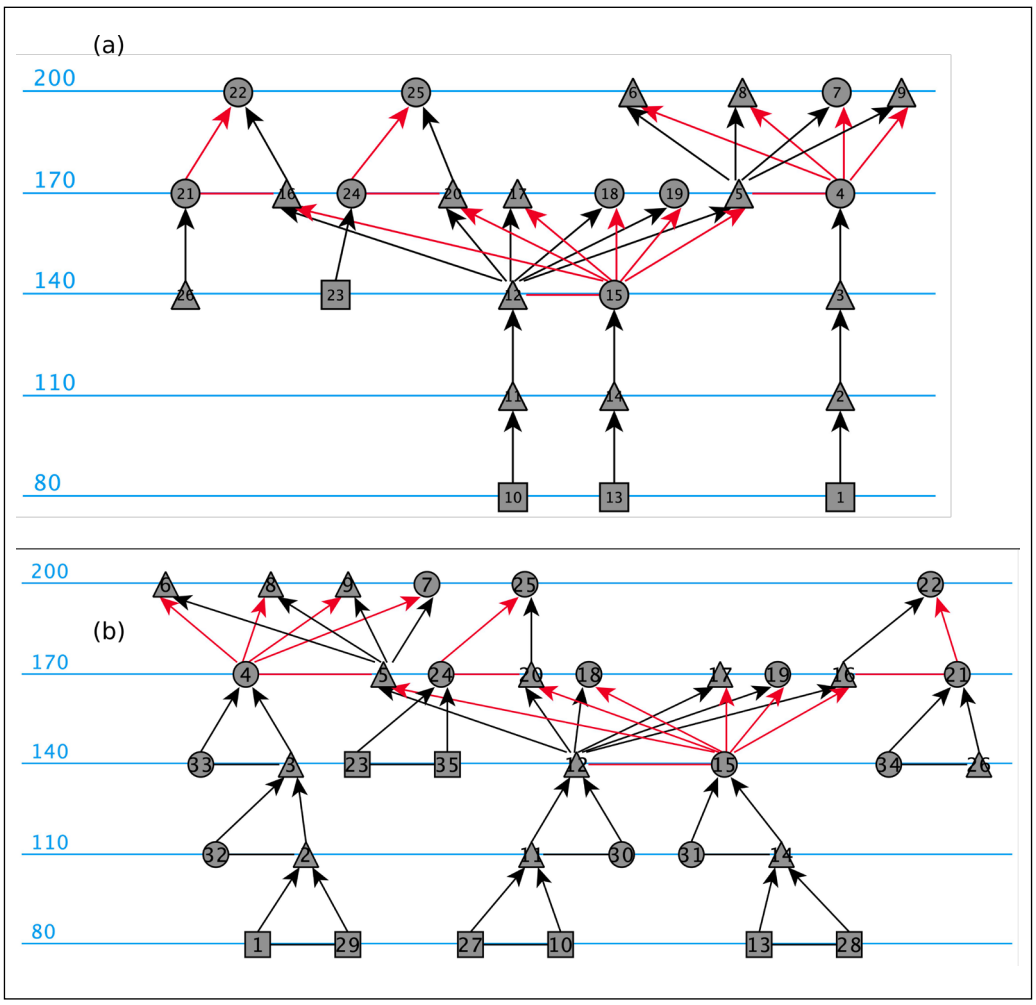

Fig. 9 Largest component of primary (a) and secondary (b) Ore graphs of the Hypogeum of Zebîdâ.

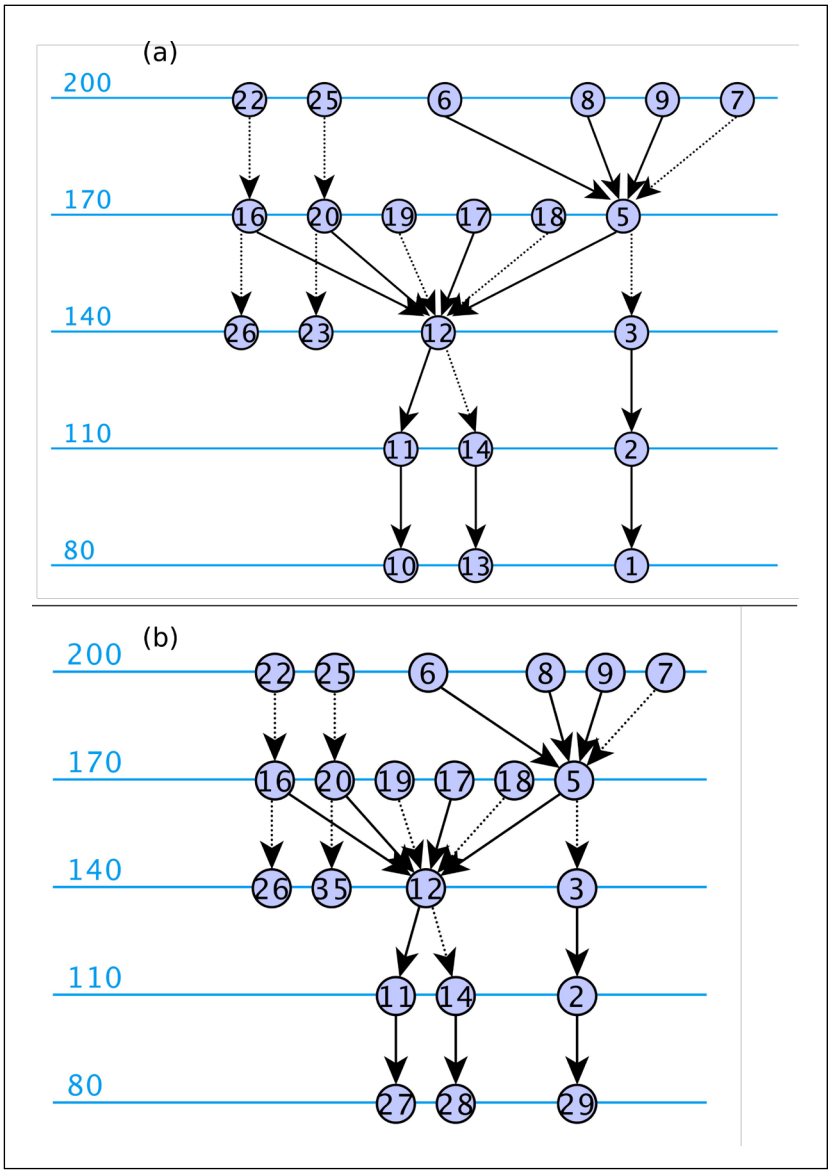

Fig. 10 Largest component of primary (a) and secondary (b) p-graphs of the Hypogeum of Zebîdâ.

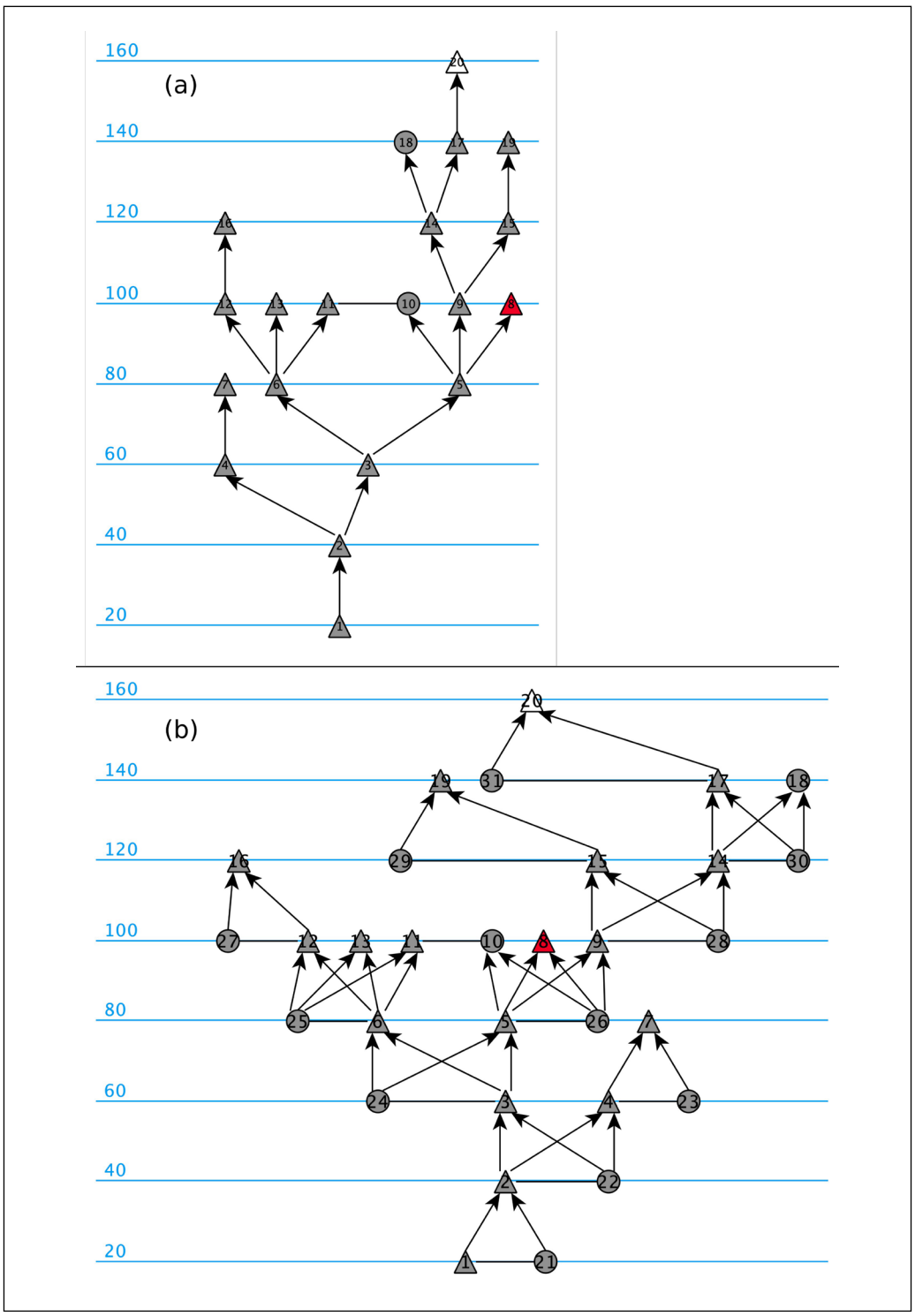

Fig. 11 Largest component of primary (a) and secondary (b) Ore graphs of the Firmôn network.

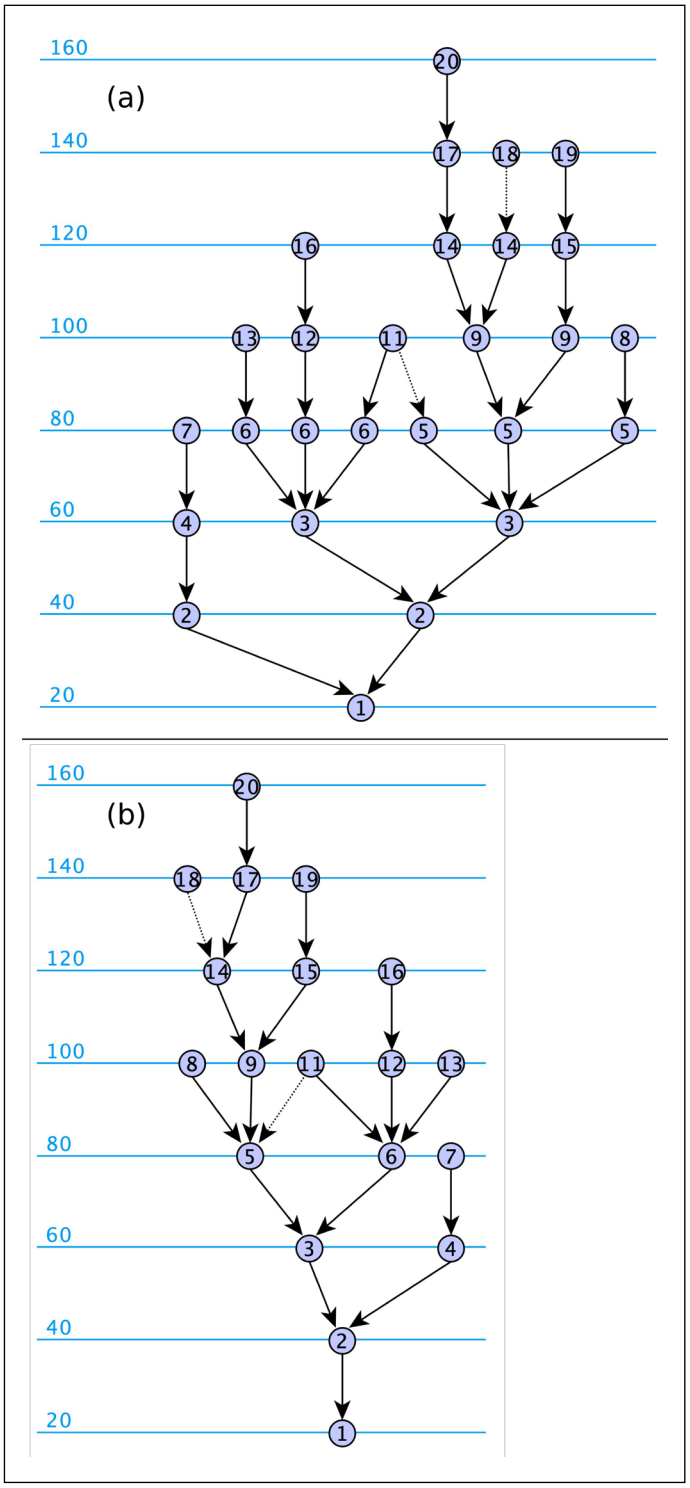

Fig. 12 Largest component of primary (a) and secondary (b) p-graphs of the Firmôn network.

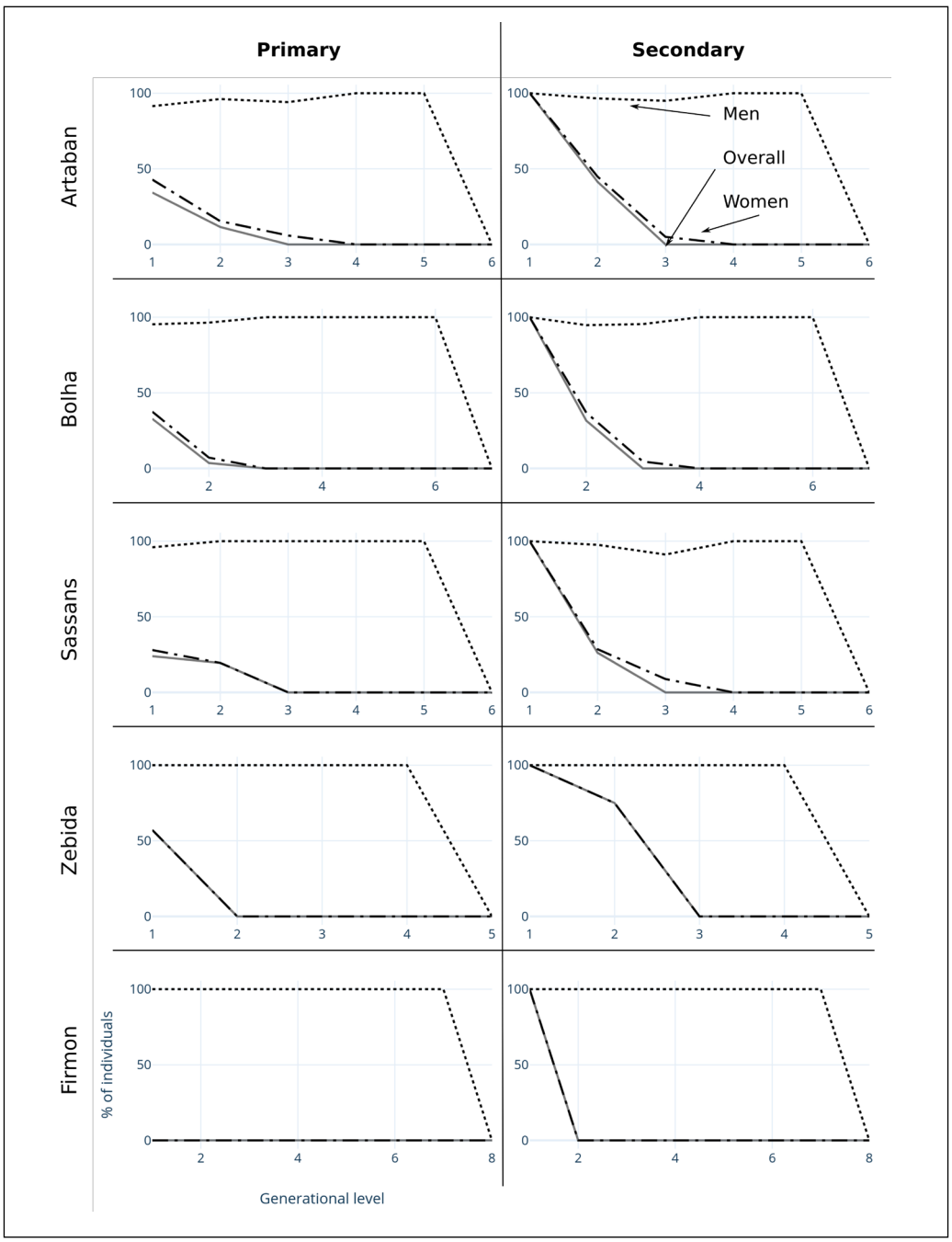

Fig. 13 The gender bias of all case studies' primary and secondary representations of the largest components. This represents the number of individuals for whom the male (dotted), female (dash-dot) and overall (solid line) linear ascendants of a given genealogical degree is known, as a percentage of individuals for whom the agnatic or uterine ascendant of that degree is known. Note the moderate decrease of gender bias in the secondary hypothesis.

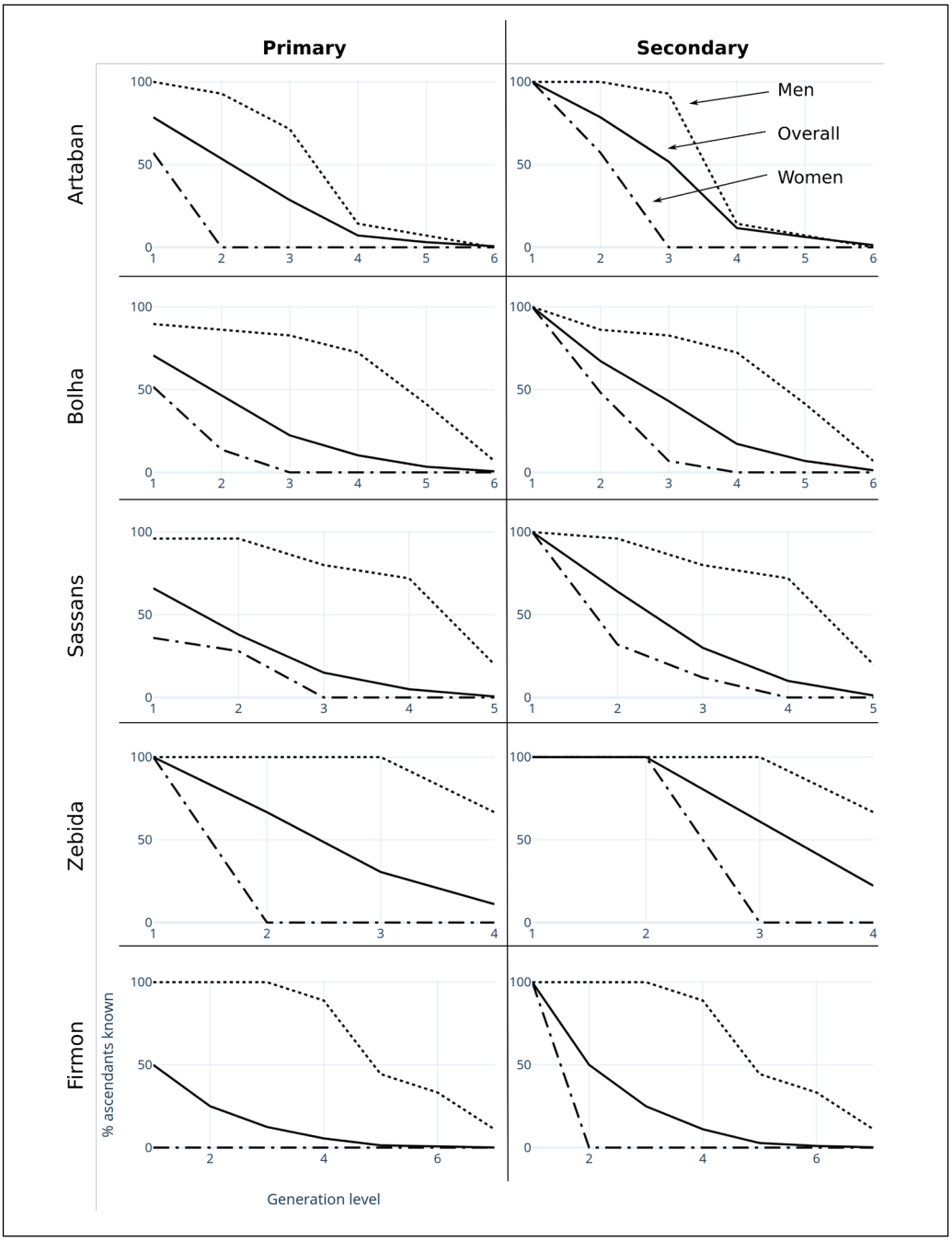

Fig. 14 The genealogical completeness of all case studies' primary and secondary representations of the largest components. This represents the proportion of male (dotted), female (dash-dot) and overall (solid line) ascendants that are known at each generation level. Note the moderate increase in completeness in the case of the secondary hypothesis.

5. Discussion

In this section, we examine these four key issues in light of our technical results, correlated with a critical examination of the nature of our sources:

1) Our sources confirm a high degree of genealogical incompleteness and gender bias, previously known from studies of Palmyrene society.[24]
2) Evaluating whether the relinking index can enhance debates on endogamy and exogamy practices in Palmyra.
3) Funerary and public inscriptions are highly complementary.
4) Assessing the assumptions behind creating uncertain relationships in funerary cases and their effects on our results.

5.1 Genealogical completeness and gender bias

A striking feature of the available sources and the resulting genealogical networks is the high number of missing individuals. It is very common for these sources not to mention one of the parents of each individual, and more often than not the unknown parent is the mother. Related to this absence of many individuals (mostly women) is the pattern, across all case studies, that very few of the marriages that must have taken place to produce the number of known descendants are actually documented. The number of documented marriages is very low, although it is much higher in the four funerary case studies than in the Firmôn network, for which just one marriage is known.

Our genealogical analysis allows us to display the extent of this missing information in a concrete manner, represented as the degree to which the genealogy is complete at different generational levels (Fig. 14), as well as identifying the proportion of individuals for whom we know the male and female ascendants (Fig. 13). For the primary networks representing our sources, these tables offer an unprecedentedly nuanced picture of the structure of the gender bias and of precisely what information is missing. For all case studies, we are highly informed about the male ascendants up to four or five generations removed (i.e. for a high proportion of individuals we know the father, grandfathers, great-grandfathers, and great-great-grandfathers). This is largely thanks to the onomastic practices and the listing of male ancestors (discussed below). The genealogies are far less complete in terms of the women: we know of the mothers for roughly 40–50% of

24 Jean-Baptiste Yon, *Les notables de Palmyre* (Beirut: Institut Français d'Archéologie du Proche-Orient, 2002); Maura K. Heyn, "Status and Stasis: Looking at Women in the Palmyrene Tomb," in *The World of Palmyra,* eds. Andreas Kropp and Rubina Raja (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2016); Signe Krag and Rubina Raja (eds.), *Women, children and the family in Palmyra* (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2019).

individuals in the four funerary case studies, but few women at subsequent generational distances. For the Firmôn network, we know of not a single woman one genealogical step removed from an individual: two women are documented for this case study, but neither of them has documented children.

We aim to partly address the incompleteness of our data through representing a hypothesis (which we refer to as the secondary networks): a new individual is added for all single individuals with children for whom the partner is not known. The secondary networks therefore have many more marriages than the primary networks representing the original data. However, when we compare the completeness and gender bias graphs of the primary and secondary networks (Figs. 13–14), we notice that the secondary hypothesis solves issues at one generational level (i.e. all parents are now known), but changes little for further generational levels.

It is crucial to realise that this secondary hypothetical network only includes a theoretical minimum number of marriages. Many of the documented single individuals for whom no children are known must have also been married. Moreover, some individuals might have remarried rather than only having ever had one partner. The number of documented multiple marriages is extremely low: 1 case for Artaban and Sassans, and 0 for all other case studies. If the practice of remarrying was common in Palmyra, then we would expect the real number of marriages to be much higher still than that represented in the secondary hypothesis. An extreme hypothetical version of this practice of remarrying is represented by the p-graph of the primary network, in which we theoretically assume that each child for whom both parents are not known had a unique parent pair (i.e. a very high frequency of remarriage). Comparing the primary and secondary networks' p-graphs allows us to grasp the potential extent of this issue. We notice that for almost all case studies, the number of nodes in the primary p-graph is much higher than those in the secondary p-graph: there are many cases where we do not know whether children with one common parent were siblings or stepsiblings. One exception to this is the Zebîdâ network, for which both parents of all siblings are known.

These issues of completeness and gender bias underline what we know about Palmyrene social and family practices. The portraits reveal a higher representation of women in the funerary sphere than the inscriptions alone would allow us to think. This discrepancy between inscriptions and portraits is interesting and reveals the complementarity of these different sources for enhancing genealogical studies. In the public inscriptions, the ratio of women is again much lower than in the funerary sphere. Thomallachis, the female scion of the Firmôn family (ID 18) documented in an inscription as a major donor to a public building, is a rare exception.[25]

25 Yon, *Inscriptions Grecques et Latines,* 264, cat. 312.

The Palmyrene *patrilineal* tradition, however, is very pronounced in the inscriptions, which tend to list male ancestors. From the onomastic practices of the Palmyrenes, we know that their society was patrilineal, and that children of both sexes belonged to the father's family.[26] For example, women still identified themselves as daughters of their fathers even after their marriage.[27] As Piersimoni notes, married women were frequently identified not only with their biological father's name, but also with the name of their paternal family.[28] We also see in the foundation inscriptions of the tower tombs, which were built expressly as family burial monuments, that only the male founders, their fathers, and male descendants are mentioned.[29] The emphasis on the male line in the epigraphic record could explain the low number of recorded marriages.[30]

Moreover, from the available evidence it seems that Palmyra was a *patrilocal* society.[31] Even though we have little evidence for the movement of women from their paternal to their husband's household,[32] we see that women in most cases were buried in their husband's family tomb, indicating that they had already moved into his household during their lives.[33]

Our primary and secondary hypotheses further explore alternative theories about the frequency of remarriage. Although two cases of remarriage are documented in our case studies, we do not know whether remarriage was common practice in Palmyra. The obvious reasons for remarriage would be either divorce or the death of a spouse. We have, however, no evidence concerning the practice of divorce in Palmyra.[34] Due to the nature of the documented cases of remarriage (that is, not having the marriage between two people recorded in the inscrip-

26 Piersimoni, *The Palmyrene Prosopography,* 550.
27 Eleonora Cussini, "Daughters and wives: Defining women in Palmyrene inscriptions," in *Women, children and the family in Palmyra,* eds. Signe Krag and Rubina Raja (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2019), 70.
28 Piersimoni, *The Palmyrene Prosopography,* 550.
29 Agnes Henning, "The representation of matrimony in the tower tombs of Palmyra," in *Women, children and the family in Palmyra,* eds. Signe Krag and Rubina Raja (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2019), 25.
30 See also Krag, "Palmyrene funerary buildings and family burial patterns," 49.
31 See, for example Nathanael Andrade, *Zenobia: Shooting Star of Palmyra* (Oxford: Oxford University Press, 2018), 59–88.
32 As, for example, we know occurred in other areas of the Roman world: Mona Tokarek LaFosse, "Age Hierarchy and Social Networks among Urban Women in the Roman East," in *Mediterranean Families in Antiquity: Households, Extended Families, and Domestic Space,* eds. Sabine R. Huebner and Geoffrey Nathan (Chichester: John Wiley and sons, 2017), 208.
33 Krag, *Funerary Representations of Palmyrene Women,* 48.
34 We have evidence of divorce in other areas of the Roman world. See Susan Treggiari, "Divorce Roman Style: How easy and how Frequent was it?" in *Marriage, Divorce, and Children in Ancient Rome,* ed. Beryl Rawson (Oxford: Oxford University Press, 1991).

tions of both partners), some scholars have supposed that the inscriptions were evidence of polygamy.[35] In one of the most likely candidates for documenting remarriage, we can see that the first wife died, after which the husband married for a second time and had several children with his second wife.[36]

The above-mentioned example also hints at one of the known causes for female mortality in the ancient world: the death of the mother at childbirth. The opposite could also happen when the husband died before the wife, in which case the woman can remarry, but we have little evidence for women remarrying.[37] In other areas of the Roman world, we know that remarriage was possible for both husbands and wives, and for different reasons: financial, political, etc.[38] For Palmyra, we have to assume that remarriage was a possibility after the death of a spouse, but we cannot formulate any hypotheses as to the precise reasons why it happened.

5.2 Endogamous and exogamous marriage practices

The relinking index results are very low in comparison to other past and present-day genealogies of urban or nomadic communities.[39] This result requires a highly cautious and nuanced interpretation, given the fragmentary nature of our sources and our patchy knowledge of intermarriage practices in ancient Palmyra. Indeed, the epigraphic record is so sparse that it has allowed scholars to argue for either practices of endogamy[40] or exogamy[41] in Palmyra: both are documented, but the extent to which one was dominant cannot be easily determined.

On the one hand, the low relinking index supports the argument that marriage outside the extended family was common. In her Palmyrene prosopography, Piersimoni argued that exogamy was common and that it was a way to forge and maintain alliances and peaceful relations between powerful families.[42] This argument states that most Palmyrenes married outside their close or extended family. Tribal affiliation, however, seems to have been important for significant

35 Signe Krag and Rubina Raja, "Representations of Women and Children in Palmyrene Banqueting Reliefs and Sarcophagus Scenes," *ZOrA* 10 (2018); Krag, *Funerary Representations of Palmyrene Women,* 83; Krag, "Palmyrene funerary buildings and family burial patterns," 50.
36 Krag, "Palmyrene funerary buildings and family burial patterns," 50, 61, cat. 54.
37 Krag, *Funerary Representations of Palmyrene Women,* 83 n. 144.
38 See, for example April Pudsey, "Death and the Family: Widows and Divorcées in Roman Egypt," in *Families in the Roman and Late Antique World,* eds. Lena Larsson Loven and Mary Harlow (London: Continuum, 2012).
39 Batagelj and Mrvar, "Analysis of Kinship Relations With Pajek," table 3.
40 Krag, "Palmyrene funerary buildings and family burial patterns," 50.
41 Piersimoni, *The Palmyrene Prosopography,* 552–553.
42 Piersimoni, *The Palmyrene Prosopography,* 552–553.

segments of Palmyrene society. The names of a significant number of tribes (*pḥd*) are known from the epigraphic record, and intermarriage between these groups took place.[43]

On the other hand, it could be argued that marriage within the same family was common practice and that the relinking index is low due to the high degree of missing information in our sources. Indeed, we should perhaps expect a high degree of endogamy in Palmyra, given that this was a relatively small desert community that placed great emphasis on lineage: it was by no means entirely isolated,[44] but we cannot expect the diversity of marriage options to have been as high as for large coastal cities with less distinct local identities. Piersimoni identified examples of marriages between first cousins (also revealed in our Artaban, Bôlḥâ, and Firmôn case studies) and of uncle/aunt-niece/nephew marriages.[45] Such endogamous relationships are generally considered to preserve property and status within the lineage,[46] which might explain Piersimoni's observation that they seem to be more common in priestly families, which were part of Palmyra's elite.[47] This argument suggests that an extremely low relinking index value is unlikely, and forces us to consider the impact of missing information on our relinking index results. Our low results are a reflection of missing individuals (was an unknown spouse a member of the extended family?) and missing information about known individuals (was a known marriage partner a member of

43 Piersimoni, *The Palmyrene Prosopography,* 530–543; Andrew M. Smith II, *Roman Palmyra: Identity, Community, and State Formation* (Oxford: Oxford University Press, 2013), 43; Yon, *Les Notables,* 251–252.

44 Two reliefs from Palmyra record the deaths of people originating from outside Palmyra: (1) one relief in Palmyra Museum (inv. no. A 133) commemorating Amata, daughter of Titus Iulius Babaeus, who was a native of Hierapolis: Yon, *Inscriptions Grecques et Latines,* 372, cat. 491; Krag and Raja, "Representations of Women and Children," 171, cat. 77, and (2) the relief of Marcus Iulius Maximus Aristides from Berytus, now in the Louvre Museum (inv. no. AO 1556): Jacqueline Dentzer-Feydy and Javier Teixidor, *Les antiquités de Palmyra au Musée du Louvre* (Paris: Èditions de la Réunion des musées nationaux, 1993), 162, cat. 166; Yon, *Inscriptions Grecques et Latines,* 413, cat. 551; Lukasz Sokolowski, "Portraying the Literacy of Palmyra: The Evidence of Funerary Sculpture and its Interpretation," *Études et Travaux* 27 (2014), 380, 386, fig. 8; Rubina Raja, "Palmyrene Funerary Portraits in Context: Portrait Habit between Local Traditions and Imperial Trends," in *Tradition: Transmission of Culture in the Ancient World,* eds. Jane. Fejfer, Mette Moltesen and Annette. Rathje (Copenhagen: Museum Tusculanum, 2015), 335–336, fig. 5. Greek and Latin names in Palmyrene inscriptions do not necessarily mean that the people were of Greek or Roman descent; Persian names, however, likely indicate Persian origin. For a list of non-Palmyrene names in Palmyrene inscriptions: Jürgen Kurt Stark, *Personal Names in Palmyrene Inscriptions* (Oxford: Clarendon Press, 1971), especially appendix 3.

45 Krag, "Palmyrene funerary buildings and family burial patterns," 50.

46 For a similar case, see Fred Strickert, *Philip's City: From Bethsaida to Julias* (Collegeville: Liturgical Press, 2011), chapter 11.

47 Piersimoni, *The Palmyrene Prosopography,* 552.

the extended family?), as well as the relatively small size of these genealogies (are we informed about all members of the family?). Even in the case of the secondary networks, where we added many hypothetical (mostly female) spouses, the relinking index is necessarily low because we do not know whether these partners were part of the extended family. However, we do notice that the hypothetical secondary networks have a higher relinking index than when we hypothetically assume all siblings with one unknown parent were stepsiblings from distinct parent pairs (see p-graph primary networks). The differences in the relinking index between these two hypotheses suggests that a key piece of information for identifying the degree of endogamy is underreported in our sources: the missing marriage partners' relationships to the family. However, it also suggests that formulating a plausible hypothesis and studying its p-graph representation offers a promising approach for future critical studies of this issue.

5.3 Funerary and public inscriptions

These five case studies highlighted differences in how genealogies are represented between funerary and other inscriptions. The Firmôn network is mostly based on non-funerary inscriptions and appears more unilinear than the other four case studies: only a very few branches of the extended family are known, and it can be assumed that many siblings of the individuals included are not known. The other four case studies are based on funerary inscriptions: even though the formula 'X son of Y', or 'X daughter of Y' appears in both the public and the funerary sphere, simply by nature of the context (i.e. extensive family tombs), we have more inscriptions documenting more members of the extended family.

Most inscriptions, both public and funerary, emphasise the male line of descent. In the funerary sphere, because of the portraits of females that have survived, our genealogies can be more complete. In the public sphere, the female portraits have either been lost, or survive without accompanying inscriptions. This could explain the apparent unilinearity of the Firmôn network: on the one hand, we have public inscriptions that emphasise the male line, while on the other we have funerary cession texts that also exclude daughters, thus creating a case study where women are not visible in the extant sources (Fig. 13).[48]

Other public inscriptions, however, show us that women can take on the same roles as men.[49] We have already mentioned Thomallachis sponsoring a public building, while in religious inscriptions referring either to benefactions or ded-

48 For example, Jean-Baptiste Yon's reconstruction of the genealogies of several elite families of Palmyra, based on evidence primarily from the public sphere, with additional information from the funerary record, underlines this tendency: Yon, *Les Notables,* 43–56, appendix 17.

49 Krag, *Funerary Representations of Palmyrene Women,* 116–123, 132.

ications, women are more prominent as agents. In particular, on the votives made to the god known as "He whose name is blessed forever" (the so-called "anonymous god"), women make offerings for their lives and those of their relatives, often giving both their patronymic name and the name of their husband, as well as those of their children.[50] Our present study contains none of these votary inscriptions, which represent an interesting basis for future work.

In general, though, we can say that both public and funerary inscriptions offer us complementary information: even though the formulae used to describe relationships are the same, funerary inscriptions emphasise family and tribal affiliations, while status and social and civic roles are transmitted through the medium of portraiture. Public inscriptions offer additional information about a person's status, civic role, donations and benefactions, as well as their piety and religiosity.

The inscriptions documenting the Firmôn network show how public inscriptions can open up additional avenues of investigation. The name of the eponymous founder is believed to be Iranian, indicating geographical mobility in the early phase of Palmyrene urbanism.[51] His great-great grandson Ḥaddûdan (8) is one of the very few Palmyrene individuals we can presume was a merchant based on the epigraphic corpus.[52] His second cousin, also named Ḥaddûdan (12), purchased a funerary space for himself and his family in 160 CE,[53] indicating upward social mobility, and Thomallachis, the grand-niece of the merchant, is a rare example of a Palmyrene woman sponsoring a public building project (in 182 CE). In this way, family networks branch out into other spheres of Palmyrene society, highlighting the significant degree of complementarity of funerary and public inscriptions for the study of Palmyrene family networks. While the genealogical results of the Firmôn case might be unimpressive compared to the larger networks based on known funerary settings, the analysis indicates that Social Network Analysis may be a suitable tool for investigating other spheres of Palmyrene society.

50 Sanne Klaver, "The participation of Palmyrene women in the religious life of the city," in *Women, children and the family in Palmyra,* eds. Signe Krag and Rubina Raja (Copenhagen: The Royal Danish Academy of Sciences and Letters, 2019), 157–167.

51 Piersimoni, *Palmyrene Prosopography,* 563; Yon, *Les Notables,* 260, 262.

52 He is named as the sponsor of a statue and inscription dedicated to the prominent caravan patron Marcus Ulpius Yarḥai in return for help offered in the Mesopotamian city of Spasinou Charax in 159 CE: Jean Cantineau, "Tadmorea," *Syria* 19, no. 1 (1938).

53 Hillers and Cussini, *Palmyrene Aramaic Text,* 101, cat. 0523.

5.4 Uncertain relationships in funerary data

In our case-studies, we have used the following three criteria: inscriptions, together with the onomastic practices documented in them, portraits, and proximity. In order to have a more certain basis for establishing relationships and thereby extend this certainty to the wider network, we have often combined the criteria.

As stated above, most of the marriages and parental relationships in our case studies can be securely identified through either an inscription or a portrait and an inscription. Several of the relationships, however, are reconstructed with a degree of uncertainty (all relationships with a degree of uncertainty are red in figures 3, 5, 7, 9 and 11). For some of these relationships, we followed Sadurska and Bounni's assertion that the same name in inscriptions, when located very close to each other in the hypogeum, might refer to the same individual. This is a reasonable assumption given that it was likely that close family members occupied the same area in the family tomb; however, these relationships should be treated with caution.

A small number of relationships are reconstructed based on onomastics only (from 4 in Bôlḥâ to 10 in Zebîdâ and Sassans). Because it was common practice in Palmyra to name children after their paternal and maternal grandfather, onomastics can be a reliable criterion for establishing both marital and parental relationships.[54] A section of the Zebîdâ family tree is a good example of how onomastics have been used as a criterion (Fig. 9a): four children (ID 6, 7, 8, 9) are linked to their father (ID 5) by inscription; however, the link to their mother (ID 4) is established because two of them are named after her father (their supposed grandfather). This then extends to the relation to the remaining two siblings and also alludes to the mother's marriage with their father.

In the case of funerary contexts in Palmyra, proximity seems to be the most unreliable of the four criteria (inscription, portrait, proximity, and onomastics) for establishing relationships. It is important to note that when an uncertain marriage is established based on a proximity argument, it affects the certainty of relations with their descendants. Nevertheless, other tomb contexts display family members in close proximity to each other with their relationships supported by inscriptions, hence making proximity a beneficial criterion for this study. Indeed, for all four funerary case studies, the removal of uncertain relationships would constitute a significant change in their structure. The Zebîdâ network would be by far the most impacted with 43% of uncertain relationships. Since the network of the Zebîdâ tomb is the smallest of the four funerary case studies, with very few portraits and family members that can be securely linked together by inscriptions and portraits, many of the family relationships are based on proximity or ono-

54 Piersimoni, *Palmyrene Prosopography,* 549–550.

mastics. Six different relations are formed on the basis of proximity of portraits; half of these are marriage relationships, while the other half are relationships between parent and child.

In contrast, the Firmôn network derived from public inscriptions does not have any relationships which are uncertain, likely a result of the nature of the inscriptions they were derived from. In these sources, only a limited number of relationships are recorded, and they therefore represent a problem of incompleteness. However, those few recorded relationships should be considered more certain compared to relationships derived from funerary inscriptions where the proximity or onomastics criteria were applied. Furthermore, the network underlines the Palmyrene preoccupation with patrilineal descent, the eponymous ancestor in this case being still remembered in the seventh generation.

6. Conclusions

A wealth of archaeological and historical information is available for studying the structure of Palmyra's family networks. In this paper, we have drawn on this data to explore how a formal network approach could enhance such studies, as well as the related methodological and data-related challenges. We have critically evaluated genealogies based on previous studies, using funerary portraits and funerary and public inscriptions. These were subsequently represented as Ore graphs to reveal family network structure, and as p-graphs to explore the degree of intermarriage within the extended family.

Our work underlines how material and written sources are highly complementary, and that their combined use enhances Palmyrene genealogical studies. The detailed study of funerary portraits allowed for a much richer picture of genealogies derived from funerary inscriptions. The inscriptions in particular omit many women, revealing a patrilineal tradition. Formal network and genealogical methods allow us to identify this incompleteness and gender bias in our sources to a high degree of detail. This has allowed us to formulate credible hypotheses to complete the genealogies. We have presented two extreme hypothetical scenarios to account for the missing individuals (most frequently women). These hypotheses significantly increase the completeness of the genealogies, but future work should specify more detailed hypothetical reconstructions, inspired by our knowledge of Palmyrene family and tribal structures.

A crucial advantage of using a formal network approach to these sources is the ability to identify the degree of intermarriage within the extended family, by calculating the relinking index based on the frequency of semicycles in the p-graph. Our results show the relinking index was very low for all case studies, which on the face of it seems to suggest exogamy as the dominant practice: marriage as a way to forge and maintain alliances between powerful families and across tribes.

However, the high degree of incompleteness in our genealogies and the few documented cases of intermarriage within the family suggest that possibly endogamy practices are underrepresented in our sources. As we have seen, both cases are documented for Palmyra, and our genealogical analysis cannot securely support one as the dominant practice, although we are able to present a methodology based on p-graphs and the relinking index to make important contributions to these debates. Moreover, the ability to formally identify the extent of endogamy using the relinking index allows for a formal comparison of the exceptional information we have about Palmyra with other ancient and present-day cases. This is a topic that a future extended analysis of Palmyrene genealogical networks should shed more light on.

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Can historians trust centrality?

Historical network analysis and centrality metrics robustness

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Abstract In this paper, we consider four measures of centrality (betweenness, closeness, degree, and eigenvalue centrality) in their use for the analysis of historical networks. Since the sources used by historians to construct such networks are by their nature incomplete and imperfect, it is necessary to consider as much as possible the robustness of these metrics, i.e., their stability with respect to the hazards that time has inflicted on historical documents. To study this, we apply a battery of tests to three networks constructed from medieval history data. The first is a political history network, which represents the links between protagonists of the conflict for the episcopal see of Cambrai in the 11th century. The second is a network of socio-economic history, describing the credit relations of merchants in Ypres during the 13th century. The third is a hagiographic network that depicts the connections between the lives of saints that are often compiled together in manuscripts. These tests are designed to simulate the processes of disappearance and degradation of the information contained in sources by imitating as closely as possible the situations that historians face when manipulating graphs. In each of them, we create a large set of new graphs by transforming the original graphs, then observing the effect of these transformations on the centrality metrics. For this, we use a random process, but one that respects the particularities of the considered networks, which are built from historical sources. Our results allow us to assess the general relevance of the use of centrality in historical network analysis, to compare the four metrics studied in terms of robustness, and to identify a set of methodological points to which the historian applying such techniques must pay particular attention.

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1. Introduction*

In 1933, when Henri Pirennne describes *what historians are trying to do,* he compares the historian's research material with "footprints in the sand which wind and rain have half-effaced", arguing that they are "merely the vestiges of events and not even authentic vestiges".[1] This observation by the great medievalist is obvious to modern professional historians: pursuing historical research involves working with incomplete and imperfect sources. Not all the pieces of the puzzle that historians put together to describe the societies of the past are available, and some are damaged, having suffered from the vagaries of time. It is therefore essential to be particularly careful when analyzing historical documents, to consider as much as possible their imperfect condition, and the hazards they have experienced. It is at this price that the conclusions drawn from historical studies can be considered as reliable, as it is a central element (if not *the* central element) of the historical method.

1.1 Robustness and Historical Analyses

This rule applies to all types of analysis that historians subject their sources to. Nevertheless, in the case of quantitative analyses, researchers have at their disposal a set of mathematical tools that allow them to assess the reliability of the results obtained with regard to the defects of the documents studied. Among them is robustness, a concept well known to statisticians and more generally to researchers in the exact sciences, but rarely used in the humanities, even when quantitative methods are applied. In his classic book devoted to the question, Peter Huber defines robustness as the "insensitivity to small deviations from the assumptions".[2] He uses the term "assumptions" to cover a wide range of modeling choices, which we will reduce here to the set of constraints that are imposed on the historian carrying out a quantitative analysis by the condition of the sources he handles. Gaps and errors in the available documents are the source of deviations in the results obtained (with respect to the correct depiction of the studied phenomenon), the effects of which can be at least partially mitigated by using a robust quantitative analysis tool.

Before getting to the heart of the matter and presenting the actual framework of our study, let's see how this concept comes into play in the context of a very

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1 Pirenne (1933), p. 438.
2 Huber/Ronchetti (2009), p. 2.

simple example of a quantitative analysis of historical sources. Suppose we want to estimate the typical amount (statisticians would say the "central tendency") of loans made by a merchant in some medieval city. We have at our disposal a set of credit contracts in which the merchant appears as the creditor, specifying each time the amount of money lent to the borrower. The first obvious way to estimate this typical amount is to calculate the arithmetic mean of the loans granted: for example, based on four amounts of 88, 95, 99 and 118 pounds, we would have an arithmetic mean of 100 pounds. Now let's imagine that a fifth loan contract resurfaces after being misclassified, in which our merchant lent 600 pounds, a very large amount compared to the first four. The arithmetic mean, recalculated on the basis of the five amounts now available, is equal to 200 pounds, double the value it had before the document was rediscovered. This high sensitivity to the addition of extreme data – or in other words, a lack of robustness – is one of the drawbacks of the arithmetic mean as a statistical indicator of central tendency. To overcome this problem, one might consider using the median rather than the mean to estimate the typical amount of the merchant's loans. This second statistical indicator is robust, and changes little when a value is added to the data, whether it is extreme or not: the median rises from 97 pounds to 99 pounds when the rediscovered loan contract is taken into account. The superiority of the median over the mean is clear in such a context. However, it is not necessary to consider adding an extreme additional value to the dataset under consideration to reach the same conclusion. This hierarchy between the two indicators can also be seen by thinking in terms of the quality of the estimate made in the specific context of an analysis of historical data: on the one hand, the median is much more stable than the mean with respect to 'forgotten' data; on the other hand, the dataset we are analyzing is necessarily fragmentary, since it is extracted from historical sources. The choice is therefore quickly made between the two indicators.

This example, although extremely simple, shows that robustness appears as a highly desirable quality when estimating the typical value of a quantity appearing in historical sources. The same conclusion can of course be drawn about any quantitative tool mobilized in any historical analysis. This is therefore also the case for the tools historians use to analyze social networks.[3] The issue of robustness is perhaps even more crucial in the application of these techniques. The fragmentary and imperfect condition of the sources is indeed an objection that is sometimes raised by historians when it comes to making use of these methods.[4]

3 Note that we will use the terms 'network' and 'graph' interchangeably throughout this paper. The same holds for 'node' and 'vertex'.

4 Often because of confutations about the implicit assumptions they presuppose, as noted by Lemercier (2015), p. 296.

1.2 Centrality Metrics

In this paper we look at the robustness of a set of metrics often used in historical network analysis to estimate the status of individuals within their network, the measures of centrality.[5] Since the first works devoted to this concept[6] and the seminal studies in which its first rigorous definitions were introduced,[7] numerous versions of it have been proposed in the literature, in order to question the importance of vertices within the graph from different angles.[8] However, historians most often focus on four of them, which we will consider here.[9] Betweenness centrality counts the number of geodesics in the graph (i.e., the shortest paths along the edges of the graph) that pass through a given vertex. Closeness centrality calculates the distances between a given vertex and all the other vertices of the graph, and aggregates them into a synthetic indicator, defined as the inverse of the sum of all these distances. Degree centrality counts the edges of which a given vertex is one of the two ends. Eigenvector centrality assigns a score to a given vertex on the basis of the scores assigned to its neighboring vertices, according to the principle that this score is high when the neighbors themselves have a high score. Linear algebra tools can assign all these relative scores at once.[10]

Each of these four metrics is a tool for estimating the importance within the network of each of the individuals who are part of it. While their general objective is identical, they do not measure exactly the same thing, and therefore differ in terms of interpretation. The interpretation that can be made depends on the context in which they are used, and the choices made to build the graph being considered (what do vertices and edges represent?), but the definitions given above still allow to draw some general principles, which we will mention very briefly here. A vertex with a high betweenness centrality score corresponds to a 'hub' (also sometimes called a 'broker'), a node through which a large number of connections between individuals in the network can pass. A high closeness centrality value indicates that the vertex can easily reach all parts of the network. The eigenvalue centrality measures the prestige of an individual, in terms of the

5 To our knowledge, only one study is devoted to the analysis of the properties of these metrics in the framework of a historical analysis: Düring (2016). This author's point of view is quite different from ours, since his goal is to compare the list of the most important individuals within a network obtained by calculating the centrality metrics with that which the historian obtains manually on the basis of his expertise concerning the dossier in question.

6 Bavelas (1948); Bavelas (1950).

7 Bonacich (1972); Freeman (1979).

8 See for example Das/Samanta/Pal (2018). A list of nearly 300 centrality definitions (at the time of writing) is given in Jalili/Salehzadeh-Yazdi/Asgari/Arab/Yaghmaie/Ghavamzadeh/Alimoghaddam (2015).

9 See e.g. Hammond (2017); Rosé (2011); Riva (2019); Cellier/Cocaud (2012).

10 For a more formal definition of these four metrics, see for example Wasserman/Faust (1995).

number of connections with prestigious individuals. These three metrics are global measures, in the sense that they account for the entire graph. On the contrary, degree centrality is a local measure, which considers only the direct relations of the vertex in question.[11] It estimates the importance of an individual by measuring his activity in the network. These four metrics thus carry quite different meanings, which can be combined to perform precise analyses (which individuals are central to the four measures, which are central only to a subset of them and why, etc.).

They are also used at a different level, that of whole graphs. It is indeed possible to aggregate the centrality scores of all the vertices of a network to calculate its centralization.[12] This indicator estimates the extent to which the graph is globally organized around one or more focal points, i.e. it accounts for the existence of extreme values among the individual centrality scores of its vertices. A star-shaped graph has a very high centralization, while a complete graph (with all vertices connected to all the others) is associated with a low value. The four centrality measures lead to four different centralization concepts.

1.3 Robustness and Centrality in Historical Networks

We are interested here in the robustness of these centrality metrics when computed in historical network analyses. However, since they are more complex than central tendency indicators such as mean and median, there is no theoretical result to assess their robustness. It is therefore necessary, in order to meet this objective, to embrace the experimental approach, by observing the impact of "small deviations from the assumptions" on the values taken by these measures of centrality. This exercise has already been carried out in graph theory literature, and has led to several interesting studies.[13] However, these reasoned within a general framework and are therefore not very well adapted to historical analyses. In order to compare the reliability of these network metrics and convince historians, it is necessary to perform these tests on historical networks, especially with "small deviations from the assumptions" that make sense in the context of historical analysis.

This is the task we assign ourselves in this article. We carry out robustness tests on the measures of centrality mentioned above, with three networks constructed from medieval sources. The first is a political history network, which represents the links between protagonists of the conflict for the episcopal see of Cambrai in the 11th century. The second is a network of socio-economic history,

11 This distinction is discussed for example in Scott (2000).
12 For details about this concept and its computation, see Freeman (1979), p. 226–237.
13 See, in addition to the references given in the bibliography of this article, the review Landherr/Friedl/Heidemann (2010).

describing the credit relations of merchants in Ypres in the 13th century. The third is a hagiographic network that depicts the connections between lives of saints that are often compiled together in manuscripts. The test methodology we implement has been designed and constructed to replicate the problems faced by the historian due to the condition of the sources he handles.

The main objective for carrying out these robustness tests is to provide answers to two questions. First, we question the confidence historians may have in the metrics of centrality, given the structurally incomplete and inaccurate nature of the historical documents that serve as the basis for the construction of the networks they study. Are these measures of centrality sufficiently stable when subjected to 'shocks' that replicate the vagaries of historical sources? Can the conclusions drawn from them be considered sound? Second, we ask questions to compare these metrics in terms of robustness. Are some of them more robust than others to these shocks? Are some of them better suited for use in the context of analyzing historical networks?[14]

We have structured the battery of tests we perform into four experiments designed to explore different aspects of the issue of centrality metrics' robustness. Our methodology is developed in detail in Section 3 of the article, following a presentation of the data used in Section 2. Section 4 is devoted to the results that it permits us to obtain, which are commented upon and discussed. A concluding point is given in the last section.

2. Data

This section is devoted to the description of the three networks that we consider in this article, and upon which our tests are performed. Our choice of these three examples was not random: as we will see at the end of this section, they have quite distinct profiles, suggesting that test results could differ significantly.

2.1 The Cambrai Investiture Conflict

The first network that we consider was built by Nicolas Ruffini-Ronzani to model the Cambrai Investiture Conflict.[15] At the end of the 11th and the beginning of the 12th century, in the context of the Gregorian reform, two politico-religious personalities clash for the episcopal see of Cambrai: on one side is Walcher of Oisy,

14 The search for the most appropriate metric for a particular context has already been undertaken in the literature. See, for example, for the dissemination of information in telecommunication networks, Kiss/Bichler (2008).

15 For a detailed description of the historical background and additional information about this network, see Ruffini-Ronzani (2020).

the candidate of the emperor; on the other Manasses of Eu-Soissons at first, then Odo of Tournai from 1103 onwards, supported by the pope. Since the beginning of the conflict in 1092, the two parties have been fighting a real war, which the Treaty of Aachen put an end to in 1107, to Walcher's disadvantage.

Several chronicles recount this conflict, but these are not the only sources that a historian can mobilize to study it: a fairly large number of charters (of which 176 were kept in good enough condition to be used, dated from 1092 to 1107) testify to legal actions undertaken during this period by members of both sides. This diplomatic corpus is the material used to build the network we consider in this article.

This graph is defined as follows. Its vertices represent the persons who appear in these charters. An edge joins two vertices each time they have one of the following relationships in a charter: Alliance (X enters into an alliance with Y); Consent (X consents to an action of Y); Donation (X gives a property to Y, or confirms such a donation); Notice (X gives notice about an action of Y); Request (X requests from Y to take some action); and Subscription (X appears among the subscribers on Y's charter). The edges of the network originally constructed by Nicolas Ruffini-Ronzani thus bear a *type* attribute, which we neglect in the context of this paper.[16] Note that these links, which are oriented by their nature, are considered to be non-oriented for the purposes of this article. An attribute *source* is also associated with each of the edges, which gives the identifier of the charter that attests to the relationship that the edge represents.

2.2 The Ypres Credit Market

The second network that we use in our experiments models the Ypres credit market in the second half of the 13th century[17]. This century is a period of economic prosperity for the Flemish city, at least in part thanks to the then flourishing textile industry. As in most medieval cities during this period, the lively market in Ypres is not without intense credit activity.

A large number of loan contracts are concluded between all kinds of individuals, including wealthy foreigners who come to buy cloth, local entrepreneurs who sell it, and the city's smallest artisans. At least a portion of such credit arrangements are subject to the gracious jurisdiction of the city eschevins, and are recorded in writing in the form of chirographs. Until the beginning of the 20th century, the archives of the city of Ypres held several thousand of these recognizances of debts, which unfortunately almost entirely disappeared during the bombing of the First World War. Around 1900, a local scholar, Guillaume des

16 The question of the simultaneous consideration of these edges of different types is treated in de Valeriola/Ruffini-Ronzani/Cuvelier (2021).

17 Details about this network are given in de Valeriola (2019).

Marez, nonetheless took note of summaries of many of these recognizances in notebooks, which the *Commission royale d'Histoire* recovered and edited.[18] The information provided describes 4,953 usable loan contracts, dated between 1249 and 1291, and includes, among other things, the names of all the parties involved, i.e. the creditors, debtors and guarantors of the corresponding loans.

These allow the construction of a graph in a similar way to that described above for the Cambrai graph. Vertices are individuals involved in at least one loan contract. An edge joins two vertices each time the two individuals in question are related in one recognizance of debt, regardless of the type of relationship involved (creditor-debtor, debtor-debtor, creditor-guarantor, etc.). The direction of links is once more neglected. As in the case of the Cambrai graph, the edges carry an attribute *source,* which gives the identifier of the chirograph from which the information carried by the edge is extracted. Finally, we associate an attribute *amount* to the edges, which gives the amount (expressed in Artesian pounds, the currency most used in our recognizances of debts) of the corresponding loan. This is used in only one of the four experiments we carry out (Experiment 3); in the other three, it is simply ignored.

2.3 The Co-tradition of Hagiographic Legends

The last network we study here models the co-tradition relationships of saints during the Middle Ages.[19] Hagiographic narratives are very often the subject of compilations, in which the legends follow one after the other. The precise selection of the texts that are compiled together is not entirely due to chance, and it is legitimate to wonder how the copyists, who are at the origin of the sanctorals, chose the saints whose stories they tell.

To investigate this question, we used the database *Bibliotheca Hagiographica Latina manuscripta.*[20] Created by the Bollandists, then extended by several researchers and now hosted in its new form by the *Institut de Recherche et d'Histoire des Textes,*[21] it lists a set of several thousand Latin hagiographic manuscripts, and gives various information for each of them, including the list of legends it contains.

Our hagiographic graph is built on this basis. Its vertices represent each of the saints for which at least one manuscript contains a legend. An edge connects two vertices each time there is a manuscript that contains a text about each of them. As previously, we associate an attribute *source* to the edges, giving the identifier

18 Wyffels (1991).
19 Further details about this dossier can be found in de Valeriola/Dubuisson (2021).
20 On this database, see Trigalet (2001).
21 The link to the *Légendiers latins* database will be available soon.

of the manuscript in which the co-tradition relation that the edge represents is found. Each edge also bears an attribute *century,* which gives the date of the manuscript in which it is attested. It is used in only one of the four experiments we carry out (Experiment 4); in the other three, it is simply ignored.

Using the entire database leads to the construction of a graph composed of 2,498 vertices and 1,487,563 edges. This huge number of edges makes calculations very long and very difficult to manage in terms of machine resources (see Section 3.4 on this subject). We therefore applied a filter to this gigantic graph: the hagiographic graph manipulated throughout this article is constituted from the manuscripts of the database whose place of conservation is Paris and which date from the 8th to the 15th century. While this means of selecting sources is of course objectionable in terms of historical analysis, it has no impact on the present methodological study.

2.4 Comparison of the Three Networks

It is natural, if we want the results of our robustness tests to be representative, to apply them to networks that differ significantly from each other. Indeed, the stability qualities of metrics can be expected to depend on the properties of the graphs from which they are calculated.[22] Table 1 presents information on each of the graphs we manipulated, allowing us to compare their main characteristics. It is to be combined with figures 1 and 2.[23] The first gives the densities of the four normalized centrality metrics (based on their theoretical maximums, see Section 3.1) for each of the three networks, and thus gives an idea of the distribution of individual vertex centrality values. On the second, the normalized centralization values are represented (i.e. the centralization values divided by the maximum value over the three networks), making it possible to compare the internal structure of the three networks.

The numbers presented indicate that the three networks have very different profiles. The Cambrai network is the smallest of the three in terms of the number of sources, number of vertices and number of edges. As might be expected due to the nature of the historical phenomenon it models (a conflict opposing two parties, each of which gathered around one or two individuals, candidates of both parties to the episcopal see), its centralization value is very high for betweenness and degree centralities. The existence of a small number of vertices with high centrality values for these two metrics is clearly visible on the density plot. We also see on this plot (for betweenness centrality) that many vertices can be considered

22 See for example Borgatti/Carley/Krackhardt (2006), p. 124; Frantz/Cataldo/Carley (2009).

23 Note that all centrality values presented here have been computed on the graphs after applying to them the simplification process described in Section 3.1.

	Cambrai	Ypres	Hagio.
number of source units	176	4,953	611
number of vertices	400	4,675	1,118
number of edges	1,419	12,012	229,672
number of pairs of vertices linked by at least one edge	685	11,050	92,667
edge density	0.008	0.008	0.143
unweighted diameter	6	14	5
average unweighted distance	2.82	5.01	1.92
transitivity	0.02	0.15	0.54

Tab. 1 Main properties of the three networks we consider

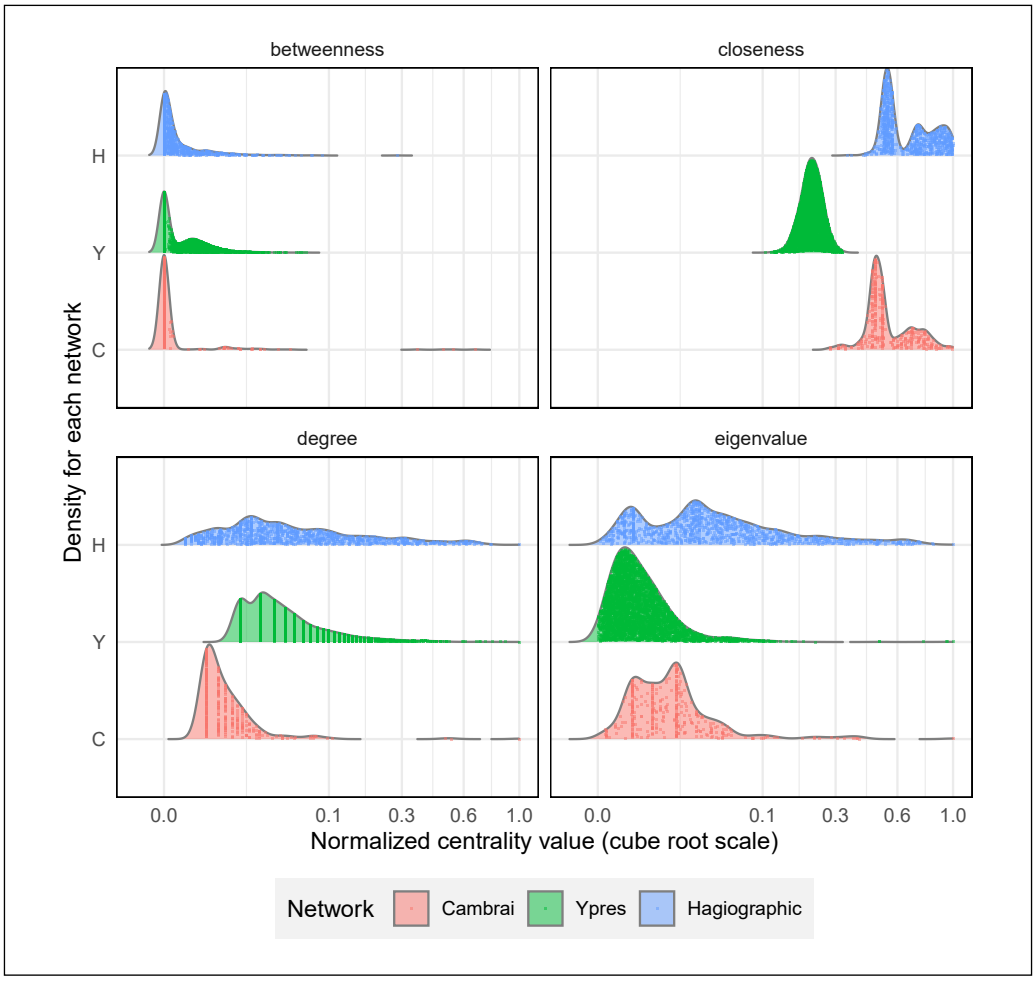

Fig. 1 Densities of centrality metrics of the three networks

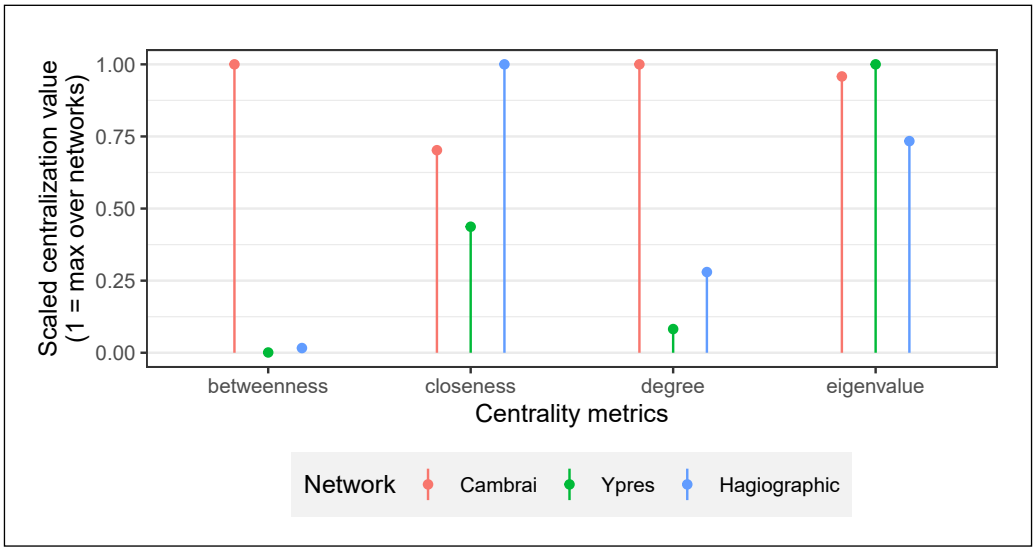

Fig. 2 Centralization of the three network with respect to the four centrality metrics

as belonging to the periphery of the network, i.e. are not a crossing point of any geodesic.

The Ypres network has the largest number of vertices and is built from the largest number of sources. The moderate value of its transitivity coefficient (the proportion of 3-cliques among the triplets of vertices X, Y, Z such that X is connected to both Y and Z), its large diameter and the high average distance between its vertices suggest that it is composed of a fairly large number of small clusters that are quite well separated from each other. This description is consistent with the way it was constructed, since all the creditors, debtors and guarantors of each chirograph are completely interconnected. Each recognizance of debt therefore corresponds to a clique (the size of which depends on the number of protagonists in the agreement). Note, however, that there is a set of well-connected vertices that act as the 'center' of the graph, as the high level of eigenvalue centralization and the eigenvalue centrality density plot suggests.

The hagiographic network has by far the highest number of edges, and therefore the highest density. Again, the graph construction process explains this: each manuscript is responsible for creating a clique whose size is equal to the number of legends it contains. Among our Parisian sanctorals, 6 include at least 100 legends, and 66 of them at least 50. The resulting graph is therefore the superposition of a set of cliques of rather large sizes. This explains the high value of its transitivity coefficient, its small diameter, the small average distance between its vertices (and consequently its high closeness centralization value), and the 'spread' shape of the densities of degree and eigenvalue centralities.

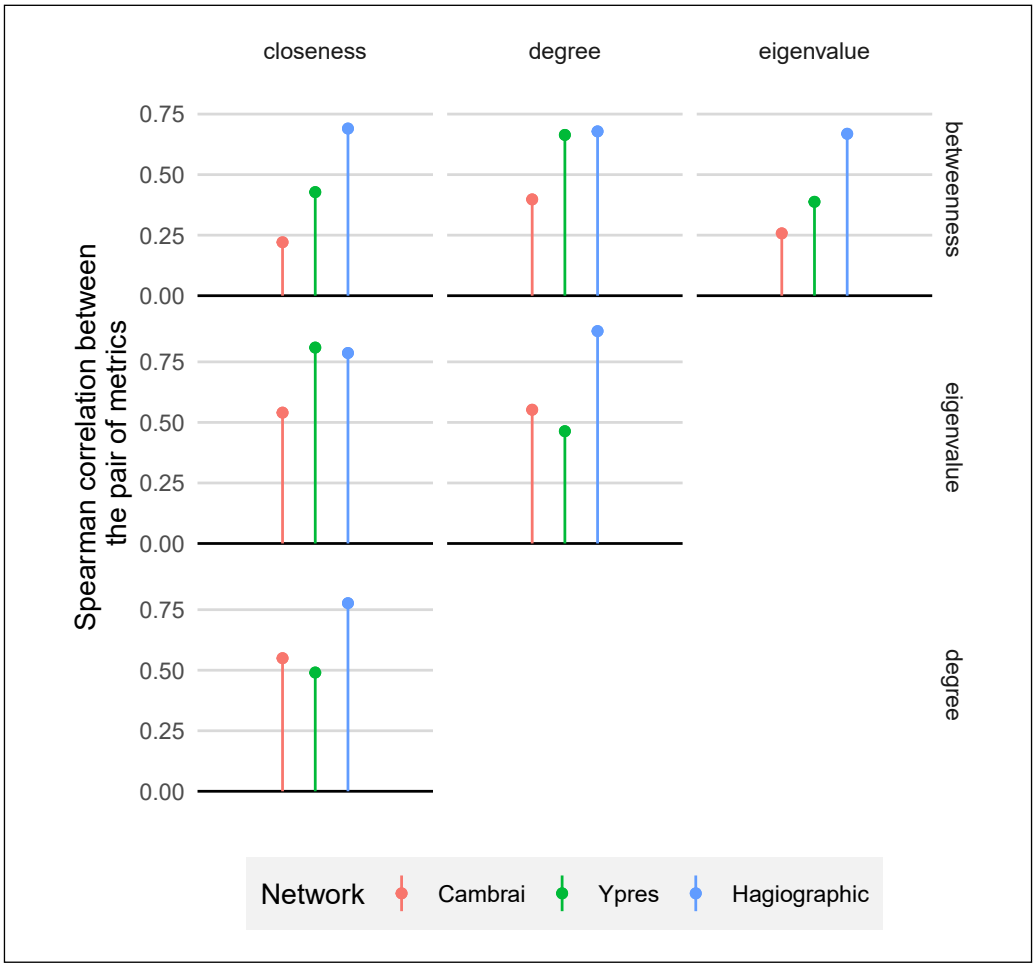

Fig. 3 Spearman correlation between the six pairs of centrality metrics in the three networks

Finally, Figure 3 gives the value of Spearman's correlation coefficients between the six pairs of centrality metrics.[24] It is interesting to observe that these coefficients change quite a bit from one graph to another, although they are always positive.[25] We can conclude that the amount of information provided by (and

24 Spearman's correlation coefficient measures the dependence between two statistical series by comparing the ranks of each value within the two series. This metric takes values between –1 and 1: a positive value indicates that the two series are 'moving in the same direction', a negative value that they are 'moving in opposite directions'. In the case we consider, it therefore compares to rank each centrality metrics assigns to the network's nodes. For a justification of this choice, see Section 3.3.

25 As the literature has already noted, for example Oldham/Fulcher (2019).

therefore the interest of) the joint use of several metrics of centrality also varies with the graph's properties: the correlations are far from perfect (with coefficients close to 1), and the metrics are therefore not completely redundant. The high values of these dependency indicators for the hagiographic network probably come from its high density.[26] For the Cambrai graph, the correlation between betweenness centrality and the other three metrics can probably be explained by the large number of zeros among the values of the first.

3. Methodology

Let us now describe the experiments we perform to estimate the robustness of centrality metrics.

3.1 General Remarks

Before doing so, a series of general remarks should be made about the way metrics and networks are handled in this paper. First of all, let us note that the comparison of the four metrics applied to the three graphs described in the previous section imposes two technical constraints upon them. On the one hand, the betweenness centrality score of almost all vertices of the Cambrai graph is equal to 0 if we consider its edges as directed. The comparison with other metrics loses part of its interest in this case; this is why the Cambrai and Ypres graphs, although in principle oriented, are considered in their non-oriented version.[27] Note moreover that comparing the centrality metrics of two oriented graphs with those of a non-oriented graph would make little sense.

On the other hand, closeness centrality is well defined only for connected graphs, i.e. those where there is a path (a succession of edges) starting from any vertex and arriving at any other vertex (since it implies the calculation of the distance between one vertex of the graph and all the others). The three base graphs described above are connected. Nevertheless, since some of the experiments we perform involve the disappearance of edges within them, the result may no longer be connected. It is therefore necessary to transform these networks into connected ones before performing our calculations. In this case, we simply restrict ourselves to the largest connected component of the graph.[28]

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26 This positive relationship has already been observed by Valente/Coronges/Lakon/Costenbader (2008), p. 6.

27 This way of making the adjacency matrix symmetrical is classical, see for example Costenbader/Valente (2003), p. 289.

28 This is also the solution adopted in Platig/Ott/Girvan (2013), p. 2. Other solutions exist, for example, we could simply not consider simulations in which the graph becomes unconnected, as in Costenbader/Valente (2003), p. 290.

Second, as we will see below, we must note that our methodology is based on operations that require the selection of all the edges of the graph considered that correspond to a given subset of sources. This is why a *source* attribute is associated to the edges of the three studied graphs. Its importance for the tests we perform prevents us from directly aggregating the multiple edges that are present in the three graphs. By 'multiple edges', we mean here the situation in which two vertices X and Y are directly connected by several 'parallel' edges (as are vertices a and c in Figure 4), a situation that is observed many times in the three networks. The parallel edges that connect X and Y in this way are attested in different sources, which is information that we lose if we aggregate them directly.

The aggregation of these multiple edges is nevertheless a step that must be taken to calculate the centrality metrics. This operation is performed just before this calculation, so as not to interfere with the attribute *source*. It simply consists of replacing multiple edges with a single edge bearing an attribute *weight* that counts the number of multiple edges it replaces. For example, if vertices X and Y are connected by 4 edges before aggregation, they will be connected by a single edge of weight 4 after aggregation. In the special case of the Ypres graph in Experiment 3, the role of the attribute *weight* is played by the attribute *amount*. The aggregation phase thus does not simply count the parallel edges, but calculates the sum of their amounts. If the 4 edges in our example are 5, 7, 12 and 21 pounds, the single edge representing them will have a weight equal to 5 + 7 + 12 + 21 = 45 pounds after aggregation. Finally, let us note that the other attributes are dropped during this step.

These two operations of aggregation and restriction to the largest connected component together form the operation of graph simplification. In the rest of this article, when we say that a graph is simplified, we must therefore understand that its multiple edges are aggregated and that it is replaced by its largest connected component.

Figure 4 shows the application of this process to a very simple example graph. The original graph (on the left) is constructed from two historical sources (n° 1

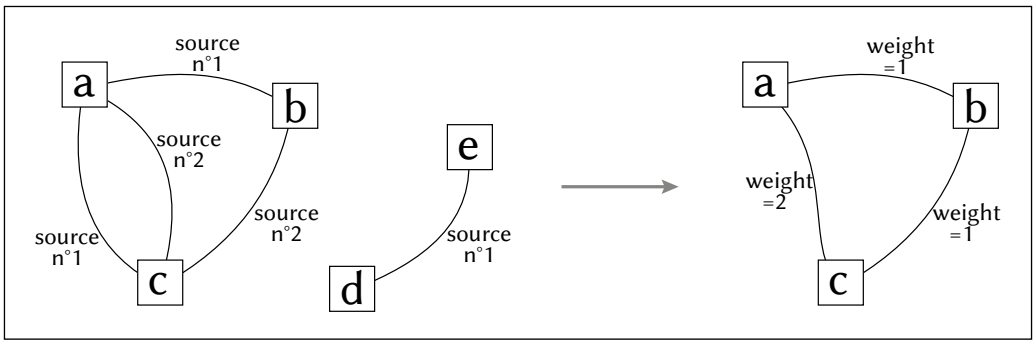

Fig. 4 Application of the simplification process to an example graph

and n° 2), information which gives rise to the edge attribute *source*. The two parallel edges linking vertices a and c are aggregated within the simplified graph (right) into an edge with weight 2. The two edges joining vertices b and c on the one hand, and a and c on the other, give rise to edges with weight 1. The vertices d and e, as well as the edge connecting them, are deleted in the process, since they form a non-maximal connected component of the original graph.

Third, and for the reasons we have just presented, we use alternative versions of the centrality metrics that are adapted to weighted graphs. The definition of betweenness and closeness centralities is easy to modify for this purpose, since it is sufficient to include the weights into how the distances are calculated.[29] For degree centrality, we sum the weights of the edges incident on the vertex, rather than simply counting them. Because the eigenvector centrality is somehow only a mathematical property of the adjacency matrix of the graph, adding weights to the edges is not a problem (it simply modifies the matrix).[30]

Fourth, since the networks being compared do not necessarily have the same structure (i.e. the same number of edges and vertices), it is necessary to use standardized versions of these metrics. Therefore, for each of these, it is a matter of dividing the result obtained by the theoretical maximum that the metric can reach given the structure of the graph. Standardized metrics take values between 0 and 1.

These remarks concern all centrality computations, whether they are applied to unshocked or shocked graphs.

3.2 Experiments

In this article we carry out four different experiments on the basis of the networks defined above. The general idea of these experiments is as follows: we subject our three graphs to shocks intended to replicate the hazards that historical sources undergo, then compare the centrality metrics of the graphs resulting from these shocks (which we will henceforth call the shocked graphs) to those of the original graphs (the unshocked graphs). We are speaking here about defects in the data manipulated by the historian in two ways: the incompleteness of the data on the

29 Note that the edge weights in our simplified graphs correspond to 'link strengths' (i.e. a high value corresponds to a strong relationship between the two vertices connected by the edge) and not to 'link costs' as expected when calculating a distance. They must therefore be transformed before being used in this way. We use the inverse function to do this: cost = 1 / weight.

30 For a description of the adjacency matrix of weighted graphs, see Wasserman/Faust (1995), p. 153.

one hand (Experiment 1), and the inaccuracies in the data on the other (experiments 2, 3, and 4).

Dealing with Incomplete Data

To estimate the robustness of the network metrics with respect to the first aspect, we will simulate the incompleteness of our datasets by removing some of the available data. This type of robustness test is relatively common in studies devoted to centrality metrics.[31] Indeed, historical networks are not the only ones to suffer from the phenomenon of incompleteness: in many fields of application, the data used to build networks are fragmentary.[32] In most of the studies in the literature on this issue, "removing some of the available data" means randomly (and uniformly) removing some of the vertices and/or edges of the graph.[33] A set of stochastic scenarios is thus generated: in each of them, a different part of the set of vertices or edges is removed, thus simulating a different set of shocks. The metrics values are then recalculated on the shocked graphs that result from these random deletions (one for each stochastic scenario), and compared to the metrics values for the unshocked graph. Conclusions about stability can then be drawn from the observed differences. In probabilistic formalism, this process can be seen as a Monte Carlo simulation: to estimate the expected value of the robustness of a metric when the corresponding graph is subjected to a random perturbation, a large number of realizations of this perturbation are generated and the arithmetic mean is calculated.

Nevertheless, this method of randomly deleting vertices and/or edges is not suitable for all application contexts, as some authors have already noted.[34] In particular, it is not at all suitable for historical networks. Indeed, they are built in a specific way: by accumulating information from historical sources, each of which brings a 'cluster' of information to the network. The incompleteness of the infor-

31 See for example Bolland (1988), which, to the best of our knowledge, is the first study to evaluate the robustness of centrality measures in a systematic experimental manner, as well as the other references cited below.

32 Landherr/Friedl/Heidemann (2010), p. 373, col. 3.

33 It is also frequent to see another operation on the graphs considered, although one which makes less sense in the context of a historical network: the addition of random vertices and/or edges (note however that in our Experiment 3 some vertices are added to the graph, see below). For these four operations of deleting and adding vertices and edges, see for example Bolland (1988); Borgatti/Carley/Krackhardt (2006); Galaskiewicz (1991); Costenbader/Valente (2003); Tsugawa/Ohsaki (2015).

34 See, for example, concerning networks constructed from interviews of community members, the remarks made in Costenbader/Valente (2003), and concerning transport networks during Roman antiquity, Groenhuijzen/Verhagen (2016). Note also that some authors do not select the edges and vertices to be deleted according to a uniform draw, but by associating deletion probabilities to the edges and vertices which depend on their properties within the graph: Platig/Ott/Girvan (2013).

mation used to build such a network stems from the incompleteness of the available sources. It is therefore natural, rather than randomly removing edges and/or vertices in these networks, to randomly remove elements from the document set used to construct the graph. For example, each Cambrai charter makes it possible to add to the network several edges (when one takes into account the relations between the author, the disposer, the witnesses, etc., learned from the document), and possibly one or more vertices. Randomly deleting edges and/or vertices would thus be tantamount to deleting only certain parts of these information clusters, a process that does not suit the issue of the absence of certain sources with which the historian is confronted. It is thus necessary, if one wants to decrease the number of edges and/or vertices of the graph of Cambrai, to do so charter by charter.

We therefore apply to the studied graphs shocks that are distinct from those applied in previous studies, but we keep the randomness of the process, a point that deserves a brief comment. The methodology we implement aims to imitate the vagaries of historical sources, some of which are preserved while others are not. These hazards, whose succession constitutes the path of the documents through time, can certainly be considered as deterministic. Events such as theft, misclassification, destruction and other disappearances of sources do not really happen by chance, but are the consequences of particular circumstances that can probably be explained. It is therefore natural to ask why the use of random draws is relevant in the context of a historical analysis. Although the course of the sources is deterministic, it is not known to us in its entirety, and in the vast majority of cases, we know nothing of the documents that have not been preserved (their number, content, etc.). Randomness is used here to model those elements that cannot be known or predicted. This way of using a set of stochastic scenarios to model the unknown and the unpredictable is very common in exact sciences, and has led to intense epistemological reflections on the notion of randomness.[35] Finally, it should be noted that the opposite approach, which would consist of not selecting the sources to be deleted randomly but on the basis of deterministic criteria, does not provide a meaningful estimate of the robustness of the metrics. Consider for example the Ypres graph, and a process of deleting the chirographs that would be based on their date. To estimate the robustness of the centrality metrics, one would, for example, remove all recognizances of debts written over a certain period of time (e.g. we would remove all the acts of 1290–1291, keeping only those of 1249–1289) and compare the results with the measures in the unshocked graph. The downside of this method is obvious: as it is very unlikely that the network is homogeneous from a chronological point of view, removing a set

35 For example, Henry Kyburg writes that "the concept of randomness [...] is relative to our body of knowledge, which will somehow reflect what we know and what we don't know". (Kyburg (1974), p. 217). A recent summary of the epistemological discussion is given in Eagle (2005).

of successive chirographs amounts to removing from the graph a part that perhaps has its own characteristics, different from the rest. The comparison with the unshocked graph would thus be meaningless. The same observation could have been made if any other selection criteria had been used, such as the geographical origin of the creditor.

Experiment 1

Let us now describe more formally the design of our first experiment, which tests robustness against data incompleteness. The first step is to choose the proportion of sources that will be removed from the set of documents used to build the network. Let's say that it is equal to 10%: in this case, we decide to remove 17 charters for Cambrai, 495 chirographs for Ypres and 61 manuscripts for the hagiographic graph. We then generate 1,000 different stochastic scenarios. For each of them, a set of documents determined by a uniform random draw and corresponding to 10% of the total available documents is erased, and a graph is constructed based on the information contained in the remaining 90% of documents. Figure 5 summarizes this process.

The truncated graph is then simplified and the values of the four centrality metrics are calculated. In this way, we obtain 1,000 shocked graphs and therefore 1,000 sets of values for the metrics. Experiment 1 is finally repeated several times with different proportions of sources removed (1%, 2%, 5%, 10%, 20% and 40%), in order to see how the metrics evolve when the loss of sources is more and more substantial. Table 2 lists the successive steps of Experiment 1.

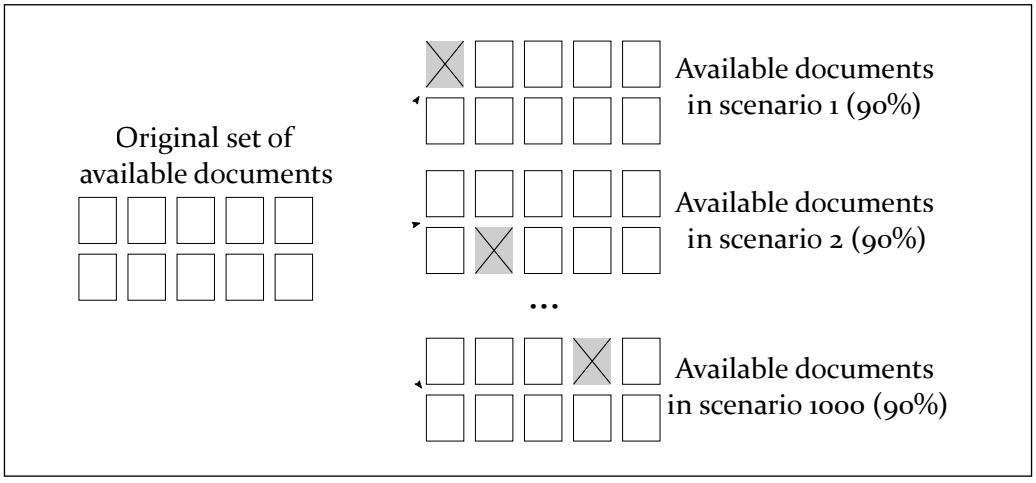

Fig. 5 Description of Experiment 1

1. Fix a proportion of sources to remove in {1% ; 2% ; 5% ; 10% ; 20% ; 40%}.
2. For each of the 1,000 scenarios:
   a. use a random draw to select the sources to remove,
   b. delete from the graph all the edges whose *source* attribute is among the selected sources,
   c. simplify the resulting shocked graph,
   d. compute the four centralities on the simplified graph.

Output: the values of the four centrality metrics for each vertex of the unshocked graph (except for those which disappear in one of the simulations) in each of the 1,000 scenarios, for each affected sources proportion.

Tab. 2 Successive steps and output of Experiment 1

Dealing with Inaccuracies

Assessing the robustness of network metrics against the existence of inaccuracies in the data or working hypotheses is a larger and more complicated task. Indeed, the potential errors that may appear in the course of the historian's analysis are of very diverse natures, and have their origins in phenomena that are also very diverse. These inaccuracies are sometimes the direct result of archive producers, such as when a scribe makes a mistake – intentional or unintentional – in a document. They can also be made by the historian who transcribes, or by the optical character recognition software he uses, which would transform one word into another. Other inaccuracies are direct consequences of the researcher's working hypotheses, for example simplifications of the reality being studied that do not take into account this or that aspect of the information contained in the sources. Since it is obviously impossible to deal with all eventualities, we have chosen to restrict ourselves to the three inaccuracies that seem to us to be the most important and most frequent in the analysis of historical networks.

The remarks made concerning the incompleteness of the data can also be formulated for the inaccuracy of the data. While the shocks we apply to the graphs in experiments 2, 3 and 4 are different from those in Experiment 1, the same general principles apply.

Experiment 2

In Experiment 2, we look at the working hypotheses related to the identification of the individuals composing the network.[36] This problem, which is faced by many researchers using historical network analysis on medieval data, is twofold. Very often, there is no reason to believe that two mentions of the same anthroponym indicate the same individual, and not two individuals with the same

36 This problem, along with possible solutions, is presented in de Valeriola (2021).

name. Conversely, mentions that designate the same individual often appear with variations in spelling that are sometimes difficult to reconcile. An extreme example would be surnames translated from one language to another in some sources, such as "Jean de Neuveglise", who also appears as "Jan van Nieukerke" in the Ypres sources (both forms are equivalent to "John of Newchurch", in French and Dutch).

To replicate problems of this type, we perform two types of operations on graphs, which we will refer to as experiments 2a and 2b. First, we merge pairs of vertices, to replicate the inaccuracy of considering that two anthroponyms designate two different individuals, where in reality they designate only one (Experiment 2a). The vertex resulting from such a fusion has as its neighbors all the neighbors of the two original vertices: in a sense, it gathers their edges. Figure 6a illustrates this operation: vertices *a* and *d* merge into a single vertex called *a + d;*

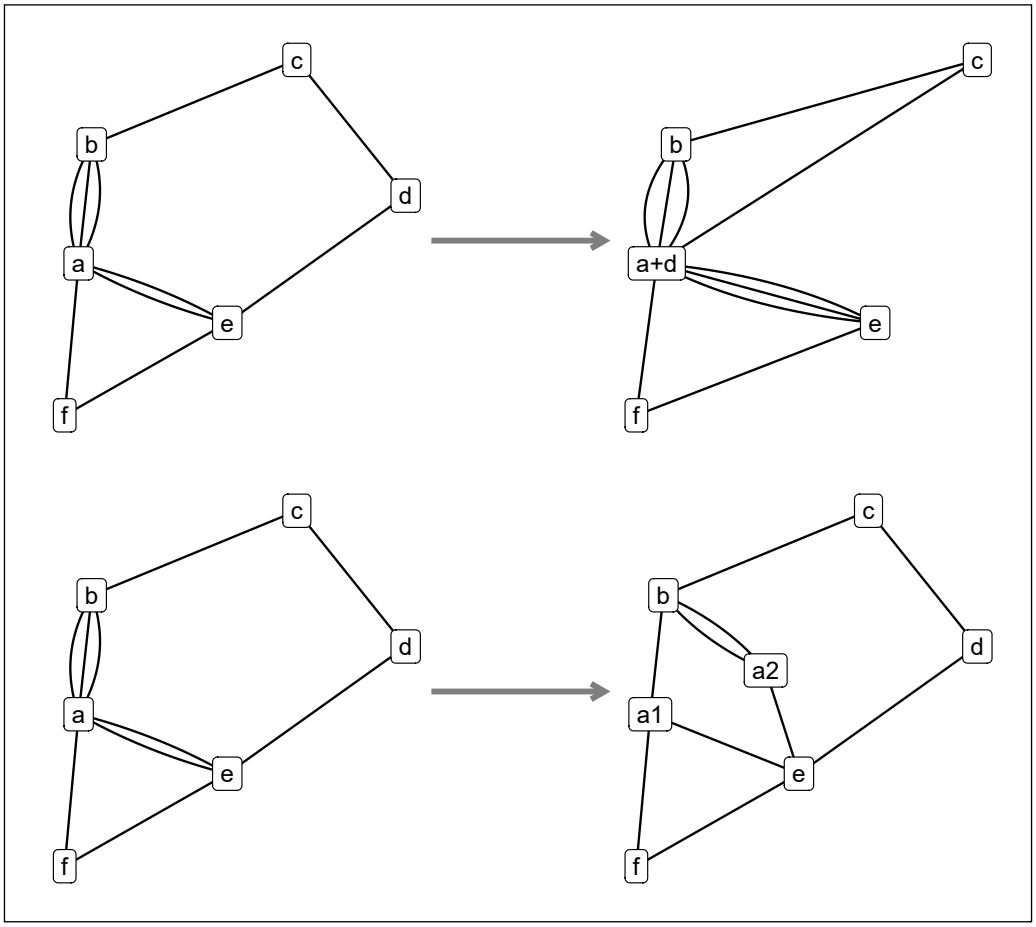

Fig. 6 Examples illustrating the two operations of Experiment 2: 2a. (above): the two vertices a and d are merged into a new vertex a+d, 2b. (below): the vertex a is split into two vertices a1 and a2.

1. Fix a proportion of vertices to affect in {1% ; 2% ; 5% ; 10% ; 20% ; 40%}.
2. For each of the 1,000 scenarios:
   a. use a random draw to select the vertices to apply the operations to,
   b. for each of these vertices, apply the following:
      - if Experiment 2a is performed (merge), chose another vertex at random and replace these two vertices with a new one,
      - if Experiment 2b is performed (split), replace the vertex with two new vertices,
   c. simplify the resulting shocked graph,
   d. compute the four centralities on the simplified graph.

Output: the values of the four centrality metrics for each vertex of the unshocked graph (except for those which disappear in one of the simulations) in each of the 1,000 scenarios, for each affected vertices proportion.

Tab. 3 Successive steps and output of Experiment 2

the edges of $a + d$ are those of a and d at the same time. Second, we divide vertices into two new vertices, to replicate the inaccuracy which arises when considering that two anthroponyms designate a single individual, whereas they are actually two different individuals (Experiment 2b). The two vertices resulting from this division split the edges of the original vertex equally. Figure 6b gives an example of such a division: vertex *a* is divided into one vertex *a1* and one vertex *a2,* each inheriting half of *a*'s edges.

After fixing the proportion to impact, we select the vertices to which the two operations we have just described will be applied by a random draw. We then subject each of these vertices to one of the two merge or split operations described above. The graph thus shocked is then simplified, and the centrality metrics are calculated. Table 3 lists the successive steps of Experiment 2.

Experiment 3

In Experiment 3, we consider the case where the quantities that are used as weights for the edges are subject to inaccuracies, such as reading or transcription errors. For this, we study the Ypres network and consider the loan amounts as edge weights, as described in Section 2.2. In order to stick as closely as possible to the situation that arises in a historical network analysis, we try to replicate as closely as possible the errors that occur when reading quantities in the sources. As these amounts are expressed in Roman numerals in the Ypres chirographs, this is the form in which we handle them. Two errors are simulated here, in what we will call experiments 3a and 3b. The first one is that of the transcriber who substitutes one letter for another, and transforms for example the number "xxi" into the number "xvi" (Experiment 3a). To do this, the computer randomly chooses one of the letters making up the amount to be processed, and replaces it with another randomly chosen letter from {i ; v ; x ; l ; c ; d ; m}. When this operation produces

a string that does not match the writing of a number in Roman numerals, another random substitution is performed instead, and so on until this is the case. The second error we replicate is that of the transcriber who forgets to copy one of the letters of the number, and transforms, for example, the number "xxi" into the number "xx" (Experiment 3b). Here, the computer randomly chooses a letter to delete, multiplying the attempts if necessary, as for the substitution error.

Since each recognizance of debt is, of course, associated with only one amount (the amount of the loan in question), it is essential to ensure that the weights of the edges of the graph that correspond to the same source undergo the same operations. To do this, we start again from the sources used to construct the graph: we first select by random draw a subset of these sources (e.g. 10% of them). We then subject each corresponding amount to one of the two substitution or deletion operations described above. The weights of all the edges in the graph that correspond to the source in question are then modified. The shocked graph is simplified, and the centrality metrics are calculated. Table 4 lists the successive steps of Experiment 3.

1. Fix one type of error to apply (substitution or deletion), and a proportion of sources to affect in {1% ; 2% ; 5% ; 10% ; 20% ; 40%}.
2. For each of the 1,000 scenarios:
   a. use a random draw to select the sources to apply the errors to,
   b. for each of these sources, apply the error to the amount:
      - if Experiment 3a is performed (substitution), replace one letter of the number in its Roman numeral form with another letter,
      - if Experiment 3b is performed (deletion), delete one letter of the number in its Roman numeral form,
   c. apply these changes to the amounts of all the edges whose source attribute is among the selected sources,
   d. simplify the resulting shocked graph,
   e. compute the four centralities on the simplified graph.

Output: the values of the four centrality metrics for each vertex of the unshocked graph in each of the 1,000 scenarios, for each affected sources proportion.

Tab. 4 Successive steps and output of Experiment 3

Experiment 4

In Experiment 4, we test the stability of the metrics against dating errors. To do so, we restrict ourselves to the hagiographic graph, as it is constructed on the basis of sources extending over a large chronological period: 8 centuries, compared to 12 years for the Cambrai graph and 53 years for the Ypres graph. To this end, we manipulate a quantity that does not correspond to the centrality metrics themselves, but a measure of their variation over time, which we must present before describing the experiment.

When we consider that the edges of this network have an attribute *century,* it can be seen as a dynamic graph, which evolves over time. Here we are interested in how measures of centrality change over the centuries, for example to find out which vertices alter their importance greatly over time. This information is valuable in the context of the historical analysis of sanctorals: it is a question of determining which saints have experienced the greatest shifts in popularity over the centuries (at least in terms of co-tradition).[37] We therefore consider the values of these metrics for the subgraphs made up of the edges corresponding to each of the centuries. For a given vertex and a given measure of centrality, we thus obtain the set of values that the metric takes successively, century after century. This way of producing a time series from a dynamic graph by cutting it into a succession of "snapshot photos",[38] each of which correspond to a static graph, is well known in the literature.[39]

The focus here is on the variation of the metrics over time: we therefore calculate the total variation of the obtained time series divided by their length, i.e., the average of the absolute values of their differences. Let us take a simple example: suppose that the degree centrality of a saint passes, between the 10th and 13th centuries, through the values 10, 15, 40, 30. In this case, the total variation is equal to $(|15 - 10| + |40 - 15| + |30 - 40|)/4 = 10$.

Let us now present the design of Experiment 4. Our goal is to simulate source dating errors. To do this, we randomly select a set of the manuscripts used as a basis for the construction of the hagiographic graph, and modify the century associated with them. To make the errors plausible, we do not make this transformation randomly: each of the drawn manuscripts is ante-dated or post-dated by only one or two centuries. Indeed, for several reasons of historical, paleographic, philological, etc. nature, it is rare for a historian to make a huge dating error. An 8th century manuscript is thus very unlikely to be mistaken for a 15th century

37 de Valeriola/Dubuisson (2021).
38 Lemercier (2015), p. 186.
39 See, among many examples, Uddin/Piraveenan/Chung/Hossain (2013).

1. Fix a shift direction (backward or forward shift) and a proportion of manuscripts to affect in {1% ; 2% ; 5% ; 10% ; 20% ; 40%}.
2. For each of the 1,000 scenarios:
   a. use a random draw to select the manuscripts to apply the operations to, then:
      - if Experiment 4a is performed (backward shift), subtract one century from the *century* attribute of 2/3 of selected manuscripts, and two centuries from the other 1/3,
      - if Experiment 4b is performed (forward shift), add one century to the *century* attribute of 2/3 of selected manuscripts, and two centuries to the other 1/3,
   b. for each century:
      - create a subgraph containing all edges whose *century* attribute corresponds to the selected century,
      - simplify this subgraph,
      - compute the four centralities on the simplified subgraph,
   c. use the centralities values obtained for each century to compute their total variation.

Output: the values of the total variation of the four centrality metrics for each vertex of the unshocked graph in each of the 1,000 scenarios, for each affected sources proportion.

Tab. 5 Successive steps and output of Experiment 4

manuscript, and vice versa. These two time 'directions' (ante-dating and post-dating) lead to the two experiments 4a and 4b.

The first step in Experiment 4 is to set a proportion of manuscripts to which to apply the transformations. For each of the 1,000 stochastic scenarios, a list of such manuscripts is then drawn randomly, of which two-thirds see their century increase (in Experiment 4a) or decrease (in Experiment 4b) by one unit, and one-third by two units. The *century* attribute of the edges associated with these manuscripts are then transformed accordingly. The total variation of the centrality metrics is calculated as explained above, based on the division of the shocked graph into subgraphs corresponding to each century. These subgraphs are different in each of the stochastic scenarios, since the set of edges that undergo a transformation at the level of the attribute *century* is different each time. Table 5 lists the successive steps of Experiment 4.

3.3 Comparison Statistics

We have presented above how we simulate the incompleteness and imperfection of the sources, which result in the random generation of shocked graphs. We now need to explain how we compare these shocked graphs with the unshocked graphs. As we will see, we calculate different quantities for this purpose, which we will call 'comparison statistics' in the rest of this article.

Let's start with the first three experiments, which give similar outputs: the centrality score of each vertex in each of the 1,000 scenarios for each of the four metrics. In this case, we compute four different statistics. First, we estimate the

'deformation' that each network as a whole undergoes. To do this, the global measure of centralization is calculated in each scenario. We then take the average of these results for each network, and normalize it with the value of the centralization of the unshocked graph (which is shown in Figure 2). The same quantity calculated for the unshocked network is, due to this division, equal to 1. This normalized average of centralizations is the first of the four comparison statistics used in the *Results* section below for experiments 1, 2 and 3.

Second, we question whether or not individual centrality scores change significantly. To test this aspect, we calculate the correlation coefficient between centrality scores of the unshocked network vertices and those of each of the 1,000 shocked networks vertices.[40] When the vertices of the unshocked network do not exactly match the vertices of the shocked network, we perform the calculation only for the vertices they have in common. Among the three main statistical correlation indicators, we have chosen Spearman's coefficient, which we believe is the most appropriate.[41] Once these 1,000 correlations are obtained, their average is calculated. The same quantity calculated for the unshocked network is equal to 1, since it then corresponds to the correlation of the series of initial centrality scores with itself. This average of correlations is the second of the four statistics used in the *Results* section below for experiments 1, 2 and 3.

Third, we look more closely at the individuals who can be considered the most important within the network. Indeed, it is often to these individuals that the historian's eye turns when using these metrics. It is therefore natural to wonder whether this list of vertices is stable when the graph is subjected to the perturbations of experiments 1 to 3. To estimate this stability, we calculate, for each of the 1,000 scenarios, the proportion of individuals who are in the top 10% of the unshocked network in terms of centrality (or, equivalently, whose centrality score is greater than or equal to the 10%-quantile of all centrality scores) and who are still in this top 10% in the shocked network.[42] It is therefore the intersection (or overlap) between the top 10% of the two graphs. Once these 1,000 proportions are calculated, we take the average. The same quantity calculated for the unshocked

40 This statistic has already been computed in the literature, see e.g. Borgatti/Carley/Krackhardt (2006); Platig/Ott/Girvan (2013).

41 It seems pertinent, in the context of a historical analysis, to work on the basis of the ranks of the vertex centrality scores, and not on the scores themselves. The ranking of individuals in the network in increasing order of centrality is indeed one of the main interests of the historian. This is why we have not chosen Pearson's correlation coefficient. We chose Spearman rather than Kendall because the latter makes an estimate relatively close to the third comparison statistic, the overlap (see below). It should be noted, however, that all three coefficients were calculated in our exploratory analyses, and the conclusions obtained did not differ significantly.

42 Several authors compute this statistic, see Borgatti/Carley/Krackhardt (2006); Tsugawa/Ohsaki (2015).

network is equal to 1, since in this trivial case we calculate the intersection of a set with itself. This average of proportions is the third of the four statistics used in the *Results* section below for experiments 1, 2 and 3.

Fourth, we are interested in the relationship of the four measures of centrality to each other. We wonder about the impact of the condition of sources on the extent to which the metrics converge or diverge. In each of the 1,000 scenarios, we calculate the Spearman correlation coefficient (for the same reasons as above) between the 6 pairs of centrality measures.[43] We then compare each of these results with the correlation between the same two metrics in the unshocked graph (which is shown in Figure 3). This matrix of correlation coefficients is the last of the four statistics used in the *Results* section below for experiments 1, 2 and 3.

Let us move on to the fourth experiment, which must be considered separately because its output is not the same as that of the other three. Our goal here is to see if the evolution of vertex centrality metrics undergoes large changes when taking into account dating errors. Once the 1,000 scenarios are generated, we obtain a set of 1,000 total variations for each metric of each vertex. For each scenario, we then calculate the correlation coefficient (Spearman) between the statistical series composed of the total variations of the shocked network and that of the total variations of the unshocked network. Finally, we take the average (over the scenarios) of the correlations obtained. The same quantity calculated for the unshocked network is equal to 1, since it then corresponds to the correlation of the series of initial total variations with itself. This average of the correlations is used in the *Results* section below for Experiment 4.

3.4 Calculability and Implementation

All our calculations were performed in the R scripting language, using the igraph library.[44]

A remark about the number of scenarios to be generated is worth mentioning here. We chose to set this number at the highest possible value, because of the large variation in the structure of the shocked graph obtained from one scenario to another.[45] Indeed, we affect a fixed number of sources in each scenario, but not a fixed number of edges or vertices, so that the shocked graphs that are constructed potentially present quite disparate profiles. As we have seen in Section 3.3, most

43 The effect of shocks on the correlation between centrality metrics has been studied in e.g. Borgatti/Carley/Krackhardt (2006); Tsugawa/Ohsaki (2015).

44 R Core Team (2020); Csardi/Nepusz (2006).

45 Compared with Bolland (1988), p. 241 (100 scenarios), Platig/Ott/Girvan (2013), p. 5 (500 scenarios) or, in a slightly different context, Borgatti/Carley/Krackhardt (2006), p. 126 (10,000 scenarios).

methods of comparing the values of the centrality metrics of randomly truncated graphs with those of the unshocked graphs are based on averages over all scenarios. By choosing a large number of random scenarios, we ensure that these means are 'stable' (or, in statistical terms, we control the variance of the estimator).

Unfortunately, it is not possible to indefinitely increase the number of scenarios to be simulated. Setting the number of scenarios means making a compromise between the stability of the results obtained and the time the computer needs to perform the calculations. In the case of the Ypres graph for example, the computer calculates 4 measures of centrality for the 4,675 vertices, in graphs generated on the basis of 6 proportions of erasure in 1,000 scenarios each time. No less than $4 \times 4{,}675 \times 6 \times 1{,}000 = 112{,}200{,}000$ calculations are made. It should also be noted that the calculation of a metric value sometimes involves heavy calculations: for closeness centrality, for example, the score of a single vertex is obtained by calculating the distance of this vertex from all the other vertices of the graph. In order to perform this vertiginous number of calculations, we have parallelized the procedure on an eight-core intel i7-7700HQ @ 2.80 GHz processor. More than eight hours of calculations were required to obtain the results of Experiment 1 for the three networks. This duration is multiplied by 10 in the case of Experiment 2, where the graph transformation operations (merging and splitting vertices) themselves take a lot of time.

4. Results and Discussion

This section is dedicated to the presentation and discussion of our results. We will first consider them raw, then at increasingly summarized levels.

4.1 Raw Results

We will present separately the results concerning the correlation between metrics and those concerning the other comparison statistics, since the output of the computation is different in these two cases: one value per pair of metrics on the one hand, one value per metric on the other. Figure 7 gives the results of the first statistic for two of the three networks.[46]

These plots show curves with fairly gentle slopes, with total value changes (differences between the correlation for the unshocked graph and for a proportion of affected sources equal to 40%) lying between –0.24 and 0.16. The correlation coefficients increase (in 30/66 curves) or decrease (36/66 curves) with the propor-

46 We omit the results for the third network here, for reasons of space. They are very similar to the two presented here.

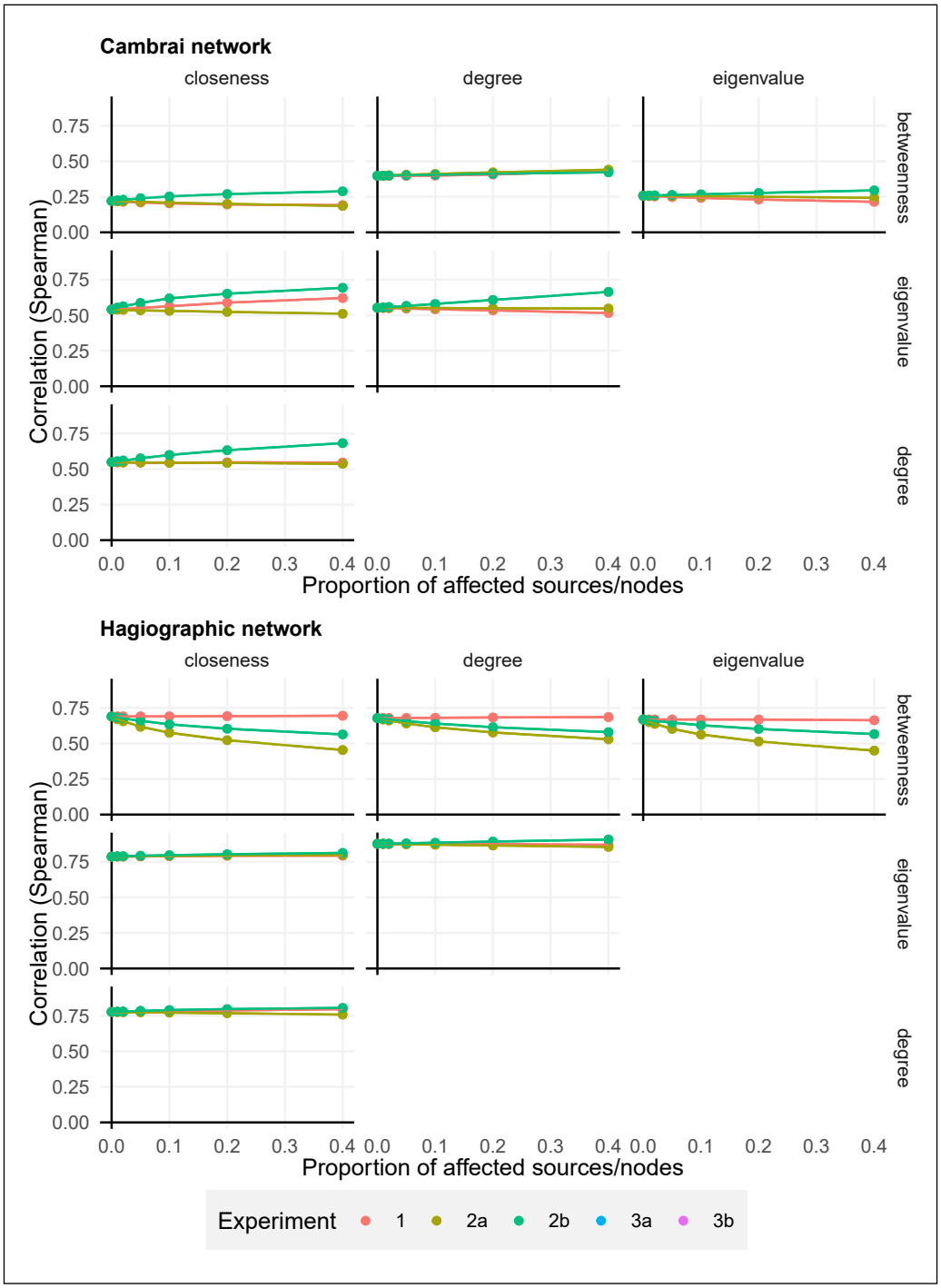

Fig. 7 Results in terms of correlation between metrics for Cambrai and Hagiographic networks

tion of affected sources depending on the experiments and networks, without any trend seeming to emerge.[47]

This stability indicates that the impact of experiments 1 to 3 on the correlation coefficients between metrics is very limited. We can therefore conclude that the vagaries of the sources do not significantly distort the relationships that our metrics have with each other. The results concerning correlation between metrics do not need to be further summarized.

Let's now look at the four other comparison statistics: centralization, correlation, overlap and total variation. For each experiment, for each proportion of affected sources, for each network, for each centrality metric and for each statistic, we obtain a number to compare with the constant value 1, which corresponds to the unshocked network. These results can be visualized as a matrix of plots, as shown in Figure 8 for Experiment 1.

If we omit the numerical results and the hierarchies it presents (which will be summarized more effectively below), the main interest of this plot lies in the general look of the represented curves.

First, it should be noted that these curves do not show very 'violent' or 'rugged' shapes. This means, on the one hand, that the impact of source removal on centrality metrics depends smoothly (if not continuously) on the proportion of removed sources, an obvious conclusion that has the merit of reassuring us of the quality of the design and implementation of Experiment 1. On the other hand, from the regularity of these curves, we see that the number of scenarios we consider is high enough to extract the trend of the observed phenomena, i.e. to obtain stable results.

Second, it is interesting to note that although the curves are all decreasing, they show differences in terms of concavity. The curves giving the results for centralization (first line of plots) are concave: their slope is more and more negative. On the contrary, those of the overlap (the third line of plots) are convex: their slope is less and less negative. This distinction is due to a major difference between these two comparative statistics. The overlap statistic considers only a small part of the vertices of the graph, and is therefore potentially (remember that we generate a large number of stochastic scenarios) strongly affected by the removal of a small proportion of the sources. When this proportion increases, this effect is gradually mitigated, as if the most important part of the damage was done with the first deletions. On the contrary, the centralization statistic is a met-

47 This contradicts Bolland's observation that the correlation between metrics tends to increase (up to a 90% limit) when edges of the unshocked graph are removed (Bolland (1988), p. 251).

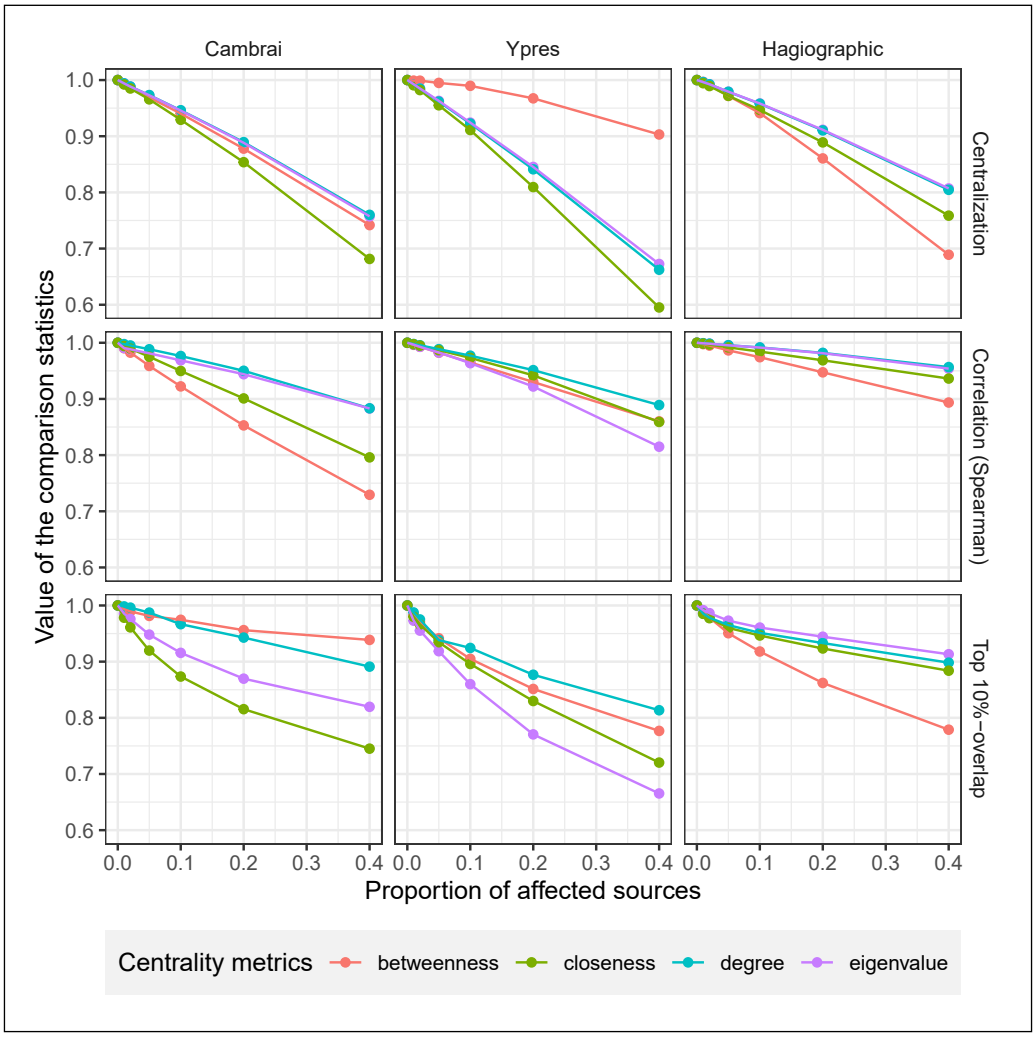

Fig. 8 Results in terms of centralization, correlation and overlap for Experiment 1

ric that takes into account all the vertices and describes the general internal organization of the graph. Removing a small proportion of the sources therefore has only a limited effect, which is compounded when the proportion of removals increases and the overall structure of the network changes.

Third, note that there is no significant crossover between these curves. The hierarchy between the metrics that their relative positioning indicates is therefore always about the same, regardless of the proportion of sources removed. For this reason, and since similar conclusions can be drawn from similar plots for the other experiments (which we do not present here for reasons of space), we can now stick to the extreme values of these curves, i.e. the values of the comparison

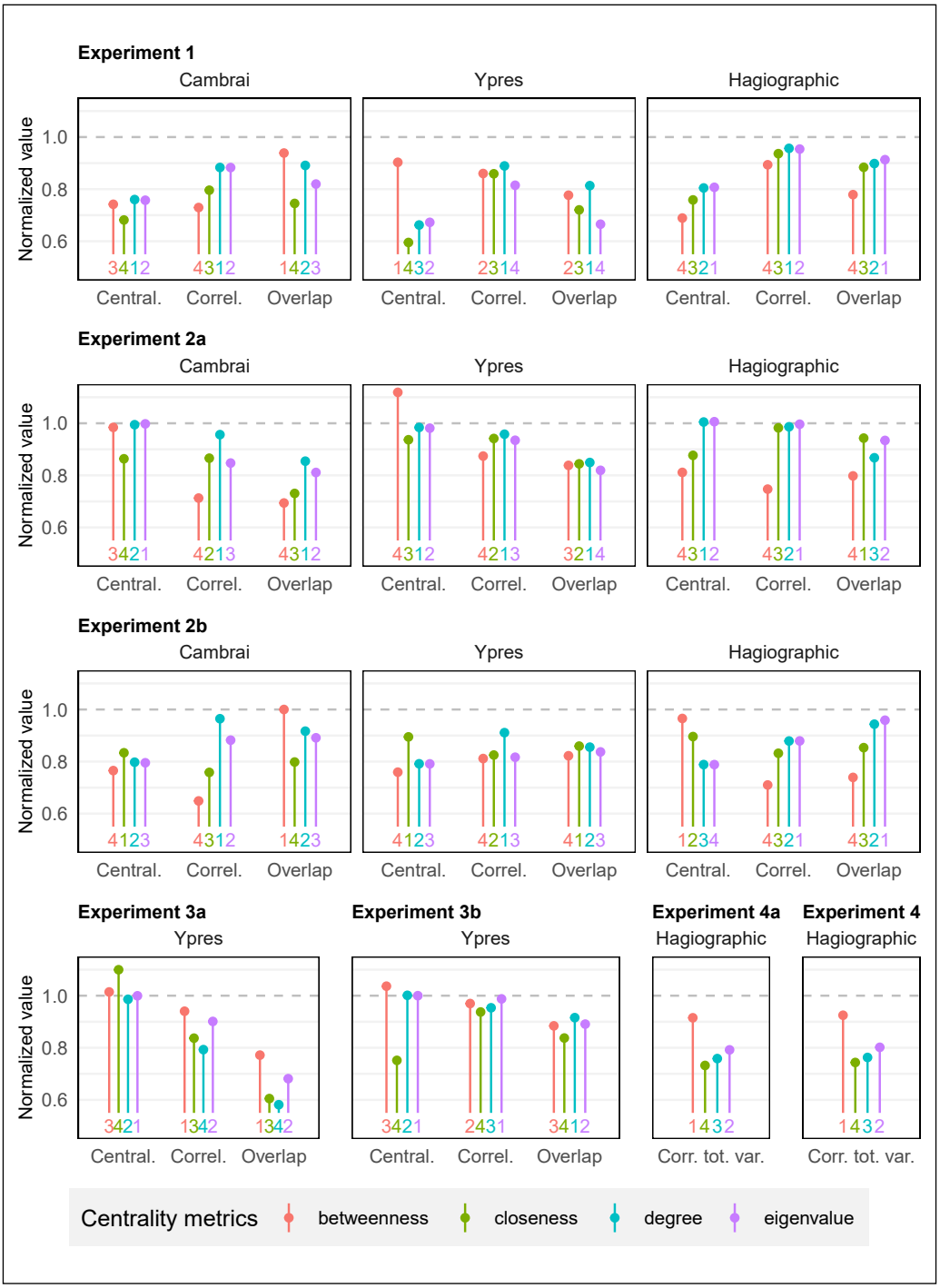

Fig. 9 Abridged results of all experiments (corresponding to a proportion of affected sources/nodes equal to 40%)

statistics when the proportion of affected sources (or nodes, in the case of Experiment 2) is 40%.

4.2 First Level of Summarization

This extreme value is the quantity represented on the plots in Figure 9, which gives an overview of the results obtained for all experiments.

These lollipop plots therefore each represent the worst value (i.e. the furthest from 1) obtained from our robustness tests. For example, the very first plot in this figure (Experiment 1, Cambrai) shows the four levels of the centralization statistic that correspond to the rightmost points of the curves shown in the plot at the top left of Figure 8 (values 0.76, 0.76, 0.74 and 0.68). Below each lollipop is written the rank of each of the centrality metrics, calculated for that particular experiment, graph and statistic, on the basis of their distance from 1.[48] We can thus read in the very first plot that, for the Cambrai graph in Experiment 1 in terms of the centralization statistic, degree centrality is the most robust metric, followed by eigenvalue centrality, then betweenness centrality and finally closeness centrality. A number of observations can be made on this set of plots, before moving on to the next level of summarization of results.

First, let's look at the values obtained as a whole. None of them goes very low, since the smallest is 0.58 (Experiment 3a, Ypres, overlap, degree centrality), and more than two thirds are higher than 0.8, despite the fact that we consider a significant proportion of affected sources/nodes (40%). This observation, combined with the fact that the curves in Figure 8 have a smooth shape, makes it possible to answer the first question asked in Section 1.3. Yes, historians can trust centrality metrics, at least to some extent. The hazards experienced by the sources (at least the replications of these hazards that we have simulated) should have a rather minor impact on the values of these metrics, and therefore do not completely destroy the conclusions that the historian can draw from their use.

Second, note that most of the values obtained are smaller than 1, but not all. This of course occurs only for centralization, since the other two comparison statistics, correlation and overlap, cannot take values greater than 1. This means that the value of centralization is most often underestimated, but it is also possible that it is overestimated. The historian's caution must therefore apply in both directions.

48 For example, in the case of centralization in Experiment 2a for Ypres, the ordered metrics are: degree (value = 0.984, distance to 1 = 0.016), eigenvalue (value = 0.981, distance to 1 = 0.019), closeness (value = 0.937, distance to 1 = 0.063) and betweenness (value = 1.12, distance to 1 = 0.12).

Third, we observe on this set of plots a great diversity of results in terms of networks, comparison statistics and experiments. This brings nuances to the overall conclusion drawn in point 1 immediately above, which should not be misinterpreted. While the overall level of results is quite good, the disparity of these figures calls for caution and further analysis.

The values taken by some statistics in particular cases can be linked to the characteristics of the corresponding objects, and thus better understood. For example, the fact that betweenness centrality shows good performance in terms of overlap in the case of Cambrai for experiments 1 and 2b is rather intuitive. Indeed, as we noticed in Section 2.4, this metric takes very differentiated values for this network, with a large number of vertices having a centrality of 0, but a very small number of vertices with a huge centrality. The objective of the overlap statistic is to account for the movements observed in the top 10% vertices, among which are obviously those of the second category that we have just mentioned. While the number of geodesics passing through these few pivots of the graph is of course impacted by the operations carried out in experiments 1 (edge suppression) and 2b (vertex split), it is unlikely that they will take them out of the leading group. The opposite phenomenon can be observed, however, for Experiment 2a: betweenness centrality is in fourth place in terms of overlap for the Cambrai graph. The operation carried out in this experiment (vertices merging) has a much greater potential impact on this metric. Let's imagine that the computer merges two 'moderately important' vertices, each belonging to a different party. Before the merging, the vast majority of the shortest paths pass through the network hubs, the candidates for the episcopal see; after the merging, it is possible that a significant portion of the shortest paths will pass through the merged vertex and no longer through the hubs. In this eventuality, the vertices whose betweenness centrality is high can 'easily' lose their status.

It is possible to identify some more global trends within this diversity, as we will see below, but these are rather rare. We are far from a perfectly clear-cut situation, with uniform patterns repeating themselves from graph to graph or from statistic to statistic. A notable exception is the hagiographic network, where a hierarchy of metrics occurs almost every time for experiments 1 to 3. Similarly, careful observation of all the plotted values suggests that closeness centrality is quite often assigned a high rank, and eigenvalue centrality a low rank. It is nevertheless difficult, on the basis of Figure 9, to trust this sketch of hierarchy, or to discover other trends in these results. In order to untangle this somewhat chaotic situation, we need to move to higher levels of summarization of the results.

4.3 Second and Third Levels of Summarization

We now build two different second level summaries. We first calculate a score that aggregates all the results obtained for each of the metrics in the four experiments, represented in Figure 10.

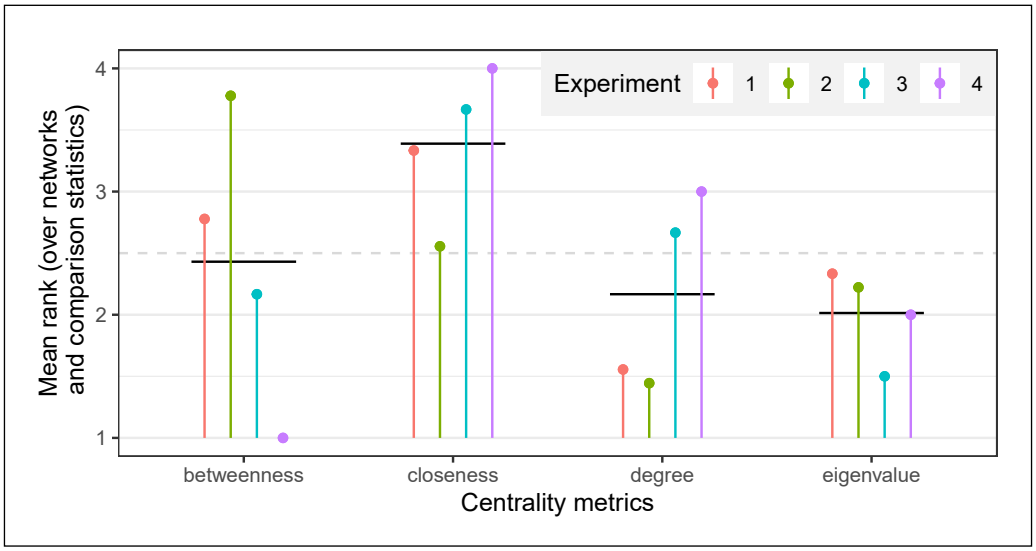

Fig. 10 Mean ranks of metrics in each experiment (lollipops) and over experiments (black horizontal segments). The horizontal dotted grey line represents the total average rank (2.5)

To do this, we take the average of the ranks of the metrics over the graphs and over the comparison statistics.[49] For example, the average score of betweenness centrality in Experiment 1 (the height of the leftmost red lollipop) is obtained by averaging the 9 ranks indicated below the lollipops in the plots in the first row of Figure 9: $(3+4+1+1+2+2+4+4+4)/9 = 2.78$. In addition, the global average over the experiments is also calculated, which is represented on the plot by a black horizontal segment and corresponds to the third level summary.

We then calculate, in a similar way, a score that aggregates all the results obtained for each of the three graphs in the four experiments, represented in Figure 11.

As in the previous plot, a black horizontal segment gives the overall average over the experiments. This plot allows us to see which networks are, on average, most impacted by the experiments we subject them to. The hagiographic network takes first place on the podium, a conclusion consistent with the observations made above on the basis of Figure 9, and that is thus rather unsurprising. Indeed, as we saw in Section 2.4, this graph is much denser than the other two. Its high number of edges probably makes it less sensitive to the operations we per-

49 It seems far better to calculate the average of the ranks than the average of the results: what would it mean to add a correlation coefficient to a normalized centralization score?

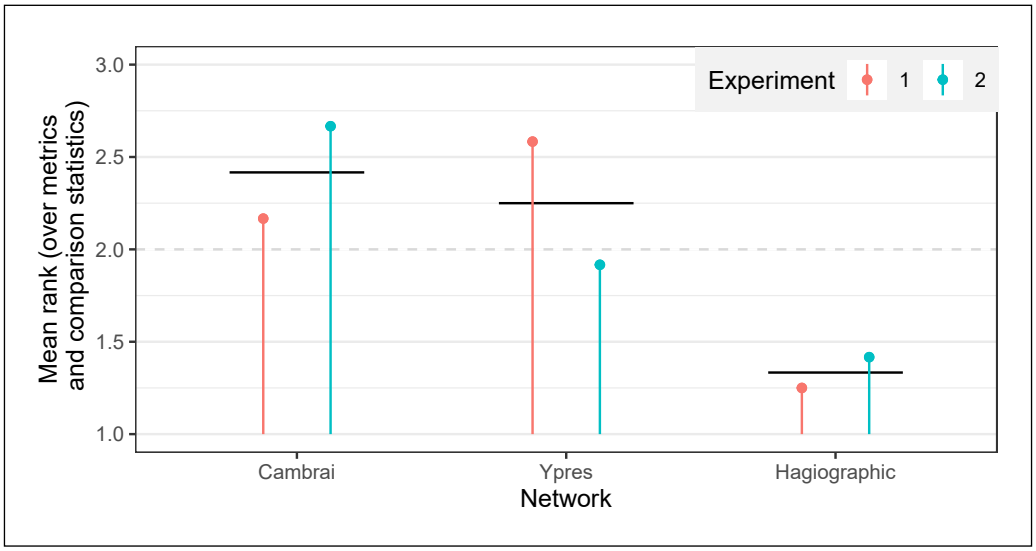

Fig. 11 Mean ranks of networks in experiments 1 and 2 (lollipops) and over experiments 1 and 2 (black horizontal segments). The horizontal dotted grey line represents the total average rank (2)

form on it.[50] The next network in order of increasing impact is that of Ypres, but it is closely followed by that of Cambrai. It is interesting to note that both have opposite profiles in terms of experiments: the Ypres graph is less affected by Experiment 2 than by Experiment 1, while the opposite is true for the Cambrai graph.

Let us now return to Figure 10, which allows to draw up a hierarchy of centrality metrics and thus provide an answer to the question asked in Section 1.3. Eigenvalue centrality is the most robust under this criterion, followed closely by degree and betweenness centralities. We also observe that, if these three mean ranks are quite close to each other, the same cannot be said for the dispersion (over the experiments) of these values around their mean: the four values of the eigenvalue centrality are much less scattered than those of the degree centrality, which in turn are much less scattered than those of the betweenness centrality.[51] Betweenness centrality is rather extreme from this point of view, since it is the most robust for Experiment 4, but the least robust for Experiment 2. This observation about

50 The literature is divided on this relationship between robustness and density. Some authors observe an inverse phenomenon to ours, in which robustness decreases when density increases (Borgatti/Carley/Krackhardt (2006), p. 134; Galaskiewicz (1991)), while others show that the relationship depends on the metric of centrality considered (Frantz/Cataldo/Carley (2009), p. 319–321).

51 This observation is confirmed by the standard deviations of these three series of four numbers: 0.37 for eigenvalue centrality, 0.78 for degree centrality, and 1.16 for betweenness centrality.

dispersion allows us to be more confident about the very tight order given by the averages for the first three metrics. Indeed, a small dispersion value is an enviable quality, since it means a great uniformity over the experiments, i.e. that the stability of the metric is about the same for each of the experiments. Finally, closeness centrality is the least robust of our four metrics, with some consistency across the four experiments.[52]

Note that looking at the mean rank and the dispersion around this mean rank is not the only way to analyze these results. We can also decide to look at the maximum rank on the experiments (which corresponds to the worst performance of each metric). This other way of comparing the results reflects the idea that a metric is globally robust if it is robust in all situations, that is, in our case, regardless of the type of experiment we subject it to. The hierarchy obtained by comparing the maximum ranks is the same as that obtained by comparing the average ranks.

5. Conclusion

In this paper, we have assessed and compared the robustness of centrality metrics in the context of their use in historical network analysis. To do this, we have implemented a battery of tests that simulate the source defects that historians face, both in terms of incompleteness and inaccuracy. Our results show that, from a global point of view, centrality is a sufficiently stable quantity to be used in such a context. However, we have also shown that the hazards experienced by the sources have impacts that differ in magnitude depending on the network studied, the comparison statistic used, and the centrality metric considered. This finding calls for caution in the choice of network tools applied, and for nuance when interpreting the results of an analysis of historical networks using centrality.

We have found throughout the previous section that our conclusions are not always consistent with the literature. It should be recalled here that the experiments we conduct are not the same as those carried out in these studies, since they are directly inspired by the historian's practice. It is therefore legitimate that the results obtained are different. One can even go further, and argue that these divergences carry an interesting meaning. Indeed, they show that it is relevant to study the robustness of centrality metrics in our particular context, that of his-

52 The literature does not give a uniform picture of this hierarchy. For some authors, the four metrics are equally robust (Borgatti/Carley/Krackhardt (2006), p. 134; Tsugawa/Ohsaki (2015), p. 34), while for others the betweenness is the most unstable (Bolland (1988), p. 248–250; Costenbader/Valente (2003), p. 305). Eigenvalue is sometimes considered the most robust (*ibid.*), but sometimes it is closeness centrality that takes the top spot (Kim/Jeong (2007), p. 5). These results are therefore sometimes in adequacy, and sometimes in complete inadequacy with ours (see the commentary on this subject below).

torical analyses. We conclude that the 'one size fits all' approach does not work well, and that the particularities of the field of application need to be considered. This begs for a multiplication of methodological studies on the properties of historical networks.

We were also able to establish a hierarchy among the four centrality metrics considered, from the most to the least robust. We think it is important to take this ranking into account, since it is directly related to the degree of confidence one can have in the conclusions that centrality allows us to draw about a network. In particular, it seems necessary to avoid basing an analysis of centrality solely on the closeness metric, and not to focus on the results it provides when other metrics are used alongside it (and especially if they lead to different conclusions).

These recommendations may seem disappointing at first glance, since they weaken some of the tools historians have at their disposal to carry out their network analyses, thus making these analyses less efficient. However, this is what it's all about: in a sense, robustness is a matter of compromise. By using a robust tool, we trade efficiency for stability, something that is essential for historical studies. The very famous statistician Anscombe presents it as an insurance policy: you pay a premium (part of the efficiency of your process), and in exchange you get protection against accidents (i.e. process deviations).[53]

This type of compromise is, of course, not unfamiliar to historians, since it also occurs when the conclusions of a historical study are nuanced with respect to the sources from which they were drawn. We can even take this reflection further, going back to the reason that led us to analyze the robustness of centrality metrics. We wondered how confident we could be in what these tools teach us about the historical objects that these networks model. This function is nothing other than that of historical criticism, if we take, for example, Paul Veyne's definition.[54] It thus appears that considerations around robustness, an a priori purely statistical concept, are an integral part of this central tool of the historical method, the "common treasure of the corporation"[55] of historians.

The case of robustness is certainly not an isolated one, and many quantitative techniques, when applied to historical data, can play the role of criticism tools. Can we not therefore rethink the place of this set of methods within history as a discipline? According to Pirenne, the various specialized branches of history that he calls auxiliary sciences (epigraphy, diplomatics, numismatics, etc.) arose from the particularization of the process of criticism to particular objects and tech-

53 Anscombe (1960).
54 Veyne (1984), p. 12.
55 Stengers (2004), p. 103.

niques (related to inscriptions, charters, coins, etc.).[56] Following this idea, historical quantitative methods would therefore deserve to be included in the list of history sub-disciplines. Placing them in this way in a new framework would make it possible to reflect on fundamental questions that have so far only been touched upon, on the historical data themselves and their relationship to the quantitative. We can only hope that this time will come soon, and that new paths will then open wide.

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56 Pirenne (1933), p. 438.

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LEANNA T. P. BRINKLEY

Understanding the Early Modern English Coastal Trading Community

A case study of network prosopography

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Keywords Network prosopography, early modern, maritime history, merchant, seafarer, Tudor

Abstract While a vibrant historiography surrounds early modern English seafaring, the vast majority of work has focused on the mercantile and maritime elite. Indeed, low-level seafarers, whose work significantly contributed to the maritime industry on which the English economy was so dependent, have been largely overlooked. In particular, a lack of insight into the lives and careers of English coastal traders has led to a skewed perspective of maritime logistics and of the socio-economic composition of Tudor society. This omission can be partially credited to a lack of qualitative sources pertaining to the lives and careers of low-level seafarers. Although there is a rich seam of quantitative data available through the national customs, few have looked to these sources to understand the social and economic dynamics of the coastal trading community.

This paper explores the possibility that a combined approach, utilising prosopography and Social Network Analysis, can reveal the ways in which small- and medium-scale merchants and shipmasters forged connections and established lasting businesses in the face of political and economic instability. Acting as a test case for future study, this paper will propose a methodological approach for the examination of a social and economic group that is often overlooked in the broad historiography, but for whom a large body of valuable quantitative data survives. By combining traditional historical methodologies with Social Network Analysis, this paper offers a new perspective on English maritime history.

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1. Introduction*

As many scholars published in this journal have alluded to, the world of Social Network Analysis (SNA) is vast, and the methods and approaches proposed by historians in this field are equally wide-ranging. Indeed, we are gifted today with a body of instructional literature that would have been invaluable to the forward-thinking scholars of even a decade ago. Yet understanding the subtle nuances differentiating the methods utilised by historians who are interested in different time periods, drawn to different geographic locations, and with different research goals in mind, is key to ensuring the continuing success of Historical Network Research (HNR) across a broad range of themes. With that in mind, this paper proposes a methodological framework for examining a social and economic group for whom we lack a large body of qualitative source material, but for whom we have been bestowed a great volume of quantitative data. More specifically, the method of interest here may be termed 'network prosopography' and should be considered an offshoot of traditional network analysis, relying more heavily on the visual elements of network graphs than on the mathematical and statistical outcomes of data analysis.

As noted by Carvajal de la Vega, incorporating traditional historical methodologies alongside SNA is vital to producing valuable Historical Network Research, and quantitative analysis alone cannot give a true sense of the nature of historic communities.[1] Therefore, for the purposes of the project described here, the graphs and figures resulting from network analysis were combined with, and to some extent used to underpin, the prosopographical examination of case study groups highlighted as being of particular importance to the coastal trading community. At the same time, network prosopography may likewise be considered an offshoot of broader prosopographical research, utilising SNA as one strand of analysis used to form a collective biography. These methods have been most frequently utilised by scholars of the ancient world, but other large-scale projects have demonstrated the potential for the application of a combined approach in medieval and early modern contexts.[2] As this case study will show, network vi-

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1 David Carvajal de la Vega, "Merchant Networks in the cities of the Crown of Castile," in *Commercial Networks and European Cities, 1400–1800,* ed. Andrea Caracausi and Christof Jeggle (London: Pickering and Chatto Publishers, 2014), 137–38.

2 For example, see, Yanne Broux, *Double Names and Elite Strategy in Roman Egypt* (Leuven, Belgium: Peeters, 2015); "People of Medieval Scotland, 1093–1314," 2012, accessed 15 June 2018, www.poms.ac.uk; G. R. Ruffini, *Social Networks in Byzantine Egypt* (Cambridge: Cambridge University Press, 2011); „(SNA)P: Standards for Net-

sualisation can go a long way in helping us to delineate the structural nature of commercial societies, to explore the character of commercial partnerships, and to unearth communities who have been lost in the historiographical narrative.

Indeed, while English maritime history benefits from a rich tapestry of existing research, the historiography of the early modern English maritime economy suffers from a significant deficiency, owing to a general tendency among scholars to overlook those who engaged in domestic exchange within English waters. Many skilled researchers have explored the commercial nature of maritime trade during the early modern period at length, identifying key overseas markets and establishing the trajectory of global commercial activity in the years preceding British imperial rule.[3] Likewise, the lives and careers of those that traded overseas have been well established and our understanding of the social, economic, and political role of the mercantile elite has significantly stabilised in recent decades.[4] However, the most comprehensive studies of the coasting trade were undertaken by T. S. Willan in the 1960s and 70s. These were intended as a jumping-off point for future research; a call that was met with little beyond simple acknowledgement that more work should be undertaken.[5] That being said, some regional studies have also included a limited examination of specific coastal merchants, but coastal trading has otherwise been rarely examined in its own right.[6]

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working Ancient Prosopographies," 2014, accessed 6 November 2019, www.snapdrgn.net. It should also be noted that Matthew Hammond has provided an excellent overview of the development of network analysis alongside prosopography, see Matthew Hammond, *Social Network Analysis and the People of Medieval Scotland 1093–1286 (PoMS) Database* (Glasgow: Centre for Scottish and Celtic Studies, 2017), 9–18.

3 Key literature includes; Ralph Davis, *The Rise of the Atlantic Economies* (London: Cornell University Press, 1973); Franz J. Fisher, "Commercial Trends and Policy in Sixteenth-Century England," *The Economic History Review* 10 (1940): 95–117, https://doi.org/10.2307/2590787; George D. Ramsay, *English Overseas Trade During the Centuries of Emergence: Studies in Some Modern Origins of the English Speaking World* (London: Macmillan, 1957).

4 For example, Robert Brenner, "The Social Basis of English Commercial Expansion, 1550–1650," *The Journal of Economic History* 32 (1972): 361–84, http://www.jstor.org/stable/2117192; Robert Brenner, *Merchants and Revolution: Commercial Change, Political Conflict, and London's Overseas Traders, 1550–1653* (London: Verso, 2003); Eleanora M. Carus-Wilson, *Medieval Merchant Venturers: Collected Studies* (London: Taylor & Francis, 1954); Evan T. Jones, *Inside the Illicit Economy: Reconstructing the Smugglers' Trade of Sixteenth Century* (Farnham: Ashgate, 2012); Alwyn Ruddock, "London Capitalists and the Decline of Southampton in the Early Tudor Period," *The Economic History Review* 2 (1949): 137–51, https://doi.org/10.2307/2590103.

5 Thomas S. Willan, *The English Coasting Trade: 1600–1750* (Manchester: The University Press, 1967); Thomas S. Willan, *The Inland Trade: Studies in English Internal Trade in the Sixteenth and Seventeenth Centuries* (Manchester: Manchester University Press, 1976).

6 For examples of regional studies, see Olive Coleman, "Trade and Prosperity in the Fifteenth Century: Some Aspects of the Trade of Southampton," *The Economic History Review* 16 (1963): 9–22, https://doi.org/10.1111/j.1468-0289.1963.tb01714.x; Ralph Davis, *The trade and shipping of Hull, 1500–1700* (Yorkshire: East Yorkshire Local His-

Instead, our understanding of the commercial nature of coastal trading, as well as of the socio-economic and socio-political positions of coastal traders, has largely formed as an offshoot of studies of overseas activity and has been based on either civic sources or on limited samples of customs records. Given that at least two-thirds of English ship-voyages during this period were coastal, this is a surprising lacuna, and one that has significantly distorted our understanding of the early modern maritime economy, causing substantial misconceptions regarding the wider English seafaring community.[7] By dismissing domestic trade as scattered, disorganised, and low-status, we have overlooked a group who were, in actuality, an integral part of the kingdom's commercial, social, and political successes, who approached their trade with sensible business strategies, and whose lives and careers can significantly contribute to our understanding of the early modern lived experience.[8]

This oversight can be attributed in part to a lack of detailed qualitative source material pertaining to those who engaged in coastwise shipping. In particular, those who did not reach the upper echelons of society, but who instead continued relatively low-value trade over an extended period, rarely appear in comprehensive records pertaining to their socio-economic status, local influence, or social ties. Yet individuals of this kind could have a marked impact on the commercial character of the ports in which they operated; they often had strong ties to the towns along their regular shipping routes, and sometimes held significant sway within their local communities. Moreover, while we may lack detailed qualitative information regarding such traders, their extensive engagement in commercial activity has left us with a mass of quantitative data, which, when analysed using innovative digital methods, can reveal much about their economic, social, political, and cultural impact on wider early modern society. This is especially true in terms of the results that are possible through the application of Social Network Analysis, as demonstrated by the abundance of recent scholars who have had

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tory Society, 1964); Susan Flavin and Evan T. Jones, *Bristol's Trade with Ireland and the Continent 1503–1601: The Evidence of the Exchequer Customs Accounts* (Dublin, Ireland: Four Courts Press for the Bristol Record Society, 2009); Michael Hicks, ed., *Southampton and its region – English Inland Trade 1430–1540* (Oxford: Oxford University Press, 2015); Jones, *Inside the Illicit Economy;* Jenny Kermode, *Medieval Merchants: York, Beverley and Hull in the Later Middle Ages* (Guildford: Cambridge University Press, 2002); Alwyn Ruddock, *Italian Merchants and Shipping in Southampton, 1270–1600,* vol. I, Southampton Record Series, (Southampton: University College, 1951); Duncan Taylor, "The Maritime Trade of the Smaller Bristol Channel Ports in the Sixteenth Century" (Doctoral thesis, University of Bristol, 2009). For similar studies outside of England, see Martin Rheinheimer, *Die insel und das Meer: Seefahrt und Gesellschaft auf Amrum 1700–1860* (Stuttgart: Franz Steiner Verlag, 2016).

7 Craig Lambert and Andrew Ayton, "The Mariner in Fourteenth Century England," in *Fourteenth Century England,* ed. Mark Ormrod (Woodbridge: Boydell Press, 2012), 157.

8 Leanna Brinkley, "England's Forgotten Maritime Communities: A study of Elizabethan coastal trading, 1568–1580" (doctoral thesis, University of Southampton, 2020), 289–97.

great success in the implementation of Historical Network Research, especially in the field of maritime history.

The benefits of applying SNA to historical research need not be reiterated to readers of this journal, but it is worth briefly unravelling how SNA has been used to date to understand medieval and early modern commercial communities, and particularly maritime communities. In continental Europe, where the uptake of HNR has been especially fervent, Andrea Caracausi and Christof Jeggle have led the way in demonstrating the power of applying network analysis to the commercial world. Their volume "Commercial Networks and European Cities (1400–1800)" brought together key historians and highlighted the breadth of analyses that are possible when strict definitions of networks are applied. By emphasising the roles of kinship and credit relationships in network formation across varying areas of interest, Caracausi and Jeggle skilfully unpacked the underlying themes that exist throughout networks of differing periods, geographic locations, and cultures. In particular, they recognised the important role of merchant communities in medieval and early modern Europe, noting that:

> Merchant networks generated the flow of material goods, money and other values. They constituted the core of urban economies and markets, influencing governance in the cities. In addition to commercial exchange, these networks established the infrastructure for the dispersion of cultural artefacts and practices as well as for migration between cities.[9]

The works assembled in this volume and beyond suggest that maritime communities across continental Europe have now been investigated in some depth, and numerous scholars have examined the intimate business and personal relationships forged by European merchants, including, for example, those of Florentine bankers, the Armenian diaspora in Venice, local Castilian traders, and the Genoese merchant class.[10] Furthermore, recent work from Eberhard Crailsham exploring the structure of commercial networks in Seville emphasised the importance of understanding the role individual merchants played in networks, rather

9 Andrea Caracausi and Christof Jeggle, eds., *Commercial Networks and European Cities, 1400–1800,* vol. 32 (London: Pickering and Chatto Publishers, 2014), 2.

10 Carvajal de la Vega, "Merchant Networks"; Evelyn Korsch, "The Scerimans and Cross-Cultural Trade in Gems: The Armenian Diaspora in Venice and its Trading Networks in the First Half of the Eighteenth Century," in *Commercial Networks and European Cities, 1400–1800,* ed. Andrea Caracausi and Christof Jeggle (London: Pickering and Chatto Publishers, 2014), 223–40; Heinrich Lang, "Networks and Merchant Diasporas: Florentine Bankers in Lyon and Antwerp in the Sixteenth Century," in *Commercial Networks and European Cities, 1400–1800,* ed. Andrea Caracausi and Christof Jeggle (London: Pickering and Chatto Publishers, 2014), 107–20; Quentin Van Doosselaere, *Commercial Agreements and Social Dynamics in Medieval Genoa* (New York: Cambridge University Press, 2009).

than just the legal or political frameworks that have been traditionally considered the catalyst for commercial enterprise.[11] Equally, Donald Harreld has shown that interactions between cities, even on a large scale, can be understood through an analysis of networks between individual traders. By looking at relationships between cities through merchants as nodes, Harreld proposed an ambitious approach to understanding large-scale networks from a micro perspective.[12] Likewise, Sheryllynne and John Haggerty have made extensive use of visual tools and graph theory to understand the networks of Atlantic slave traders in the eighteenth century, Henning Hillmann has had much success examining networks of politics and trade across a broad geographic and chronological spectrum, and Erikson, Samila, and Bearman have taken an institutional approach to network analysis to explain the commercial successes of the English East India Company.[13] In particular, Erikson, Samila, and Bearman demonstrate the importance of informal information exchange, challenging the perceived organisational structure of large monopolies, and crediting informal network structures, bolstered by private trade, with enabling Company expansion, rather than centralised administrative processes.[14] Similarly, in viewing merchant networks through the lens of marketing structures, Richard Britnell successfully combined traditional ideas surrounding the medieval and early modern market economy with subtle

11 Eberhard Crailsheim, *The Spanish Connection: French and Flemish Merchant Networks in Seville (1570–1650)* (Cologne, Germany: Böehlau Verlag GmbH & Cie, 2016); Eberhard Crailsheim, "Seville and Manila: Illegal trade, corruption, and the phenomenon of trust in the Spanish Empire," *International Journal of Maritime History* 29 (2017): 175–81, https://doi.org/10.1177/0843871416679120.

12 Donald Harreld, "Merchants and International Trade Networks in the Sixteenth Century," *XIV International Economic History Congress,* 110 (2006), https://www.academia.edu/6204913/Merchants_and_international_trade_networks_in_the_sixteenth_century.

13 For example, Henning Hillmann, "Mediation in Multiple Networks: Elite Mobilization before the English Civil War," *American Sociological Review* 73:3 (2008): 426–54, http://www.jstor.org/stable/25472536; Henning Hillmann and Brandy L. Aven, "Fragmented Networks and Entrepreneurship in Late Imperial Russia," *American Journal of Sociology* 117:2 (2011): 484–538, https://doi.org/10.1086/661772; Henning Hilmann, *The Corsairs of Saint-Malo: Network Organization of a Merchant Elite Under the Ancien Régime* (New York: Columbia University Press, 2021); John Haggerty and Sheryllynne Haggerty, "Visual Analytics of an Eighteenth-Century Busines Network," *Enterprise and Society* 11 (2010): 1–25, https://www.jstor.org/stable/23701218; John Haggerty and Sheryllynne Haggerty, "The life cycle of a metropolitan business network: Liverpool 1750–1810," *Explorations in Economic History* 48 (2011): 189–206, https://doi.org/10.1016/j.eeh.2010.09.006.

14 Emily Erikson and Peter Bearman, "Malfeasance and the Foundations for Global Trade: The Structure of English Trade in the East Indies, 1601–1833," *American Journal of Sociology* 112 (2006): 195–230, https://doi.org/10.1086/502694; Emily Erikson, *Between Monopoly and Free Trade: The English East India Company, 1600–1757* (Woodstock: Princeton University Press, 2014); Emily Erikson and Sampsa Samila, "Social Networks and Port Traffic in Early Modern Trade," *Social Science History* 39 (2015): 151–173, https://www.jstor.org/stable/90017171.

indicators of network formation.[15] More broadly, the extensive works of Avner Greif, Jessica Goldberg, Henning Hillmann and others have examined in detail the role that various forms of institutions played in the establishment of modern economic systems, and have combined detailed readings of extensive primary material with robust economic theory, opening a gateway to the lives of historic commercial communities across a wide geographic plain.[16] Moreover, recent work on the part of Greif and Hillmann has challenged the traditional reliance on economic, legal, and political institutions, refocusing the discussion towards the role of social institutions in individual and national commercial development.[17]

In combination, these works lay a strong grounding for the analysis of interest in this paper. Borrowing from Caracausi and Jeggle, we will use social networks to observe the structural nature of an important commercial group and to situate those network structures within the commercial activities and commercial practices around which they formed. Likewise, we will utilise the economic arguments put forward by scholars such as Erikson, Samila, Bearman, Britnell, and Greif to contextualise those very specific findings into broader economic theory. Taking the English coastal trading community as a case study, this paper will contribute to a wider conversation regarding the formation, expansion, and collapse of business networks within particular commercial contexts, observing those common threads that appear to have run through the networks forged within highly varied social, political and, economic environments, as well as those that were unique to particular regions or socio-economic groups. At a more intricate level, we will use SNA as a tool to examine the particular commercial strategies utilised by individual traders and maritime subgroups and to explore the impact that personal

15 Among others, Richard Britnell, *The Commercialisation of English Society, 1000–1500* (Manchester: Manchester University Press, 1996); Richard Britnell, "Urban demand in the English economy, 1300–1600," in *Trade, Urban Hinterlands and Market Integration c.1300–1600,* ed. James A. Galloway (London: Centre for Metropolitan History, 2000).

16 For example, Avner Greif and David D. Laitin, "A Theory of Endogenous Institutional Change," *American Political Science Review* 98:4 (2004): 633–52, https://web.stanford.edu/~avner/Greif_Papers/2004%20A%20Theory%20of%20Endogenous%20Instituitonal%20Change.pdf; Avner Greif, *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade* (Cambridge: Cambridge University Press, 2006); Jessica Goldberg, *Trade and Institutions in the Medieval Mediterranean: The Geniza Merchants and Their Business World* (Cambridge: Cambridge University Press, 2012).

17 Avner Greif and Christopher Kingston, "Institutions: Rules or Equilibria?" in *Political Economy of Institutions, Democracy and Voting,* ed. N. Schofield. and G. Caballero (London: Springer, 2011): 13–43, https://web.stanford.edu/~avner/Greif_Papers/2011%20rules%20or%20eq.pdf; Avner Greif and Murat Iyigun, "Social Organizations, Violence, and Modern Growth," *American Economic Review: Papers & Proceedings* 103:3 (2013): 534–8, https://web.stanford.edu/~avner/Greif_Papers/2013%20AER%20Social%20Organization.pdf; Henning Hillmann, "Economic Institutions and the State: Insights from Economic History," *Annual Review of Sociology* 39:1 (2013): 251–73, https://doi.org/10.1146/annurev-soc-071811-145436.

attitudes towards risk, career progression, wealth accumulation, and commercial collaboration could have on wider economic trends. Together, these approaches will contribute to a body of literature that has, to date, made use of a wide variety of sources and methodological frameworks, but that has largely circumvented historic maritime communities that existed in England before 1600.

It is important to emphasise that, despite this historiographic omission, there is much that can be ascertained about the early modern English maritime community from the sources that survive. It is of great fortune for the maritime historian seeking qualitative information regarding those who are poorly represented in qualitative sources that commercialised communities are particularly well represented in quantitative records. Where there was a custom to collect, the crown tended to be particularly proactive in its record-keeping and, after 1565, English records pertaining to maritime activity were extremely well regulated, being kept in blank books provided directly by the exchequer and being populated with extraordinary regularity, following a pre-defined format and being largely consistent across all ports. Moreover, they were subject to examination by multiple customs officials and, in theory, should have been minimally vulnerable to manipulation for the purposes of smuggling.[18]

The records that were kept after 1565 are immaculate. Thousands of port books have been preserved, containing millions of entries, many of which are legible and undamaged, each containing a wealth of information regarding the voyages undertaken through each of England's head ports, including:

- Details of the ship, including its homeport and tonnage.
- Voyage start, end, and stopping points.
- Details of the shipmaster and merchants carrying cargo on the ship, often including their full name, place of residency, and occupation.
- A detailed description of the cargo carried, including volumes and details of any tax paid or exemption granted.[19]

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18 It should be noted that, despite the best efforts of the crown, smuggling was still a significant problem in the second half of the sixteenth century. However, the methods of smuggling that were most prevalent largely revolved around the manipulation of volumes and types of goods, and details relating to ships, shipmasters and merchants were less commonly falsified. See, Jones, *Inside the Illicit Economy;* George D. Ramsay, "The Smugglers' Trade: A Neglected Aspect of English Commercial Development," *Transactions of the Royal Historical Society* 2 (1952): 131–57, https://doi.org/10.2307/3678787. For broader discussion on the development of the early modern customs system, see Norman S. Gras, *The early English customs system: a documentary study of the institutional and economical history of the customs from the thirteenth to the sixteenth century* (Cambridge: Harvard University Press, 1918), 59–103. https://archive.org/details/earlyenglishcust00grasuoft.

19 Donald Woodward, "Short Guide to Records: 22. PORT BOOKS," *History* 55 (1970): 207–10.

Re-evaluation of this material, including detailed examination of patterns of trade and interpersonal engagement, can provide much evidence relating to the business approaches and socio-economic position of coastal traders, who are otherwise invisible in the historiography and minimally represented in sources of a more qualitative nature. In this way, it is possible to diversify the historiographical narrative and give a voice to a marginalised community of vital commercial and social importance, as this paper will demonstrate.

1.1 Data compilation, data extraction and practical concerns

As many scholars of HNR have well established, any venture into the world of SNA must be preceded by a thorough consideration of the practical concerns associated with the application of such methods. First and foremost, it is important to determine whether the data provided in the source materials available are suitable for analysis using network methods. Various scholars have produced detailed instructional materials that provide a starting point for such an assessment and it is important to consider whether the application of SNA to a specific field is of sufficient benefit to outweigh the time and energy required to carry out the analysis.[20] In the case of this research, the greatest concern was not whether the data available was suitable for the application of SNA, but rather whether there was adequate justification for re-examining a body of source material that had already been studied extensively elsewhere.

In view of the significant historiographical omission noted above, and considering the possible trends that could be identified through the application of SNA, it was concluded that there was clear justification for the application of such analyses. More specifically, it was considered that re-evaluation of the Tudor customs using SNA was likely to significantly improve our understanding of the commercial nature of the early modern coasting trade, to provide a better understanding of the ways in which coastal traders ran their businesses, and to allow for structured analysis of the socio-economic and socio-political position of such indi-

20 See, for example, Bonnie H. Erickson, "Social Networks and History: A Review Essay," *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 30 (1997): 149–57, https://doi.org/10.1080/01615449709601182; Joanna Innes, „'Networks' in British History," *The East Asian Journal of British History* 5, Special Issue: Anglo-Japanese Conference of Historians 2015, Changing Networks and Power in British History: Politics, Society, Trade (2016): 51–72, https://www.academia.edu/27240701/Networks_in_British_History; Claire Lemercier, "Formal network methods in history: why and how?," in *Social Networks, Political Institutions, and Rural Societies,* ed. Georg Fertig (Turnhout, Belgium: Brepols, 2015), 281–310; C. Lemercier, C. Zalc, and A. Goldhammer, *Quantitative Methods in the Humanities: An Introduction* (Virginia: University of Virginia Press, 2019), 101–41. For discussion of a more informal nature, see "Historical Network Research: First Steps," 2019, accessed 5 November 2019, www.historicalnetworkresearch.org/resources/first-steps; "the scottbot irregular," 2019, accessed 5 November 2019, www.scottbot.net/2019/09/.

viduals within broader society. It was considered that such findings would have a significant impact on the wider historiography, calling into question a number of key elements of maritime scholarship. For example, by solidifying our understanding of the relationship between overseas and internal trade, by exploring the role that coasting played in the ability for merchants and mariners to obtain wealth and socio-political influence, and by challenging our assumptions surrounding the contemporary allocation of titles such as 'merchant' or 'mariner'.

Once it had been determined that there was sufficient justification for the application of SNA, it was necessary to configure the customs data into a suitable format for analysis. A purpose-built relational database was created, into which around 4,000 ship-voyages, undertaken through the case study ports of Southampton, Bristol, and Hull between 1565 and 1590, were transcribed (containing the details of around 1,500 shipmasters and 2,000 merchants).[21] Shipmasters and merchants were then extracted from the database as nodes, tied by their involvement in the same voyage, and parsed into "Gephi" for analysis and visualisation. This resulted in two types of tie: merchant-merchant ties and merchant-shipmaster ties. Merchant-merchant ties represented commercial relationships through which two or more traders shared a voyage to transport goods, while shipmaster-merchant ties represented commercial relationships between traders and mariners, in which the mariner was paid (albeit through a variety of means) for their services in commanding the vessel.[22] Each node was labelled according to the role played on the voyage (shipmaster or merchant) and by home county (as shown in Figures 1a and 1b).

Although the nature of the ties and attributes that were drawn out were relatively straightforward and (compared to those examined in some scholarship) very clearly defined, the nature and configuration of the customs records raised various methodological concerns that needed to be addressed before analysis could begin. First, in any scholarship that involves the examination of a large body

21 For more detailed discussion regarding the applications of historical databases, see, Justin Colson, "Web Databases for Late Medieval Social and Economic History: England's Immigrants and the Overland Trade Project," *Reviews in History* 19 (2015), accessed 17 January 2021, http://www.history.ac.uk/reviews/review/1820; Charles Harvey and Jon Press, *Databases in Historical Research: Theory, Methods, and Applications* (London: St. Martin's Press, 1996); Kees Mandemakers and Lisa Dillon, "Best Practices with Large Databases on Historical Populations," *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 37.1 (2004): 34–8 https://doi.org/10.3200/HMTS.37.1.34-38.

22 For discussion regarding the various means through which shipmasters were paid for their services, see Cheryl A. Fury, "The Elizabethan Maritime Community," in *The Social History of English Seamen, 1485–1649,* ed. Cheryl A. Fury (Woodbridge: Boydell Press, 2012), 118–20; Geoffrey V. Scammell, "Manning the English Merchant Service in the Sixteenth Century," *The Mariner's Mirror* 56 (1970): 10–11, https://doi.org/10.1080/00253359.1970.10658528; Robin Ward, *The World of the Medieval Shipmaster: Law, Business and the Sea C.1350–c.1450* (Woodbridge: Boydell Press, 2009), 52–66.

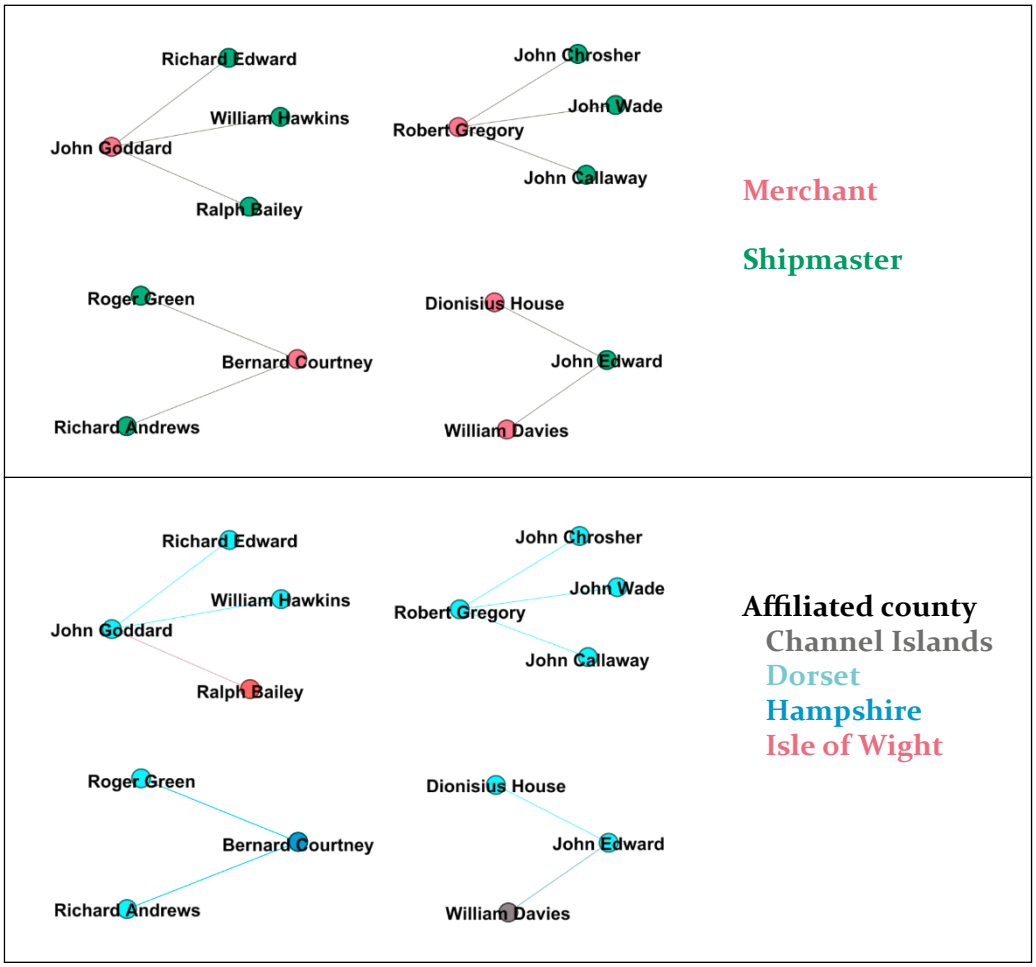

Fig. 1 1a and 1b: Example graphs demonstrating two forms of node visualisation

of personal data, and especially one derived from pre-modern sources, nominal linkage presents a significant problem. Failure to comply with the fundamental principles of reliable nominal linkage will have severe adverse effects on the network graphs generated. Indeed, the inability to accurately identify references to the same individual within the source material will almost certainly result in the creation of duplicate record IDs, or to the incorrect linkage of names that were actually separate persons.

In this project, investigation covered a sample of only around 3,500 individuals, and so each trader was examined case-by-case in the context of their voyages (examining the ships, cargoes, trade routes, occupations, residences, and other notes made by the customs officials in each entry) to make an informed decision per record. Likewise, additional information gleaned from civic sources and admiralty court records was used to decipher whether two names referred to

the same individual or perhaps to, say, a father and son. However, even with this degree of detailed examination, it was sometimes impossible to distinguish between individuals listed under the same names. Thus, any individual not identified with a high degree of certainty was excluded from the analysis, although this primarily applied to traders who appeared in the port books very infrequently and who formed dyads separately from the core macro-network, which were anyway excluded from examination. In other words, the vast majority of individuals that formed the core networks were positively identified, and it was primarily those that traded only very occasionally through the ports under investigation that were difficult to distinguish. It is important to note that for samples larger than this, it would not be possible to examine individuals on a case-by-case basis and, therefore, broader principles of nominal linkage would need to be applied, such as those described by Bloothooft, Boonstra, Breure and Doorn.[23]

Secondly, the sporadic survival of the port books has the potential to cause significant selection bias. For the 150-month period between Michaelmas 1565 and Easter 1578, the surviving coastal port books for Hull cover around 96 months (a survival rate of around 64%); for Southampton that figure drops to 81 months (54%), and for Bristol to 69 months (46%).[24] The surviving port books are scattered across the full spectrum of the period under investigation. Thus, although the characteristics of the total networks could have been explored further, such inconsistency in the survival of the customs records meant that observations using the full dataset would have been extremely vulnerable to selection bias. To ensure robust analysis, it was therefore deemed necessary to select comparable periods of six or eight months for each case study port. These periods are listed in Table 1. Importantly, these periods cover the same months of the year for each port, in order to account for the seasonal nature of trade and shipping, which resulted in certain goods being transported only during certain times of the year.

There is not space here to discuss in detail the specific seasonal characteristics of all trades across all regions, but to take just one example, the trade in fresh herring, which was a fundamental component of the east-coast economy, was almost exclusively undertaken in the autumn and winter months to account for herring

23 Gerrit Bloothooft, "Assessment of Systems for Nominal Retrieval and Historical Record Linkage," *Computers and the Humanities* 32.1 (1998): 39–56; Onno Boonstra, Leen Breure, and Peter Doorn, "Past, Present and Future of Historical Information Science," *Historical Social Research/Historische Sozialforschung* 29.2 (2004): 16, 43–49, 53–55. For an example of these methods used in practice, see Zhichun Fu et al., "Automatic Record Linkage of Individuals and Households in Historical Census Data," *International Journal of Humanities and Arts Computing* 8.2 (2014): 204–25.

24 These figures were collected by Dr Craig Lambert at the University of Southampton, see Craig Lambert and Gary Baker, *The Medieval and Tudor Ships Project* (2017), accessed 16 January 2021, www.medievalandtudorships.org.

	Hull	Bristol	Southampton
Period 1	Sept–Apr 1568/69	Apr–Sept 1569	Apr–Sept 1569
Period 2	Sept–Apr 1570/71	Apr–Sept 1570	Apr–Sept 1575
Period 3	Sept–Apr 1571/72	Apr–Sept 1572	Apr–Sept 1576
Period 4	Sept–Apr 1573/74	Apr–Sept 1576	Apr–Sept 1577
Period 5	Sept–Apr 1577/78	Apr–Sept 1580	Apr–Sept 1579

Tab. 1 Periods under investigation for each port

migration patterns.[25] Equally specific seasonal patterns of trade existed across all regions of the country, some determined by the weather, some by the physical characteristics of the port or the region, some by the commodities traded, and some by broader features of the global economy. However, unlike overseas trade that was, in some cases, limited by the weather to the spring and summer months, coastal shipping was undertaken continually throughout the year. As a result, comparison of different months of the year would have generated little useable data, and it was necessary instead to make annual comparisons of the same periods for each port. From this point forward, reference will be made to Periods 1–5 in line with the dates noted below. Deconstruction of the data in this way allowed for analysis of change over time in a way that was minimally susceptible to the influence of extraneous variables (such as missing data).

Thirdly, the degree to which the weighting of ties can be considered a useful measure of the strength of the relationships between nodes depends on the nature of the sources under investigation. For example, in his work on fifteenth-century wills, Justin Colson observed that repeated mention of beneficiaries gave a heightened semblance of importance to such individuals, which was not necessarily representative of a stronger relationship.[26] However, in the case of this research, the repeated overlap of individuals in the port books represented a genuinely useful measure of the strength of the relationships formed. After all, for a merchant and shipmaster to repeat a voyage together must imply that their previous interaction made for a successful collaboration. Therefore, rather than attempting to counteract the weighting of ties, the number of voyages undertaken between a pair was used to measure the strength of their relationship. There are,

25 Sheila Sweetinburgh, "Fishermen and their families in late medieval and Tudor Kent" in *The Routledge Research Companion to Marine and Maritime Worlds, 1400–1800: Oceans in Global History and Culture,* ed. Claire Jowitt, Craig Lambert and Steve Mentz (London: Routledge, 2020), 202–20.

26 Colson, Justin, "Local Communities in Fifteenth Century London: Craft, Parish and Neighbourhood" (Doctoral thesis, Royal Holloway, University of London, 2011), 56–60.

of course, some problems with this measure since the run of data is only partially complete and it was not possible, therefore, to guarantee that all voyages for all merchant/shipmaster pairs were accounted for. However, by dividing the data specifically into complete runs and directly comparing data year-to-year, some useful measures were obtained.

Fourthly, all ties were input undirected and no distinction was drawn between shipmaster-merchant ties and merchant-merchant ties. Arguably, some shipmaster-merchant ties could have been directed, since shipmasters were sometimes hired for single voyages in the form of a clear employer-employee relationship. However, most relationships were more complex and visualising them as directed ties would have given a false impression of the way in which merchants and shipmasters interacted.[27] Furthermore, the varying ways in which shipmasters and merchants formed business ties also meant that, in some cases, the shipmaster would have been hired by the shipowner and provided to the merchant (or merchants) as part of a charter party (or other legal arrangement). In these cases, it is possible that the merchant(s) would have had no part in the decision to utilise a specific shipmaster, and the shipmaster may not have necessarily known in advance which merchant's (or merchants') goods were on board. However, as argued by Andrews and others, in many cases the shipowner was also either one of the merchants carrying goods on board or the shipmaster commanding the vessel, especially in the case of vessels under around fifty tons, which made up the majority of the ships used in coastal commerce.[28] Moreover, a review of various Hampshire ship surveys suggests that some 20–40% of ships were owned (or at least part-owned) by the shipmaster, and this figure would very likely be higher were we able to isolate vessels that were exclusively engaged in coastal shipping.[29]

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27 Fury, Lambert, Ward and others have provided detailed assessments of the career paths and business approaches taken by seafarers, see Cheryl A. Fury, "Training and Education in the Elizabethan Maritime Community, 1585–1603," *The Mariner's Mirror* 85 (1999): 117–39, https://doi.org/10.1080/00253359.1999.10656737; Fury, "Elizabethan Maritime Community."; Craig Lambert, "Tudor Shipmasters and Maritime Communities, 1550–1600," in *The Routledge Research Companion to Marine and Maritime Worlds, 1400–1800: Oceans in Global History and Culture,* ed. Claire Jowitt, Craig Lambert, and Steve Mentz (London: Routledge, 2020), 323–48; Ward, *World of the Medieval Shipmaster.*

28 Kowleski and others have found that there was a clear divide between ownership of vessels above and below 50 tons, with shipmasters being much more likely to own vessels below that threshold, see Kenneth R. Andrews, "The Elizabethan Seaman," *The Mariner's Mirror* 68 (1982): 257, https://doi.org/https://doi.org/10.1080/00253359.1982.10655868; Maryanne Kowaleski, "The Shipmaster as Entrepreneur in Medieval England," in *Commercial Activity, Markets and Entrepreneurs in the Middle Ages: Essays in Honour of Richard Britnell,* ed. Ben Dodds and Christian D. Liddy (Woodbridge: Boydell Press, 2011), 165–70.

29 The National Archives of the United Kingdom, Kew (TNA) SP12/38, SP15/22.

Additionally, the signatures present in the Southampton port books suggest that most merchants engaging in coastal commercial activity were aboard the vessel themselves, rather than hiring agents or utilising servants to undertake those voyages on their behalf.[30] As such, they will have had direct interaction with the shipmaster during both the voyage preparations and the voyage itself. Likewise, in the ports of Southampton and Bristol, there is much evidence that merchants and shipmasters usually occupied the same physical space within the town and were part of the same community, suggesting that most merchants would have been aware of most shipmasters and *vice versa*.[31] As merchants inevitably had some say over the shipmasters they utilised and many shipmasters could be selective in the merchants they worked for, repeat interactions between shipmasters and merchants were usually reflective of a positive prior experience, even in cases in which the shipmaster was hired by the shipowner rather than the merchant(s) on board.

Finally, as the research undertaken here pertained to only three case study ports – Southampton, Bristol and Hull – we were clearly limited to seeing the ties of merchants and shipmasters relating to their voyages through those ports. Some of the individuals identified most likely carried out some degree of their business elsewhere, visible in port book data that is beyond the scope of this paper. However, since this research was primarily interested in the networks, communities and business activities surrounding the three case study ports, this did not limit the results to a significant degree. Therefore, dyads (or single pairs) of individuals that represented only a single voyage across the full dataset were removed. This served to limit investigations to only those who traded frequently through the port and who built up networks surrounding that particular commercial activity.[32]

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30 Of the 782 visible signatures, at least 235 can be positively identified as belonging to the merchant himself, while only 38 were clearly the mark of a servant, apprentice or agent. The remaining 509 were either merchants' marks that could not be clearly tied to a specific merchant or were illegible. TNA E190/814/5, E190/814/6, E190/814/7, E190/814/11, E190/814/12, E190/815/1, E190/815/2, E190/815/8.

31 Brinkley, "Elizabethan coastal trading," 230–33, 45–54.

32 To give a sense of the degree to which individuals operated across diverse ports towns, it is worth noting that, of the 267 Southampton merchants identified in the port books, only one appeared in Bristol across the full dataset and none appeared in Hull. Likewise, of the 496 Bristol merchants identified, only one appeared in Southampton across the full dataset and only 2 in Hull. TNA E190/1128/12, 13, 14, E190/1129/1, 18, 20, 22, E190/1130/2, E190/814/5, 6, 7, 11, 12, E190/815/1, 2, 8, E190/305/1, 11, 12, E190/306/1, 4, 16, 17, E190/307/2, 3, 9, 16.

1.2 Methods of network prosopography

Having addressed the above practical concerns, it was then possible to begin formulating a robust network approach that was both methodologically sound and practically useful to the broader study. In order to achieve this goal, each network exposed in the graphs that were generated was reviewed in isolation, in the context of the other networks formed in that period, and in relation to the networks of the preceding and subsequent periods. Moreover, the graphs showing the nodes as shipmaster/merchant were reviewed both separately and alongside those showing home counties, in order to establish whether specific forms of commercial interaction correlated with traders from particular regions. This allowed for a broad overview of the trends in network formation surrounding each port, highlighting the degree to which propinquity played a role in each town and allowing for a broad overview of the methods of commercial interaction across an extended period. In addition, having already undertaken a great deal of prosopographical analysis of the individuals trading through each port, it was possible to begin to tie the networks of particularly prolific traders to their socio-economic, socio-political, and familial positions. As such, trends and themes pertaining to the networks that formed around the coastal trade of each port were quickly isolated and case study groups that were of particular interest within the wider study were rapidly highlighted.

From this initial starting point, analysis was separated into three Research Streams, reflecting the overarching goals of the project. The best means of explaining these methods is through a number of exemplary case studies. Therefore, the remainder of this paper will be dedicated to drawing out the methods of data analysis that were utilised within the context of particular findings, each of which stemmed from the following Research Streams:

Research Stream 1: The commercial nature of coastal trading
Aim: To establish the commercial nature of coastal trading activity in Bristol, Southampton, and Hull in the late sixteenth century.

Research Stream 2: The commercial strategies and business networks of coastal traders
Aim: To understand how coastal traders and shipmasters ran their businesses. In particular, how they forged and maintained business networks.

Research Stream 3: The socio-economic and socio-political position of coastal traders
Aim: To assess the socio-political and socio-economic position of individuals that engaged in coastal trading, and to challenge our established notions of what it meant to be a merchant during the Tudor period.

While Research Stream 2 was the most closely associated with the SNA that was undertaken, each Stream benefitted from and was beneficial to our understanding of the networks through which coastal trading was undertaken. In fact, it is impossible to separate the commercial nature of coasting activity, or the socio-economic and socio-political positions of the individuals who plied that trade, from their business networks. Therefore, the application of SNA represented not just a research stream in and of itself but was also a major factor in the wider research goals of the project. The sections that follow will not provide all of the findings resulting from each research stream, but will instead provide just a few examples of findings that demonstrate the potential opportunities presented by the application of SNA to this particular maritime community.

1.3 Research Stream 1: The commercial nature of coastal trading

Turning first to the broad commercial nature of coastal trading, the key factor in the successful application of SNA for the purposes of this stream was the need to contextualise any findings within a robust quantitative analysis of corresponding economic data. In other words, the broad trends evident in the network graphs generated could not be understood without first understanding the commercial character of the ports around which they revolved. For example, among some communities, the network graphs revealed a deep-set division of commercial activity along the lines of socio-economic factors (such as wealth or occupation) and the structural nature of particular commercial networks correlated strongly with engagement in specific trade routes. Yet these trends on their own revealed little about the commercial character of the Tudor marine until they were placed within wider knowledge of the kingdom-wide, regional, and local commercial situation. This was evident in the case of Hull, for example, where the specific commercial character of the port led to a clear division within the mercantile community between the very wealthy, elite mercantile class who monopolised Hull's trade with London, and lower-wealth and lower-influence merchants, who dominated the frequent but comparatively low-value trade in Newcastle coal.

Such a divide was immediately apparent in the network graphs for the region but did not reveal much about the reality of the commercial situation without corroboration from economic data.[33] Yet when the structures of the networks surrounding the port were placed in the context of the region's commercial character, it was evident that the practical nature of the trade undertaken between Hull and London and between Hull and Newcastle had a direct bearing on the

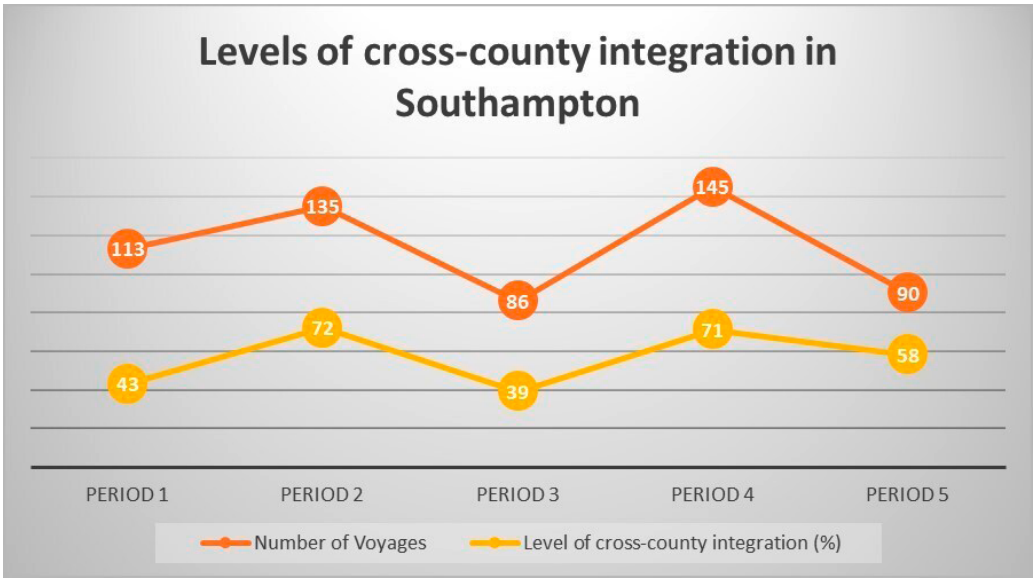
33 Brinkley, "Elizabethan coastal trading," 191–209.

socio-economic character of the mercantile networks through which it was carried out. More specifically, while trade with London revolved around high-value goods that required substantial financial investment and a highly reliable professional shipmaster, but relatively small vessels, the trade in Newcastle coal revolved around the transportation of a low-value commodity in large volumes, requiring little risk-limitation but large, specialist ships. As a result, the London trade attracted the wealthiest and most well-established members of the mercantile elite in Hull, who had the financial security to invest in high-value shipments, the commercial contacts in the capital to integrate into the London trading circles, and who represented the core of the merchant community in Hull. Conversely, the trade in Newcastle coal attracted those of lower socioeconomic status, who lacked the financial privilege to fund high-value trade with London, but who operated within their own commercial group that was defined and limited by their ability to access only low-value commercial activity.

Thus, it became clear that the practical character of these two strands of coasting activity had a marked impact on the degree of integration between traders operating in the port. In other words, the network graphs highlighted the degree to which economic factors impacted the local trading community, and the economic data explained the division in such a way that rendered the findings beneficial to the wider historiography. In combination, these two approaches allowed for the formulation of a clear image of the commercial nature of coastal trading in the port of Hull, and one that revealed a deep-set division between elite merchants and lesser merchants operating in the port. While we could have guessed at such a division without SNA, and case studies of particular merchants would have likely revealed specific examples of a commercial divide, the generation of network graphs served to demonstrate the extent of the gulf and confirm that the economic character of the region had a community-wide impact on those trading in the area.

Furthermore, similar conclusions can be drawn from trends pertaining to the degree to which traders from different regions formed business partnerships (described here as 'cross-county integration'). While shippers from different regions did sometimes interact, partnerships between residents of the same hometown were more common and evaluation of the network graphs revealed much about the factors that impacted cross-county integration. For example, as shown in Figure 2, levels of overall trade had a very different impact on cross-county integration in Southampton than in Bristol, such that the correlation between trade and integration was much more marked in the former than in the latter. If we examine this difference in the context of the broader histories of the ports, we see that both towns were important entrepôts, but that the social basis for their commercial position was substantially different.

While Bristol had a centuries-long history of commercial domination by a small group of powerful local merchants, Southampton's overseas trade had long



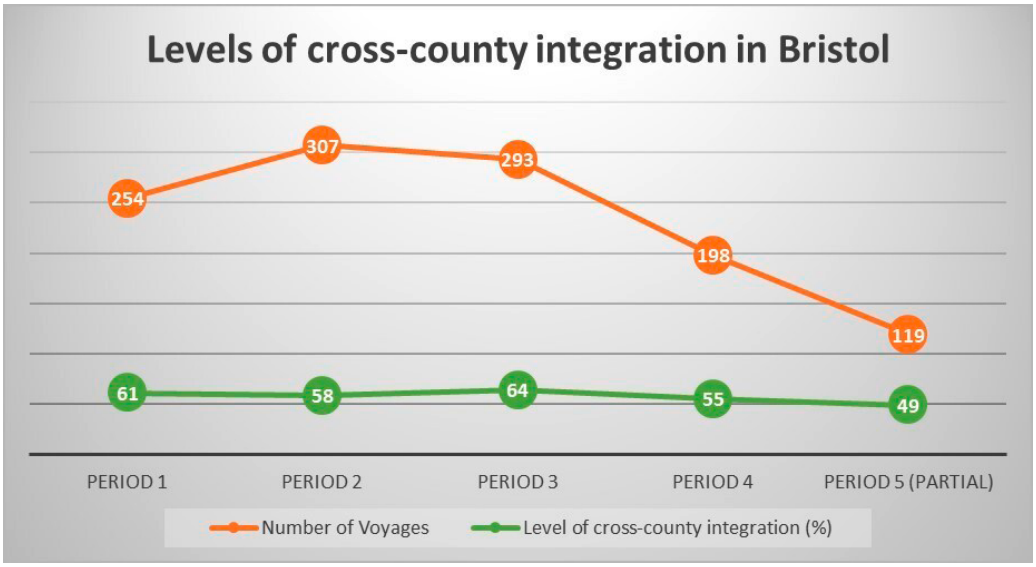


Fig. 2 Graphs showing the correlation between levels of trade and levels of cross-county integration. (Level of cross-county integration was calculated by determining the percentage of nodes that had an individual from outside their own affiliated county within their first order zone.)

been controlled by foreign traders.[34] As such, Bristol merchants were primarily concerned with overseas trade and largely left domestic exchange in the hands of River Severn and Welsh traders, whereas in Southampton, a number of elite merchants from the port itself were deeply immersed in coastal commerce. Therefore, the biggest shift in cross-county integration in Southampton came from the influx of traders from other regions during periods of increased activity, whereas in Bristol the sporadic involvement of Bristol's mercantile elite caused the greatest shift. Since Bristol merchants had the networking power to draw in local traders, their presence on the coast had the effect of splitting up previously diverse networks, forming networks that were dominated by Bristolians, thereby reducing cross-county integration.

Moreover, we can take this a step further and evaluate the differences between particular groups that traded within specific port towns. For example, a similar analysis of particular subgroups within the town of Southampton shows that levels of overall trade through the port had a significant impact on levels of integration between Southampton and Sussex traders, whereas levels of integration between Southampton and Channel Island traders remained steady throughout the approximately ten-year period under investigation. This difference can again be attributed to the specific character of the trade between Southampton and those two regions. Whereas trade between Southampton and Sussex was highly sought after, being dominated by the supply of iron and ordnance sourced from the Sussex Weald, trade between Southampton and the Channel Islands relied on the provision of low-value essential products (such as beer and firewood) to the Islands and was therefore of less significance to outside traders.[35] As a result, Channel Island trade was consistently dominated by islanders, whereas trade with Sussex made an appealing commercial activity for those seeking to operate within the region during periods of economic growth.

Such trends have a marked impact on our understanding of early modern commercial communities and have significant implications for historians of the sixteenth century beyond the maritime world. Not only can we use levels of cross-county integration to understand the personal business activities of individual

34 See, among others, Eleanora M. Carus-Wilson, "The Merchant Adventurers of Bristol in the Fifteenth Century," *Transactions of the Royal Historical Society* 11 (1928): 61–82, https://doi.org/10.2307/3678539; Eleanora M. Carus-Wilson, "The Overseas Trade of Bristol," in *Studies in English Trade in the 15th Century,* ed. Eileen E. Power and Michael M. Postan (London: Routledge, 1933), 183–247; Coleman, "Trade and Prosperity," 9–22; Jones, *Inside the Illicit Economy;* Leanna T. Parker, "Southampton's sixteenth-century illicit trade: An examination of the 1565 Port Survey," *International Journal of Maritime History* 27 (2015): 268–84, https://doi.org/10.1177/0843871415578392; Ruddock, *Italian Merchants,* I, 268.

35 Brinkley, "Elizabethan coastal trading," 52–55,61–65.

shipmasters and merchants, but we can use that measure to gain a broader insight into the commercial nature of port towns and of port communities, impacting our broader understanding of early modern society. Without visualisation of the port book data in the form of network graphs, such trends would be very difficult to identify or to quantify, and we could only guess at the impact that the broader commercial history of these towns had on the communities that operated within them. There is not space here to examine the various other examples that could be highlighted in support of this suggestion, but it is evident from these two examples alone that a combination of SNA and economic analysis can offer a powerful insight into otherwise invisible trading communities. In turn, improving our understanding of how such communities operated serves to extend our comprehension of the broader commercial nature of English maritime trading, substantially strengthening the historiography and counterbalancing an oversight in the existing scholarship.

1.4 Research Stream 2: The commercial strategies and business networks of coastal traders

Similar principles also apply to the application of SNA to commercial strategies and trade networks. For example, in isolation, the various forms of shipmaster-merchant interaction that were evident in the network graphs generated mean very little, but when corroborated with historic evidence they represent key commercial strategies for the establishment of particular forms of maritime career. For simplicity, these forms of interaction were categorised into three types, which are displayed in Figure 3 and can be described as follows:

Type 1
Individual shipmasters who catered for numerous unconnected merchants (i.e. one green node surrounded by various pink nodes).

Type 2
Individual merchants who employed the services of numerous unconnected shipmasters (i.e. one pink node surrounded by various green nodes).

Type 3
Larger networks containing numerous shipmasters and merchants.

Type 1 and 2 networks did not usually involve the formation of long-lasting business partnerships and, instead, short-term network ties were formed on the basis of a single voyage. However, Type 3 networks were larger and more complex, and usually involved various forms of interaction, often revolving around the most integrated members of the port's maritime community. In addition, networks that formed a star or a kite shape represented voyages on which merchants shared hull space.

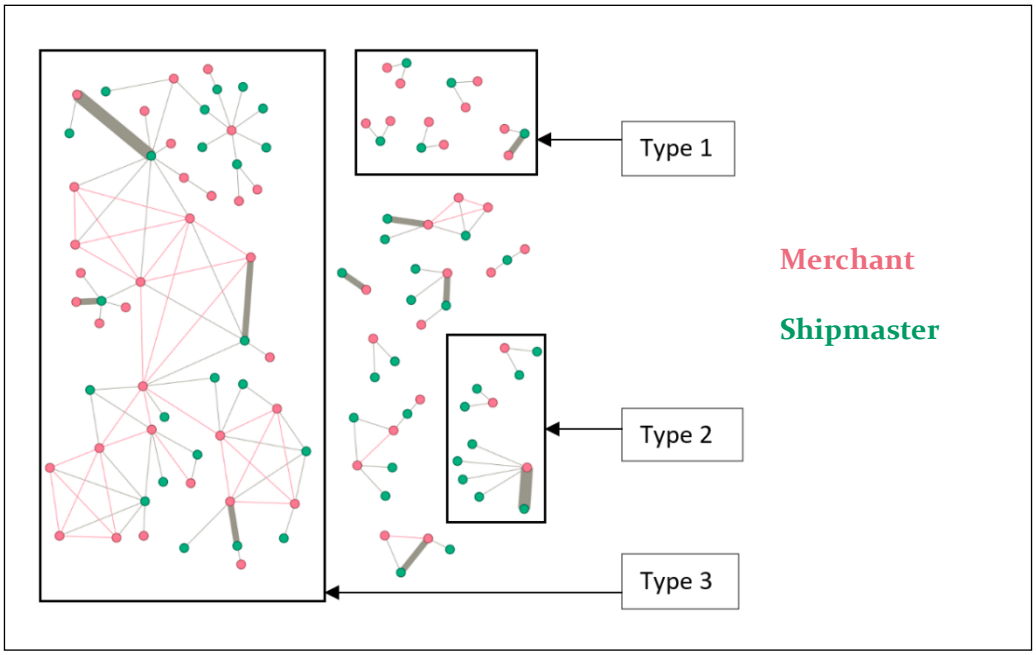


Fig. 3 Common forms of interaction present in coastal trading networks

These forms of engagement were not present in every graph and were by no means representative of every possible form of interaction between shipmasters and merchants, but they were particularly common network structures and serve as a useful reference for analysis of particular commercial trends or case study groups. For example, if we turn back to Hull, where we saw above there was a clear commercial divide between those engaged in the lucrative London trade and those involved in the lower-value trade in Newcastle coal, we see a well-defined split in the structure of the network graphs surrounding those trades. While coal traders tended to act in the dual-capacity of shipmaster and merchant, and thus formed very limited commercial networks, London traders represented the key members of the mercantile elite in Hull and thus formed large and well-connected Type 3 networks. Moreover, when we examine the lives and careers of primary characters in the large London networks, we see that they were wealthy, politically-inclined, and key nodes in the socio-economic character of the port. As a result, they were well placed to forge network ties with individuals from across the region and attracted shipmasters keen to find a place among the mercantile elite, much like the Bristol elite discussed above.

Importantly, this division also applied to other forms of coastal activity through Hull. In particular, individuals from outside of Hull who engaged in *ad hoc* trade through the port tended to operate within Type 2 networks, hiring shipmasters on a voyage-by-voyage basis for specific shipments. As voyages of this kind did not represent a permanent presence in the port but were rather reactionary ship-

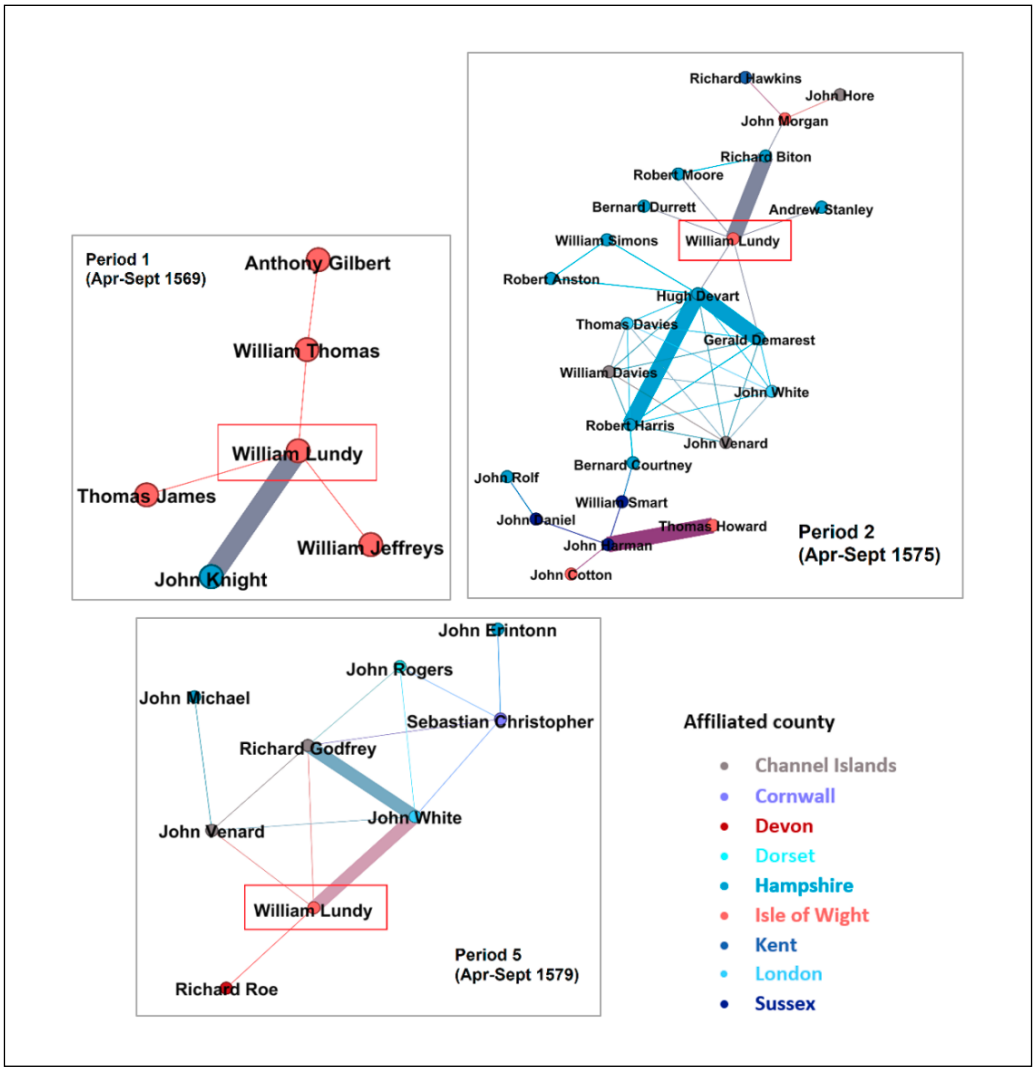


Fig. 4 Select network graphs showing network ties of shipmaster William Lundy.

ments in response to particular demands, few shipmasters specialised on those routes, and thus commercial relationships were formed on the basis of a single trip, rather than an established partnership. Again, the visual representation of the data in the form of network graphs highlighted the structural trends in the commercial relationships that were formed, but until a strong understanding of the commercial nature of the region within which they formed was established, these offered limited historical value.

This was also true in terms of trends pertaining to specific individuals or social groups. For example, the ego-networks of particular individuals helped to qual-

ify an implied commercial shift or personal career development. For instance, the case of shipmaster William Lundy can be used to exemplify the impact that purchasing a vessel could have on the ability of shipmasters to expand their businesses. As shown in Figure 4, Lundy was an Isle of Wight shipper who began the period under investigation with limited reach, but who managed to extend his network extensively over the 1570s, such that by 1579 he was able to collaborate with prestigious London merchant John White.[36]

Lundy was an active member of the maritime community in Southampton and he likely had a strong reputation as a desirable hire. However, the data also suggests that Lundy was a shipowner and that, between Periods 1 and 2, he upgraded from the 10-ton *Mary* to the larger 16-ton *Hare,* both of Newport.[37] This change in vessel correlated with the extension of Lundy's network beyond Isle of Wight traders and suggests that his desirability as a mariner was accelerated by his access to an appropriate ship. This example alone is insufficient to suggest a broader trend but, in conjunction with other case studies demonstrating similar themes, there is much basis to suggest that ownership of a vessel could increase the networking power of local mariners.[38]

Building on the findings of Stream 1, which focused on the broad character of particular regional and local commercial enterprise, Stream 2 focused in more detail on the individual business strategies adopted by merchants and mariners in their quest to establish lucrative maritime businesses. The findings of Stream 2 were contextualised by the findings of Stream 1, providing explanations for the operational approaches utilised by particular seafarers within their specific commercial activities. In this way, a combined methodological approach again enabled for detailed examination of a generally overlooked subgroup, such that the findings contributed to our broader understanding of the early modern merchant marine. Importantly, we can use similar techniques to identify other key events in the lives of traders that impacted the formation of the networks in which they operated, as well as to establish the correlation between particular socio-economic and socio-political themes and network formation.

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36 Brinkley, "Elizabethan coastal trading," 149.

37 While ship ownership is difficult to determine using the port book data alone, various scholars have demonstrated that coastal shipmasters were especially likely to own the vessels they utilised, particularly when those vessels measured under 50 tons. Thus, exclusivity in ship usage over several years is a good indication that an individual either owned or had an interest in that ship. Throughout the 1560s, all of Lundy's voyages with numerous merchants were carried out on the *Mary;* then, throughout the 70s, he mastered only the *Hare.* See, Andrews, "Elizabethan Seaman," 257; Brinkley, "Elizabethan coastal trading," 31–32; Kowaleski, "The Shipmaster as Entrepreneur in Medieval England," 165–82.

38 Brinkley, "Elizabethan coastal trading," 144–45, 95, 99–200.

1.5 Research Stream 3: The socio-economic and socio-political position of coastal traders

Indeed, we can find numerous examples of particular socio-economic and socio-political changes impacting the networks through which coastal trading was undertaken. For instance, in Southampton, Channel Island mariner Peter Janverin ended the 1560s well integrated with a community of Channel Island seafarers who engaged in frequent trade through the port of Southampton, as shown in Figure 5. On closer inspection of local civic records, it is clear that Janverin was well placed to forge successful business ties with a broad range of seafarers in the region, being a merchant of significant standing on the island of Jersey and marrying into a Southampton innkeeping family in 1566, thereafter acting as landlord to a high-status Southampton inn.[39]

However, Janverin's inclination to operate as a shipmaster within Channel Island networks only endured for a limited period and the longer he acted in the capacity of landlord, the more integrated he became into the Southampton community, taking up minor political offices and forging network ties with Southampton merchants for his overseas activity.[40] From the perspective of Janverin's personal career progression, the transition from local domestic exchange within Channel Island networks to long-distance overseas trade among Southampton merchants represented significant professional growth. However, from the perspective of the coastal trading networks under examination here, Janverin's departure had a significant knock-on impact on those who continued to trade between the mainland and the Islands. In fact, Janverin appeared so infrequently in the Southampton coastal port books after 1569 that he was excluded from the subsequent network graphs. As a result, the islanders that remained formed smaller networks and began to engage in a limited capacity with some Southampton traders, as shown in Figure 6. Such trends were very common in the world of coastal enterprise, with many shipmasters and merchants only sporadically engaging in domestic trading activity. A large body of individuals embraced and abandoned the industry with regularity, often resulting from personal social and economic changes. This meant that personal circumstances and individual decision making could have a significant impact on the broader trading activities of the port community, and even more so in the case of domestic trade than in overseas activity, where the threshold for participation was low and where individuals with other career paths would occasionally partake as an aside to their routine trade.

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39 Cheryl Butler, "Peter Janverin (1559–1596)" in *The Southampton Tudor Project: From Records to Revels,* accessed 2 November 2020, http://www.tudorrevels.co.uk/records.php.

40 Butler, "Janverin".

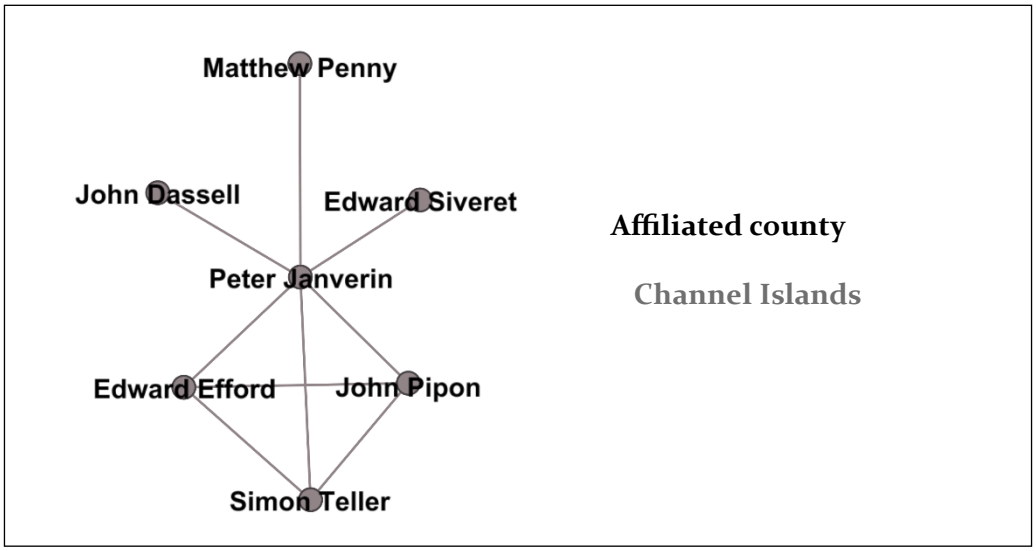

Fig. 5 Networks graph showing network ties of shipmaster Peter Janverin in Apr–Sept 1569

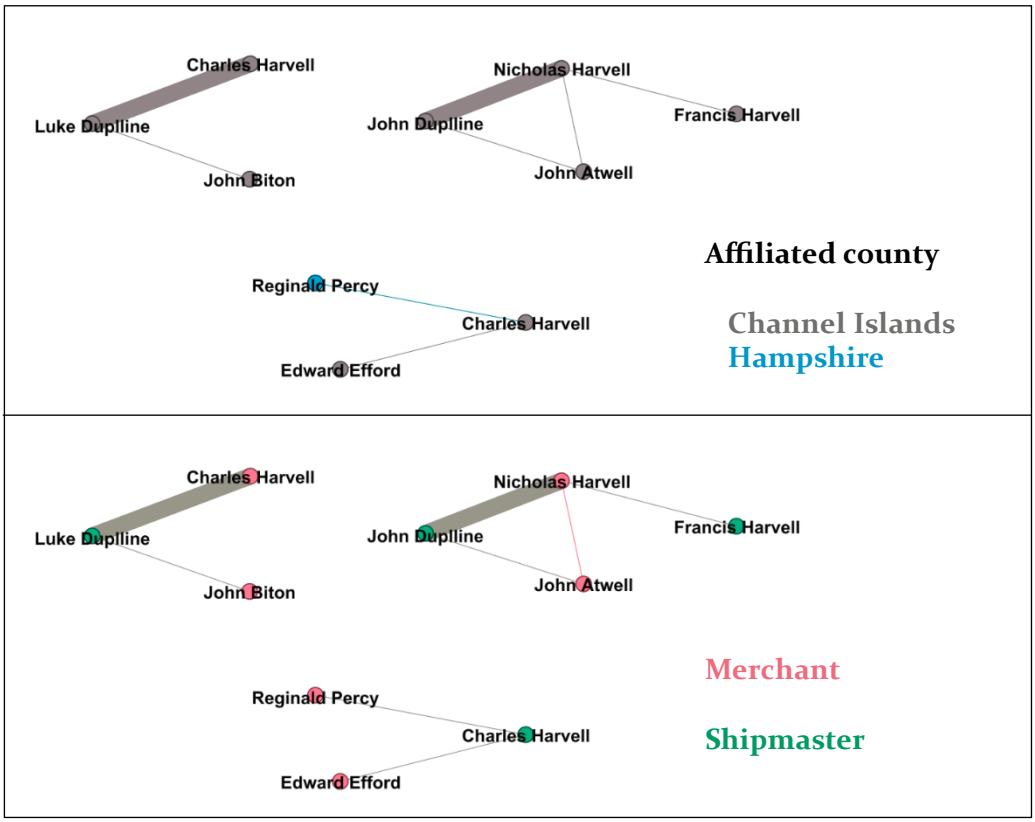

Fig. 6 Networks involving members of the Duplline and Harvell families of Alderney (Apr–Sept 1577)

Furthermore, aside from the commercial trajectory of particular coastal networks, the familial ties and residencies of coastal traders often impacted their fundamental structure. For example, Figure 6 shows several networks that included members of the Duplline and Harvell families of the Channel Island of Alderney, which suggest that Harvell merchants had a standing partnership with Duplline mariners, whom they favoured as their shipmasters.[41] The forging of strong ties between merchants and their chosen shipmasters was a fairly common form of engagement among career coastal traders (although it was less common among those who dabbled in coasting only occasionally). However, this case stands out since the structure of the network and the form of shipmaster-merchant engagement was a common thread throughout the familial unit, rather than being an individual business strategy. This suggests that these family groups were operating as established commercial units, sharing business contacts and operational approaches and, as a result, operating in similarly structured commercial networks.

Moreover, such similarities also ran through other family groups operating on the English coast. For example, in the case of the Courtney family of Hampshire, merchants Bernard and William Courtney both engaged with other Hampshire shippers for the majority of their coastal activity but formed specific 'Sussex-branches' of their business networks in order to facilitate trade into Sussex, as shown in Figure 7. This example again suggests that, in some cases, the means through which individuals engaged in coasting was consistent among family units. This is an important finding within the field of maritime history, as it aligns the business approaches of coastal traders with those of large-scale overseas merchants, indicating that seafarers operating in domestic waters approached their craft with sensible business strategies that were uniform across commercial units.

Likewise, similar analysis of the port books in Bristol suggests that traders who appeared in the same networks very often resided within the same areas of the port. This is evident in Figure 8 and suggests that propinquity played some role in the formation of network ties. Like in the case of the family units above, individuals who resided in the same parts of the town seem to have shared business contacts and formed intimate networks operating on the same trade routes and participating in the same commercial activity. This supports the findings of other early modern historians, who have found that individuals engaged in the same commercial activity or craft tended to gravitate to the same parts of the towns in

41 There is limited substantiating evidence that the Harvells and Dupllines listed here were members of the same families. However, given that they haled from the small island of Alderney, occupied the same trade routes, carried the same commodities, utilised the same vessels, and engaged with the same shippers, it is highly likely that they were. TNA E190/1128/12 f.15v, E190/1128/13 f.21r, E190/814/7 f.3v, E190/814/12 f.8r, 9v, E190/815/1 f.1r, 2r, 3v–5r, E190/815/2 f.4r–6v, 8r, E190/815/8 f.4r–5v.

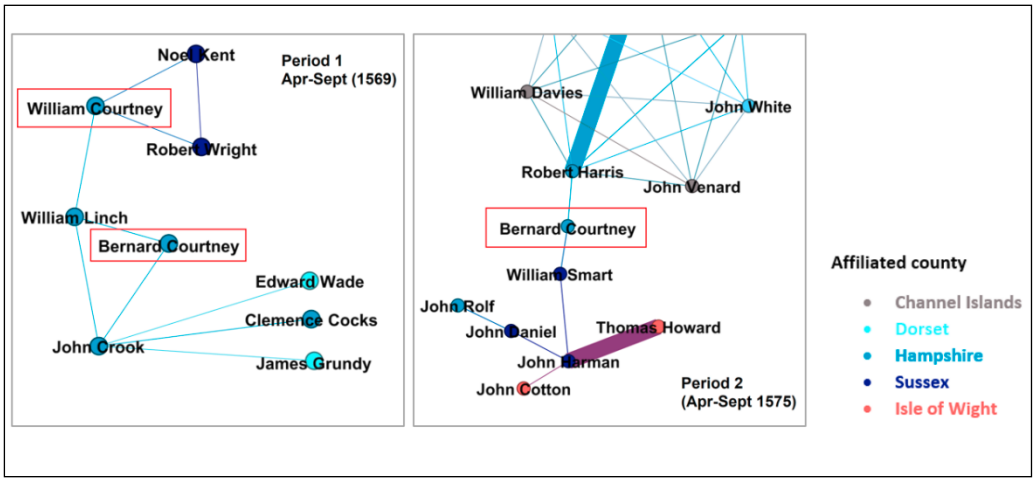

Fig. 7 Select network graphs showing the network ties of William and Bernard Courtney

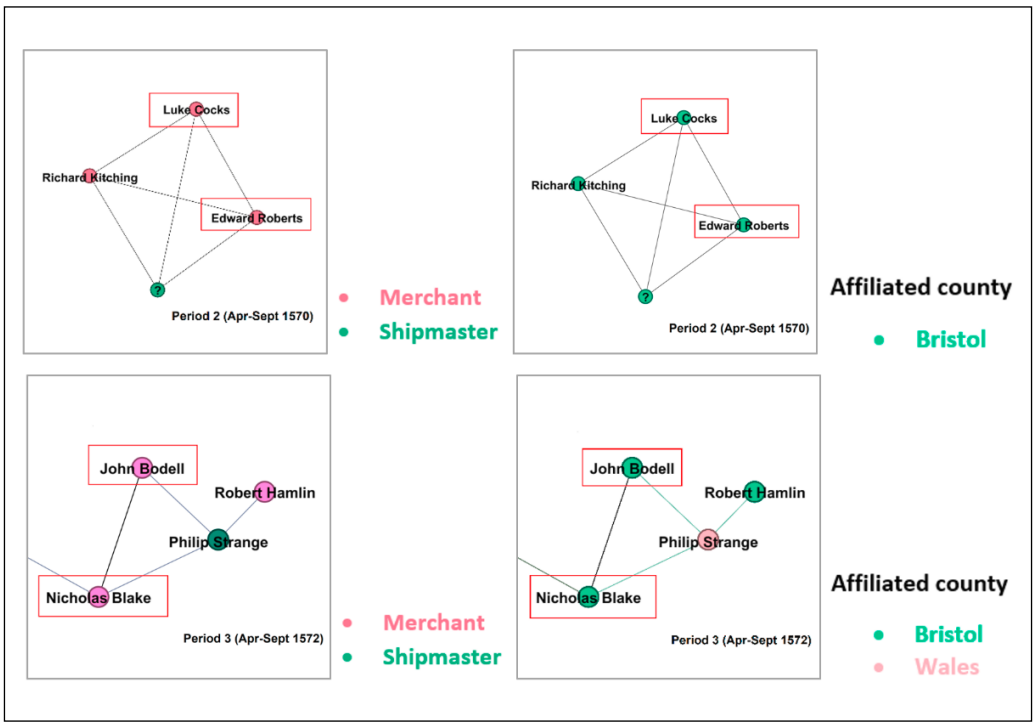

Fig. 8 Select network graphs showing multi-merchant voyages undertaken through the port of Bristol (John Bodell and Nicholas Blake both resided in the ward of Mary le Port, and Luke Cocks and Edward Roberts both lived in Redcliff Ward). (TNA E179/115/373 mem. 2, 3., E179/115/386 mem.6)

which they resided.[42] Such patterns are easily discernible within a large dataset through the application of SNA in collaboration with prosopography and can add much to our understanding of early modern society.

In combination, these brief examples serve to demonstrate that utilising SNA alongside detailed examination of customs records and local civic sources can allow us to form a broad understanding of the types of interactions that facilitated coastal commercial activity in early modern ports. Like each of Streams 1 and 2, the application of a combined methodological approach allowed such findings to be easily identified, to be quantified by numerical data, and to be qualified by a prosopographical examination of case study communities, adding valuable findings to the existing body of historiography and exposing the lives and careers of a poorly represented commercial group.

1.6 Conclusions

The methodological approach described in this paper can be characterised as network prosopography. It utilises SNA as one of several strands of analysis to reveal the collective commercial, social, and economic character of a little-known but hugely important early modern community. While the early modern customs records have been extensively studied, and many historians have guessed at the nature of coastal commercial enterprise, re-examination of the port books within the specific context of coastal trading has allowed for investigation of a group that is largely ignored or disregarded in the historiography and that is difficult to access using the qualitative sources that survive. Examination of the customs records using SNA has enabled the exploration of both broad overarching trends and trends specific to particular individuals or social groups, such that our wider understanding of the Tudor marine is generally improved. This method has allowed for the formation of wide-reaching conclusions regarding the social composition of the coastal workforce, of the operational means through which coasting was undertaken, and of the broader impact of coastal commercial activity on Elizabethan society. Many of these trends only become apparent through the visualisation of data in network graphs and this dual-approach allows for quantification of historic trends alongside more traditional prosopographical evaluation.

42 For example, see Fury, "Elizabethan Maritime Community," 117–39; Lambert, "Tudor Shipmasters," 315–41; David Sacks, *The widening gate: Bristol and the Atlantic economy, 1450–1700,* vol. 15 (California, USA: University of California Press, 1991), 147–53.

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The Presbyterian International and the Case of Robert Cowan

A Study in Robust Action, c. 1710–34

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Keywords Ethnic Networks; Intra-Asian Trade; Presbyterian International; Robert Cowan; Robust Action

Abstract This article examines the career progression of Sir Robert Cowan, governor of Bombay (1729–34), during the years c. 1710–34. This is undertaken as an exercise in the application of ethnic commercial networks in the early eighteenth century, incorporating aspects of organizational science, such as the robust action theory and the concept of grand challenges. The focus lies on the discussion of a defined Ulster-Scots ethnic network termed the 'Presbyterian International', which is then linked to East India Company gentlemanly capitalist networks orchestrated by the patrons and familial links of Cowan, and other aspiring privately interested traders. It is argued that Cowan's successful Company career was based on his interpersonal relationships within these networks, providing him with necessary patronage and capital and therefore enabling him to follow both Company as well as his private trading interests. Moreover, it will be demonstrated how regional networks, governed by established customs and traditions, had the potential and means to access global markets and exert control.

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I. Introduction*

It may be said that the study of networks, and the theory surrounding them, can be broadly categorized as seeking to explain two generic outcomes. First, that of the choice taken, whereby the merits of comparable decisions at a given time are analyzed based on the possible results. The associated behaviors, attitudes, and actions come under the heading of social homogeneity, in which the preferences of individuals in a society are judged based on how alike they are. Second, the rate of success, which is understood in terms of social capital through action and reward. A network is a construct with a specific meaning and purpose, understood through a series of linked nodes, which is utilized for a series of actions. As Borgatti and Halgin have noted, however, it is the scholar, by choosing a set of nodes to study, who comes to more fully define a network.[1] This concept is a key consideration for the current study due to the aim of overlaying the career of Robert Cowan onto the concept of the proposed 'Presbyterian International' and considering his progression in terms of gentlemanly capitalism.[2] Recent research into the life and career of Cowan during his East India Company employment has demonstrated how he benefitted from landed gentlemanly capitalist networks, which provided him with the patronage and capital necessary to have a successful Company career in South Asia.[3] These networks were based in London, Dublin, and Londonderry, with the link between London and Irish landed interests being a key element of the present study. Familial and interpersonal links between Cowan, Ulster-Scots ethnic patrons, and multivocal Company interests in London are of particular interest in order to connect Cowan and the Presbyterian International to the gentlemanly capitalist order. Due to the multifaceted nature of early modern commercial networks, particularly that of Cowan, strategies, such as examination through robust action, are, it is argued, an effective way of more thoroughly unraveling networks and their functions.

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1 Stephen P. Borgatti and Daniel S. Halgin, "On Network Theory," *Organization Science* 22, no. 5 (2011): 1169.

2 The theory of gentlemanly capitalism, first put forward by Peter Cain and Antony Hopkins, argues that the British imperial project was driven by landed capital and London commercial interests. This viewpoint emphasizes the role of privately interested city finance in the expansion of empire.

3 Edward Owen Teggin, "The East India Company Career of Sir Robert Cowan in Bombay and the Western Indian Ocean, c. 1719–35," (PhD diss., Trinity College Dublin, 2020), 258–61.

By explicitly choosing Cowan and his wider ethnic network connections to act as nodes in the present study, the current understandings of regional trade as subsets of a much wider trading apparatus will be re-examined, which at the same time demonstrates the utility of emerging letter archives in the study of early modern commercial networks. The Cowan Papers, Cowan's personal archive, are held at the Public Record Office of Northern Ireland, Belfast, and contain approximately 3,000 individual documents. Encompassing a date range of 1719–35, this archive spans Cowan's entire career in the western Indian Ocean. The archive, as a collection of papers belonging to a privately interested Company servant, is of course subject to numerous biases. The strong Anglocentric perspective is an important consideration here, with the archive strongly aligned to personal and Company interests. Whereas the collection is for the most part written in the English language, there are also examples of documents in French, Portuguese, and several northern Indian languages. Of the latter, these are most likely Gujarati or other indigenous languages used in early modern South Asian commerce. This large, and as yet underused, archive can be used as a tool for a wide range of interdisciplinary investigations into early modern empire. Whilst the archive's existence has been flagged by scholars such as Ashin Das Gupta and Om Prakash, the full potential of the collection has yet to be realized.[4] The present study is merely one example of how rich a source for focused axial studies it can become. As mentioned above, the broad date range for Cowan's archive is 1719–35, though this can be widened to 1680–1750 with the inclusion of relevant documents from the National Archives, Kew, and the British Library, London. The geospatial range covers South Asia, the Middle East, China, and Southeast Asia.

It has been suggested that Cowan, and indeed others like him, benefitted from ethnic commercial networks which sought to propagate the interests of culturally, religiously, and familiarly linked individuals.[5] In the case of Cowan and his Ulster-Scots dissenting[6] background, he appeared to thrive within a networked association of transnationally interested parties of what may be called the 'Presbyterian International'. This, it is argued, constituted an aspect of what Padgett

4 See also, Ashin Das Gupta, *Merchants of Maritime India, 1500–1800* (Aldershot: Variorum, 1994); Om Prakash, "English Private Trade in the Western Indian Ocean, 1720–1740," *Journal of the Economic and Social History of the Orient* 50, no. 2/3 (2007): 215–34.

5 David Hancock, "Combining Success and Failure: Scottish Networks in the Atlantic Wine Trade," in *Irish and Scottish Mercantile Networks in Europe and Overseas in the Seventeenth and Eighteenth Centuries,* ed. David Dickenson, Jan Parmentier and Jane Ohlmeyer (Gent: Academia Press, 2007), 14–5.

6 Dissenters, in the history of the Anglican church and English state in the seventeenth and eighteenth centuries, refers to sects of Protestant Christians who opposed state interference in religious matters and founded their own religious communities in opposition to the Anglican church. Restrictions on public employment and rights were imposed upon those who did not take communion in the Anglican church.

and Ansell have developed as the theory of robust action.[7] Robust Action accomplishes short-term objectives while preserving long-term flexibility. It is comprised of non-committal actions that keep future lines of action open in strategic contexts where opponents are trying to narrow them. The theory's innovation was the creation of a means to differentiate active and politically relevant communities in fifteenth-century Florence through variables, such as kinship and financial, political, and patronage networks, in order to define the boundary of the Florentine elite. In this way, the structure of elite communities in Florence was reimagined, similar to the present undertaking with the example of Robert Cowan. Moreover, the style of control used by the Medici patriarch, Cosimo, in which actions seemed to benefit him without necessarily being attributed, led his behavior to be labeled as robust action. This method of control is evidenced in Cowan's chief patron, John Gould Jr., in his dealings with Cowan in empire, which once again makes it an important point for this study.

Necessarily, by invoking the argument that robust action was involved in the orchestration of what may synonymously be termed the 'Cowan network' or the 'Presbyterian International', the notion that 'grand challenges' were involved must be incorporated into the below discussion.[8] Whilst recent scholarship, particularly that by Ferraro, Etzion, and Gehman, has focused on robust action being used to tackle such grand challenges as climate change and international financial movements, the malleability involved in the term grand challenges – ironic, given the commonly understood immutability of the problem of grand challenges – enables a more focused discussion.[9] Whilst networked individuals and organizations in the early modern context did not necessarily act in the public interest, or indeed for an overtly identifiable purpose, they banded together in order to create solutions to problems which, when confronted, displayed many characteristics of grand challenges. Perhaps the most obvious facet of this was the concept of uncertainty, tied into risk. This has been highlighted as the radical form of uncertainty associated with grand challenges; effectively, the concept of Knightian uncertainty.[10] The justification and discussion for the use of robust action theory in this context shall be examined further below.

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7 John F. Padgett and Christopher K. Ansell, "Robust Action and the Rise of the Medici," *American Journal of Sociology* 98, no. 6 (1993): 1263.

8 See also, Matt Levy *et al.,* "Robust Action Strategies in a Connected but Unequal World: Revisiting American Pragmatism for Social Justice Focused Research in Information Systems," *Communications of the Association for Information Systems* 47 (2020): 113–39.

9 Grand Challenges are to be understood as difficult but important problems that are more than ordinary questions and capture the imagination of the audience. They are global problems that can be addressed though collaboration. See also, Stephen Brammer *et al.,* "Grand challenges in management research: Attributes, achievements, and advancement," *Australian Journal of Management* 44, no. 4 (2019): 517–33.

10 Fabrizio Ferraro, Dror Etzion and Joel Gehman, "Tackling Grand Challenges Pragmatically: Robust Action Revisited," *Organization Studies* 36, no. 3 (2015): 366; Frank H.

In demonstrating the inherent links between Irish landed gentlemanly capitalist interests and the wider global trading sphere through Cowan's involvement in the intra-Asian trading world, the Cowan archive has served to highlight the multivocality of Cowan network nodes.[11] The Presbyterian International interest in the Atlantic wine trade, in which large numbers of ethnic Scottish merchants engaged in the trade of Madeira wine between 1700 and 1815 was, it is argued, a stepping stone towards the far more lucrative prize of intra-Asian trade, though certainly one which was also profitable in its own right. This profitability was largely made possible by the signing of the Methuen Treaty in 1703, which shall be elaborated upon in the following section, serving to more closely tie English and Portuguese commercial strands together. The wine trade, it will be argued, served as a preliminary association for Cowan into Margot Finn's highly networked familial proto-state discussion. This associated the Cairnes–Gould nexus, a function of the wider Presbyterian International network consisting of two influential families important for Cowan's career, with regional trading structures acting as a laboratory for commercially-networked trading apparatuses in early modern empire.[12] The idea of a laboratory-esque structure for Irish involvement in trade and empire is nothing new, with Ireland being seen as a laboratory for empire used by the British.[13]

2. The Presbyterian International

Robert Cowan was born c. 1680–90 in Londonderry. His family was of Scots-Presbyterian descent, having been based in Londonderry since the early seventeenth century.[14] As such, it was likely that his family traveled to Ulster from Stirling in Scotland, post-1609, as part of the plantation of Ulster under King James VI & I. Cowan's father, John, was a merchant, landowner, burgess, and alderman in the

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Knight, *Risk, Uncertainty and Profit* (Boston and New York: Houghton Mifflin Co., 1921), 19–20.

11 Multivocality signifies having many meanings, understandings or narratives. The suggestion is that it can be difficult to ascertain which interest is being acted in at which time. See also, Margaret C. Rodman, "Empowering Place: Multilocality and Multivocality," *American Anthropologist,* New Series 94, no. 3 (September 1992): 640–56.

12 The familial proto-state argument ties the idea of family into elements of the 'new' imperial history by making the role of family instrumental in understandings of capital creation, race and colonial mentalities. Effectively, the family and kin-network informed the individual as to expected behaviour, loyalty, hierarchy, and identity. See, Margot C. Finn, "Family Formations: Anglo India and the Familial Proto-State," in *Structures and Transformations in Modern British History,* ed. David Feldman and Jon Lawrence (Cambridge: Cambridge University Press, 2011), 101–3.

13 Jane Ohlmeyer, "Ireland, India and the British Empire," *Studies in People's History* 2, no. 2 (2015): 169–70.

14 Robert Cowan, Letter to William Cowan, Bombay, 8 January 1734, Cowan Papers, D654/B/1/2D, f. 80v, Public Record Office of Northern Ireland, Belfast.

city of Londonderry from 1693 to his death in 1733.[15] Cowan's identity was thus that of an Irish dissenter, though it must be acknowledged that he did not express any firm religious views in his correspondence. Dissenters were Protestant Christians, such as Ulster-Scots Presbyterians, who were outside the church of England and did not take communion under its auspices. The Sacramental Test, introduced in January 1704, required all those serving in civil or military office to receive the sacrament in the established Anglican church once a year. Here, the concept of an Irish ethnicity apart from the ruling English identity was important, and demonstrates that dissenters such as Cowan were outside of mainstream politics and limited in their choice of profession. The example of Cowan's father, John, being removed from the office of Mayor in December 1703 due to his dissenting background is a good example of this.[16] However, through connections to powerful London and East India Company figures via an ethnic or familial network, such barriers to advancement may have been overcome. The Company, being a body politic and not an organ of the state, was able to choose which individuals to patronize through the circumvention of established norms, which is why the concept of ethnicity is important in this discussion. Further, this argument lines up with Craig Bailey's assumptions about Ireland acting as a place for ethnic patronage networks to connect to the British imperial world and in turn feeds into the gentlemanly capitalist order.[17]

In the context of the Presbyterian International structure, the proposed timespan ranges from c. 1660–1778. This takes in the early modern political repression faced by Catholics and Dissenters under the Penal Laws.[18] As such, effective collaboration to bypass restrictive legislation was a key aim of the Presbyterian International. To justify the interdisciplinary use of robust action and incorporation of the Cowan archive into the current discussion surrounding the existence of the Presbyterian International, the argument must be considered in terms of agency. The concept of robust action requires that ambiguous action leads to a series of events and results that 'just so happen' to benefit the network's agency.[19] Cowan's agency in this can be demonstrated by his numerous declarations of gratitude for patronage and promises to act in his patrons' inter-

15 Londonderry Corporation Minute Books, Volumes 1–4, MIC440/1, PRONI, Belfast.

16 Londonderry Corporation Council Meeting, Londonderry, 7 December 1703, Londonderry Corporation Minute Book, Vol. 2, f. 240, MIC440/1, PRONI, Belfast; Londonderry Corporation Council Meeting, Londonderry, 21 Dec. 1703, Londonderry Corporation Minute Book, Vol. 2, f. 241.

17 Craig Bailey, "Metropole and Colony: Irish Networks and Patronage in the Eighteenth-Century Empire," *Immigrants & Minorities* 23, nos. 2–3 (July–November 2005): 163.

18 The Penal Laws were a series of edicts enacted in an attempt to force Irish Catholics and Protestant Dissenters to accept the Anglican Church. These laws severely limited access to education, land rights, official service, and marriage recognition.

19 Padgett and Ansell, "Robust Action," 1263.

est.[20] The construction of his own private patronage network in India, arising out of his patronage benefits, was also tied to this.[21] This could certainly be seen as nothing more than verbal pleasantries, but that is also rather the point. According to the theory of robust action, individuals are too intelligent not to see through such words; however, Cowan successfully made the correct statements and did not divulge what he really sought to achieve.[22] As such, an effective presentation to the audience was required.[23] Therefore, his actions can be judged in terms of his zeal in protecting the Company's interests at Surat (1722) and Mocha (1724–7), when the Company was defrauded by native brokers and merchants, and his successful private trade at the same time.[24] Whereas Cowan bemoaned his private trading prospects at Mocha in particular, what can actually be witnessed is a thriving personal trade from the Red Sea to China, the Maldives, and South East Asia.[25]

The concept of ethnicity, the belonging to a social group with shared national or cultural traditions, in the context of such networks warrants further discussion. The Ulster-Scots Presbyterian identity held by Cowan and many of his networked contemporaries derived from the above-mentioned historic plantation of Ulster during the years 1603–25. In other words, the colonization of Ulster by the English government, with thousands of British protestants being transported in the early seventeenth century to settle lands in Ulster. Scots-Presbyterians, as with Cowan's ancestry, were a large part of this and over time became known as Ulster-Scots in order to designate their mixed ethnicity in Ireland. Michael Banton's interpretation of Max Weber's work holds that in many cases the decisive factor in individuals more easily associating with others was that, to an extent, they were unaware they were following established social conventions. As such, conventions functioned as differentiating factors for communities to distance themselves from others, particularly when seeking to capitalize on social and economic problems, which required a degree of collaborative effort.[26] This

20 Robert Cowan, Letter to John Courtney, Goa, 8 February 1721, f. 3v; Letter to Mrs. Gould, Surat, 20 April 1722, f. 141; Letter to John Gould Jr., Mocha, 8 Jul. 1724, ff. 3v–5.

21 East India Company Court of Directors, Letter to Governor and Council at Bombay, London, 27 February 1729, India Office Records, IOR/E/3/104, ff. 360v–361, British Library, London.

22 Padgett and Ansell, "Robust Action," 1307.

23 Stoyan V. Sgourev, "How Paris gave rise to Cubism (and Picasso): Ambiguity and fragmentation in radical innovation," *Organization Science* 24, no. 6 (2013): 1611.

24 Robert Cowan, Letter to William Phipps, Surat, 9 May 1722, f. 147; Letter to William Phipps, Surat, 22 May 1722, f. 149v; Letter to William Phipps, Mocha, 10 March 1725, f. 55v; Letter to William Phipps, Mocha, 25 April. 1725, f. 75v.

25 Robert Cowan, Letter to John Cowan, Mocha, 8 July 1724, f. 15v; Robert Cowan, Trading Accounts, 1724–5, D654/B/1/7B.

26 Michael Banton, "Max Weber on 'Ethnic Communities': A Critique," *Nations and Nationalism* 13, no. 3 (2007): 26.

understanding is reminiscent of solutions to grand challenges. Utilizing the belief in shared ethnicity allowed political communities, in particular pressure groups, to thrive. There was, it appears, a defined structural understanding of such actions, in that belief in these ethnic apparatuses strengthened constructs, and the existence of structures, be they imagined or otherwise, reinforced belief in them. Ethnicity, in this way, provided the means for a structural understanding, particularly through shared conventions, of a concept, such as the Presbyterian International.

The use of dissenting Irish contacts, connected to Scots-Presbyterian interests based in Belfast, was an important first step for Cowan as he strived for a commercial career. Therefore, he began participating in the Atlantic wine trade with Henry Cairnes.[27] This is in line with research into prominent Scottish-ethnic participation in the Madeira wine trade, which has stated that there was a growing number of Scottish wine distributors on Madeira during the eighteenth and nineteenth centuries. Indeed, between 1700 and 1815, there were a total of at least 929 individuals involved in the trade through purchasing, packing, and shipping on Madeira, with an estimated number of 66 (7.1 Percent) identifiable as Scottish.[28] Whilst this was not necessarily a large proportion of the total number, it did point to a specific commercial activity for Scottish trading interests in the Atlantic Ocean.[29]

While it was only later that the Irish joined the trade in greater numbers through their Atlantic connections, Cowan's Ulster-Scots ethnicity gave him the ability to join what was largely a Scottish trade. This implies the cooperation between Scottish Presbyterian and Ulster-Scots Presbyterian commercial interests. The connection between this grouping and London-based finance, through the alliance of the Cairnes and Gould families, which shall be elaborated upon below, comprised an aspect of the gentlemanly capitalist system whereby Ulster landed interests aligned with London capital and political power. Whilst Cowan was involved in the Atlantic wine trade with Cairnes, the fact that Irish merchants sought foreign enclaves through which to bypass trading restrictions was suggestive of his choice of Lisbon as the site of his trading house.[30] Likewise, the circumstances surrounding the already mentioned 1703 Methuen Treaty give an interesting perspective on Cowan's operation at Lisbon.

27 Fitter vs. Cairnes, Bill and Answer, 1718, C/11/2614/26, National Archives, Kew.
28 Hancock, "Combining Success and Failure," 9–10.
29 Jean Agnew, *Belfast Merchant Families in the Seventeenth Century* (Dublin: Four Courts Press, 1996), 108.
30 Barry Crosbie, *Irish Imperial Networks* (Cambridge: Cambridge University Press, 2011), 38.

The genus of the Methuen Treaty was in the commercial difficulties of the English woolens export trade.[31] Similarly, the Portuguese struggled to compete in the international sugar market.[32] The treaty itself guaranteed that duties on wine imported from Portugal would be one-third less than its French competition, whilst the Portuguese removed tariffs placed on English woolens.[33] Whereas the Methuen Treaty was a catalyst for trade between the two nations, the assumption that the trade with these goods was lacking in general, prior to the treaty, would be misplaced. The seventeenth-century Atlantic trade saw the import of French and Spanish wines, as well as sugar from the West Indies and tobacco from America.[34] This pointed to a defined and long-term engagement with the regional trade. Cowan's interest in the Atlantic wine trade was therefore unsurprising, but his connection to Cairnes was intriguing.

As Patrick Walsh has discussed, the Cairnes family was heavily involved in the Belfast corporation prior to the Sacramental Test and had well-established commercial and governmental links in Dublin and London.[35] At the same time as Cowan's father, John, was writing letters and carrying government documents to Dublin, William Cairnes was involved in correspondence between the Irish government in Dublin and Londonderry, suggesting an early connection between the two families.[36] This was further reinforced by the Cairnes family being linked to the powerful Irish dissenting landowner and member of Parliament, John Conolly, who also held large landed interests at Limavady in County Londonderry. A further Cowan connection can be added to this, with Cowan's father, John, having held lands at lease in the Limavady area at this time.[37] Walsh has highlighted Conolly as holding numerous multivocal political and commercial interests in Londonderry and beyond in the late seventeenth and early eighteenth centuries, controlling local affairs through both his local standing and via patronage hierarchies, which he accessed through his revenue office service. With

31 Signed 27 December 1703 between England and Portugal, the treaty came about as part of the War of the Spanish Succession (1701–14). The treaty, in two parts, more clearly defined the war aims of securing the Spanish Empire for Charles of Austria (r. 12 October 1711–20 October 1740) and laid out trading concessions on wine and woollens between England and Portugal.

32 A. D. Francis, "John Methuen and the Anglo-Portuguese Treaties of 1703," *Historical Journal* 3, no. 2 (1960): 103.

33 Charles Ludington, *The Politics of Wine in Britain: A New Cultural History* (New York: Palgrave Macmillan, 2013), 2.

34 Agnew, *Belfast Merchant Families,* 108.

35 Patrick Walsh, *The South Sea Bubble and Ireland: Money, Banking and Investment, 1690–1721* (Suffolk: Boydell & Brewer, 2014), 47–8; 51–2.

36 Londonderry Corporation Council Meeting, Londonderry, 26 Sept. 1699, Londonderry Corporation Minute Book Vol. 2, f. 174, Public Record Office of Northern Ireland (PRONI), Belfast; 2 January 1700, ff. 178, 184.

37 Conveyance between John Cowan and William Ross, Londonderry, 4 Nov. 1715, (PRONI, Londonderry Papers, D654/D/2/A/14).

Conolly an MP and thus part of the Irish Whig network of Sir Robert Walpole's government,[38] in tandem with the Cairnes–Gould commercial interest linking Ulster and London, it can be said that dissenting Irish interests combined to the benefit of chosen individuals, who were incorporated into their network as nodes.[39] This can be described as gentlemanly capitalism at work.

Cowan's acceptance into this Ulster-centric commercial network was thus a useful stepping stone towards his entry into the wider East India Company apparatus later in his career, particularly given the Cairnes' marriage links to the powerful Gould family in London, with Nathaniel Gould being the father-in-law of Sir Alexander Cairnes. The Cairnes connection tied commercial interests in Dublin and Belfast to the Gould family, thus ensuring a defined presence in both Ireland and London.[40] The Dublin connection also had another connotation for Cowan, however, in that Alexander Cairnes was involved in Dublin banking circles with Hugh Henry, a prominent banker for dissenting interests, and a man who Cowan used as the fulcrum of his cash remittances to Ireland.[41]

The East India Company connection is important here as both the Cairnes and Gould families were heavily involved in its operation, with the use of landed capital from Ireland providing the means to invest in the Company trade. This was an aspect of the gentlemanly capitalist order. The fact that John Gould and John Gould Jr. both sat on the Company's board of directors during the 1720s and 1730s also flags ample opportunity for Cowan and his ethnic network. Indeed, it may be said that the Company patronage structure itself offered the potential for robust action, given the highly personal bonding process in which new servants were proposed, and stood surety by, senior Company figures, therefore allowing for numerous loyalties within the Company hierarchy.[42] The suggestion being that an individual would likely act in his patron's interest ahead of the wider board of directors. This also allowed for the concept of the Presbyterian International to be active within Company networks. Cowan's own interpretation of this system was that more powerful patronage gave access to better positions and opportunities in India.[43]

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38 The Whig party were a British political party active between 1678 and 1859 which followed the tenets of British Liberalism. Sir Robert Walpole was the first Prime Minster of Great Britain (3 April 1721–11 February 1742).

39 Patrick Walsh, *The Making of the Irish Protestant Ascendency: The Life of William Conolly, 1662–1729* (Suffolk: Boydell Press, 2010), 114–5; 116–8.

40 Teggin, "Sir Robert Cowan," 46–51.

41 Robert Cowan, Letter to Henry Cairnes, Bombay, 25 December 1725, f. 127v; Letter to Henry Cairnes, Surat, 11 January 1726, f. 143.

42 Santhi Hejeebu, "Contract Enforcement in the English East India Company," *Journal of Economic History* 65, no. 2 (June 2005): 500.

43 Robert Cowan, Letter to John Hinde, Mocha, 20 May 1725, f. 87v.

Cowan's entry into the Presbyterian International raises questions about his path to it, and indeed what criteria he met for entry. The answer is partially found in the underlying concept of networks such as this being used as a means to regulate its participating actors. Choosing potential members from among preexisting acquaintances and familial connections could help to overcome the dangers of miscommunication and lack of cultural affinity through a form of shared memory. Similarly, the trust element involved in having shared characteristics with potential network nodes was also important given the labor-intensive nature of early modern correspondence and remittance procedures. By reducing the perceived risk, and indeed by having a quantity of risk that may be measured, however small it may be, the network managers may have had the potential for greater control and confidence.[44] The Scots' Madeira trade provides a fine example in this case, whereby actors shared culture, memory, and often familial links.[45] By analyzing the actors and potential choices associated with the respective trade, the network managers could predict possible outcomes with more certainty. If there was an existing trade with a defined ethnic connotation to it, it was unsurprising that Cowan succeeded in entering it.

Whilst the Madeira wine trading apparatus was certainly well-established, it did not guarantee that Cowan would have had easy access to it without the benefits of the Cairnes network. Invisible barriers to trade, such as closed markets, credit deficiencies, and a lack of local knowledge would likely have stymied an individual trader. These factors could be overcome through participation in a commercial network already active in the trade.[46] The personal nature of early modern business networks was crucial to this. In particular, the idea of shared experiences and memory between network members were powerful motivators, with common links to home, family, and ethnicity appearing to have been the most important.[47] As a result of Cowan's dissenting background, shared ethnicity, and adherence to customs, his father's Londonderry corporation service during Conolly's government service, as well as his locational base in Londonderry, he was likely viewed as an acceptable candidate for the Cairnes commercial network.[48] This in turn was, it is argued, linked to the broader Presbyterian International commercial apparatus.

In the wider context, Ireland's potential to serve as a fulcrum for initiating networks of ethnic patronage connected to the imperial sphere made it plausible that such a vetting procedure was in place. This runs concurrently with Stoyan Sgourev's assertion that disconnected actors may succeed in innovation not only

44 Frank H. Knight, *Risk, Uncertainty and Profit,* 19–20.
45 Hancock, "Combining Success and Failure," 9–10.
46 Bailey, "Metropole and Colony," 163.
47 Hancock, "Combining Success and Failure," 14–5.
48 Teggin, "Sir Robert Cowan," 46–51.

because of their specific actions, but rather because their actions were favorably appraised by members of their audience.[49] The audience, in the Cowan example, is taken to mean those who were in a position to judge his actions and merit within the Presbyterian International. The specific term audience has been used to tie in with the argument regarding perceptions over actions. In the highly political and patrimonial world of Company relationships, this was a key factor. In the context of this study, it is presupposed that the Cairnes–Gould familial network operated as Cowan's audience for the most part, with John Gould Jr., in particular, serving as a powerful political and commercial figurehead in the city of London at this time. Gould's leading role is proposed due to the number of financial transactions between himself and Cowan, as well as Cowan acknowledging Gould as his chief patron and declaring that he would serve as governor of Bombay as long as Gould wished it.[50]

Linked to this idea of an elite cadre of privately interested parties is the concept of gentlemanly capitalism, through which private landed interests combined with well-connected city mandarins to aid in the creation of wealth through overseas trade.[51] This was represented by the union of rural landed elites and their cosmopolitan counterparts in the city, creating an essential alliance due to the economic strength derived from agricultural rents and wages throughout the eighteenth century. Thus, it was no surprise that political power consolidated itself with the control of landed estates following the Glorious Revolution of 1688.[52] Since, in the case of Cowan, there is an ethnic and familial connotation to his networked trade, the concept of the familial proto-state may be aptly applied. This theory posits that privately interested commercial families and kinship groups orchestrated familial alliances and sequences of patronage for network members in order to direct imperial trade and policy in the colonies.[53] Cowan's progression from the Atlantic wine trade to East India Company service, with the continued patronage of the Cairnes–Gould family, was a good example of this. A favorable reception from the audience and continued adherence to established customs were essential here. Whilst this shall be expanded upon in the following section, the present question must be one of how Cowan succeeded in making the transition from a regional commercial network to an imperial one in the space of a few years. An intriguing link is to be found in his betrothal to the daughter of John Gould Sr.

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49 Sgourev, "Cubism (and Picasso)," 1611.
50 Robert Cowan, Letter to William Phipps, Parel, 4 September 1734, f. 138v; Letter to John Gould, Bombay, 2 January 1726, f. 133; Letter to John Gould Jr., Bombay, 12 January 1721, f. 212.
51 P. J. Cain. and A. G. Hopkins, *British Imperialism: Innovation and Expansion, 1688–1914* (New York: Longman, 1994), 85–6.
52 Cain and Hopkins, *British Imperialism,* 58–9.
53 Finn, "Family Formations," 101–3.

Since personal networks tended to involve network nodes in complex matrices of personal and professional involvement, it was possible for nodes to interact with each other in a variety of ways.[54] These interactions can be discerned in terms of the multivocality of roles and diverse hierarchical structures, something discussed as having a horizontal network hierarchy.[55] The most common association when building networked alliances was that of intermarriage between network members' families. In Cowan's case, he became engaged to Elizabeth Gould sometime before he sailed to India in 1719. A specific date for the formalization of this arrangement is difficult to determine, but the union was approved before he left London and he corresponded with Elizabeth in this light for many years after.[56] However, owing to Cowan's extended service in India, the betrothal was broken off in 1724–5, with Elizabeth instead marrying Albert Nesbitt.[57] Two factors are important here; first, that Nesbitt was another dissenting Irishman with London commercial links to the Gould family.[58] Second, that Cowan's relationship with the Gould family, and the wider Cairnes–Gould nexus, was undamaged following this divergence.

The choice of a second dissenting-Irish groom for Elizabeth Gould is indicative of a defined goal of securing network connections within the wider Presbyterian community in London and Ireland. City interests, in the form of the Gould family, acting in this way to secure regional connections for commerce on a global scale is indicative of gentlemanly capitalism at work. Indeed, the choice of Nesbitt solidified Gould links with the Nesbitt family in London, who occupied offices at Coleman Street in an existing partnership with Nathaniel Gould; further, this area of London housed numerous Irish merchants with Ulster connections.[59] Cowan's continued favor with the family also pointed to a recognition of the value of ongoing ethnic and familial cooperation, as per the familial proto-state. This, it is argued, was part of a wider effort to consolidate Irish commercial links. Ethnic links consolidated through marriage were important, but shared identity and adherence to common customs, as discussed above, also counted for much in terms of audience. This demonstrates that marriage was not the only means of securing patronage with such a network, but that an element of shared community and customs was necessary. Cowan had been on intimate terms with the entire nuclear Cairnes–Gould family and served as an attorney for their Indian trading

54 Hancock, "Combining Success and Failure," 14–5.
55 Emily Erikson, *Between Monopoly and Free Trade: The English East India Company 1600–1757* (Princeton: Princeton University Press, 2014), 19–20.
56 Robert Cowan, Letter to Betty Gould, Bombay, 20 October 1723, f. 14v; Letter to John Gould Jr., Mocha, 8 July 1724, ff. 3v–5.
57 Robert Cowan, Letter to Betty Gould, Mocha, 15 July 1725, f. 98v.
58 Craig Bailey, "The Nesbitts of London and their Networks" in *Irish and Scottish Mercantile Networks in Europe and Overseas in the Seventeenth and Eighteenth Centuries,* ed. David Dickson, Jan Parmentier and Jane Ohlmeyer (Gent: Academia Press, 2007), 243–5
59 Bailey, "Nesbitts of London," 235–6.

affairs for over ten years. His correspondence networks with the women of the Cairnes–Gould family are particularly interesting in this regard, with intimate letters being exchanged between Cowan and these ladies.[60]

Such a gendered correspondence network has been the subject of a separate network study, though a brief commentary is warranted here.[61] It has been argued that defined spikes in Cowan's correspondence occurred during times he was suffering from elements of colonial anxiety when posted at Goa (1721–2) and Mocha (1724–7).[62] In his letter books for these placements, letters addressed to female members of his network, such as his fiancé, Elizabeth Gould, and Frances Cairnes (née Gould), contained personal descriptions of his difficulties. While these letters only amounted to 16 out of 287 at Goa and 18 out of 558 for Mocha, such spikes are not witnessed anywhere else in Cowan's correspondence. This strongly suggested a defined need or want for emotional support from his ethnic or kin network, specifically through female correspondence. It must be acknowledged that although the wider debate involving colonial anxiety and its signifiers is currently undergoing an alteration in focus, the use of highly networked individual archives, such as Cowan's, can provide a great deal of insight into the structures and identity of early modern networks in the context of family and shared community.

Whilst a recognized marriage to the familial community was no longer an option, there was seemingly a significant degree of respect and effective patronage between Cowan and the Goulds based on shared emotional bonds.[63] This, it is argued, is connected to the value of shared memory and identity within networks, and further points towards the existence of the Presbyterian International which acted as a privately interested network.[64]

60 Robert Cowan, Letter to Mrs. Cairnes, Surat, 20 April 1722, f. 140; Letter to Mrs. Gould, Surat, 20 April 1722, f. 141; Letter to Mrs. Gould, Mocha, 8 July 1724, f. 8v.

61 Edward Owen Teggin, "Colonial Anxiety and Identity: Ethnic Networks as Cultural Supports in Colonial South Asia and Sumatra," *Indonesian Historical Studies* 4, no. 2 (December 2020): 84–99.

62 Colonial Anxiety is a difficult subject to adequately define, and increasingly so given the recent re-examination of the field. In a broad sense, it is taken to refer to feelings of discomfort, fear of attack, feeling lost in an unknown world, cultural disconnection, or awareness of a defined lack on the part of the individual in empire. See also, Ranajit Guha, "Not at Home in Empire," *Critical Inquiry* 23, no. 3 (Spring 1997): 482–93.

63 Robert Cowan, Letter to John Gould Jr., Bombay, 25 July 1729, f. 82v; Letter to John Gould Jr., Bombay, 13 February 1734, f. 121; Letter to John Gould, Bombay, 25 August 1734, 149v.

64 Hancock, "Combining Success and Failure," 15.

3. Robust Action in the Cairnes–Gould Network

In this section, the style of control and identity used by the Cairnes and Gould families will be discussed in relation to robust action in order to more accurately describe the Presbyterian International and link it to the theory of gentlemanly capitalism. The concept of robust action has been the subject of much debate over the past few decades and, as a topic, has great potential for future interdisciplinary studies. Indeed, the pragmatic philosophy, viewed through robust action, provides a toolkit for a multifaceted problem-solving approach that is situated, distributed, and processual.[65] This is in turn linked to the role of humans as problem solvers and the function of thought as being to guide action in the service of solving practical problems.[66] As has been alluded to above, the current experimentation with robust action and intra-Asian commercial pursuits necessitates that the problem of engaging with and controlling segments of the various trades may be classified as a grand challenge. Of this, it may be said that there is a clear linkage of distributed action and novel solutions to problems within such networks, as well as a certain complexity due to the number of actors involved in fulfilling roles as network nodes.

In the context of the current study, it is necessary to view such networks as patrimonial creations of social exchange through which collective action provided resources, capital, and expertise.[67] Admittedly, however, the control of networks, became in turn a great difficulty, with those approaching grand challenges being unable to view the system in its entirety. As a result, they then had to rely on trusted actors, going beyond traditionally understood patronage relationships which relied on written bonds and good faith. Effectively, too many variables and situations were in play to maintain sufficient control, so appointing those with as many commonly held attributes and customs as possible made much sense; the ethnic dimension is a key consideration here. A further problem emerges, however, in that the preferences of actors are not stable, but in fact a constantly evolving field of interests. It will be observed that the Presbyterian International, which we take as our case study, firmly consisted of a small cadre of privately interested network nodes, as opposed to the more traditional structure of public interest and a wide public impact ratio commonly associated with our understanding of grand challenges. In answer to this problem, the example of the investigation into the Medici may again be referenced.

65 Ferraro, Etzion and Gehman, "Grand Challenges," 370.
66 Neil Gross, "A Pragmatist Theory of Social Mechanisms," *American Sociological Review* 74, no. 3 (2009): 366.
67 Bailey, "Metropole and Colony," 162.

Accordingly, the term robust action has been used as a means of describing Cosimo de Medici's style of control, whereby everything that was done in response to a flow of petitions, coincidentally or otherwise, appeared to serve Cosimo's wider interests.[68] This is tied to the understanding of multivocality as permitting single actions to be moves in many different games simultaneously. The Medici have been lauded for being able to exhibit great collective action, while at the same time successfully concealing their true ambitions. This was an extension of Cosimo's reputation for being anxious to remain behind the scenes and only directly acting when he had no other choice, or indeed through a chosen deputy.[69] The construction of the Cowan network, and the wider Presbyterian International, may be said to have functioned with a similar goal. Whilst it was clear that merchants involved in early modern trade were seeking profits, creditors desired a return on interest, and brokers sought commission on contracts, it was difficult to pin down who was acting in which interest at which time, particularly given the multivocality of roles possible in networks such as this.[70]

In the case of the Presbyterian International, ethnically and religiously linked nodes were actively recruited into the network, which in turn led to the increasingly overlapping array of nodes with high multivocality.[71] The key appears to have been in the effective projection of ambiguous behavior. Whilst others are too shrewd not to see through individual self-interest, the portrayal of one's attributed interests as multivocal is a path towards understanding the reproduction and control of networked behaviors.[72] This has the effect of obscuring private interests amongst a myriad of competing interests that may or may not be in play at any one given time. Such multivocality was important in order to allow actors to maintain their involvement across conflicting positions, particularly in the face of disruption or change of environmental factors. In this way, separate interpretations may be presented to varying audiences with differing evaluative criteria. Servants, such as Cowan, engaging in illicit private trade personally, or on behalf of a patron, such as John Gould Jr., are a good example of this. This again returns to arguments on audience reception.[73]

Therefore, one might incorporate an example of robust action at work with Thomas Edison and his team inventing the electric lightbulb through skeuomorphic design. It has been argued that Edison and his network specifically designed the lightbulb and its attendant systems to mirror the existing gaslight technology

68 Padgett and Ansell, "Robust Action," 1263.
69 Curt S. Gutkind, *Cosimo de' Medici: Paterpatriae, 1389–1464* (Oxford: Oxford University Press, 1938), 124.
70 Hancock, "Combining Success and Failure," 14–5.
71 Hancock, "Combining Success and Failure," 14–5.
72 Padgett and Ansell, "Robust Action," 1307.
73 Sgourev, "Cubism (and Picasso)," 1611.

in order to appear familiar to customers, while at the same time not constraining the future development which ultimately follows extended usage of technology. Edison's network accomplishment was therefore twofold; first, he designed a technology that was more efficient than the existing product. Second, he laid the foundations for future technological and commercial innovation. Essentially, competitors to this new technology were pushed to the side in the present and the future, though the innovators remained ambiguous and concealed their true intention, namely the domination of the lighting industry, from their audience by delivering their products in recognizable formats in the process.[74]

A key factor in the effective functioning of a network is the successful flow of information, which is significant, considering Cowan and his ethno-familial network, where he served as a conduit of information for the Cairnes–Gould nexus whilst he was in South Asia.[75] This idea runs concurrently with the vital role which individual actors, as part of wider networks, could play in the cohesive management of intra-Asian trade and the reduction of risk in the early modern period.[76] Risk refers to decision-making situations in which potential outcomes and occurrences are known to the decision-maker. Uncertainty, on the other hand, highlights when outcomes and their probability are unknown. The resulting risk-uncertainty dialectic, discussed by Frank Knight, needs discussion here. Uncertainty must be understood in a radically different sense than risk, though the two terms had never been properly distinguished before Knight; whereas risk may at times appear as a measurable quantity, and others not, the same cannot be said of uncertainty. Knightian uncertainty is a lack of quantifiable knowledge about some possible occurrence, as opposed to the presence of quantifiable risk.

The concept acknowledges a degree of ignorance, limits to knowledge, and unpredictability of the future. In effect, this Knightian uncertainty posits that it is this measurable quality that distinguishes risk and uncertainty. It is therefore the 'true' uncertainty, and not risk, that forms the basis of a valid theory of profitability.[77] A profit-seeking man, for example, contracts for services or goods in advance based on what he expects to make by their investment. The return is, however, unknown at the time of initial investment.[78] Through the context of such unknowns, the concept of the Presbyterian International gains traction as a

74 A. B. Hargadon and Y. Douglas, "When Innovations Meet Institutions: Edison and the Design of the Electric Light," *Administrative Science Quarterly* 46, no. 3 (2001): 479–80.
75 Borgatti and Halgin, "Network Theory," 1172; Robert Cowan, Letter to John Gould, Goa, 25 November 1721, f. 101v; Letter to John Gould Jr., Mocha, 15 July 1725, f. 91; Letter to John Gould Jr., Bombay, 6 January 1729, f. 44v.
76 Søren Mentz, *The English Gentleman Merchant at work: Madras and the City of London, 1660–1740* (Copenhagen: Museum Tusculanum Press, 2005), 81.
77 Knight, *Risk, Uncertainty and Profit,* 19–20.
78 Knight, *Risk, Uncertainty and Profit,* 363.

solution to the grand challenge of networks entering and exerting control over regional markets on a global scale. At the same time, it is important to view diverse geopolitical spheres concurrently in order to obtain an accurate observation.[79]

The usage of such a system of economic control to deal with the risk-uncertainty question can best be seen through the correspondence of Cowan with his ethnically motivated patronage circle, with Cowan acting as a conduit for political and economic information.[80] This, in itself, runs in tandem with his emotionally driven gendered correspondence, discussed above. Key to this is the focus of robust action on the movements and decisions of individual actors. Whereas Cowan was actively engaged in his own private trade in the intra-Asian sphere, he was also an involved network node in official Company commerce and the Presbyterian International structure, and as such interested his fellow network members in his intra-Asian voyages. Cowan was thus an active node in the wider network, seemingly serving his audience, but was also acting ambiguously in terms of his own trade. Whilst it is true that Cowan included his patrons and network nodes in intra-Asian trade, fulfilling a role in their familial proto-state, it was likewise the case that he traded for his own benefit to a large degree and returned to England a very wealthy man in 1735.[81] The generation of such wealth, it is argued, was made possible by gentlemanly capitalist action through imperially linked networks, such as the Presbyterian International. The presentation of an acceptable set of circumstances to his audience was crucial for Cowan in order to conceal that personal gain was his true intention. Table 1, below, demonstrates the complex nature of such private trade.

In commercial terms, eighteenth-century British trade in the intra-Asian sphere was largely concerned with providing luxury items, such as cloth, pepper, coffee, spices, and indigo for European markets. During Cowan's time as governor of Bombay, the supply of pepper, coffee, and cloth, in particular, were his most pressing demands. Indeed, between 1729–31 Cowan had to contend with fluctuations in the supply and price of pepper and cloth, caused by political instability at the hub-port of Surat and the Malabar Coast.[82] Further, the long-term difficulties in Yemen and Persia made the supply of coffee inconsistent.[83] Whilst it

79 Philip Stern, "British Asia and British Atlantic: Comparisons and Connections," *William and Mary Quarterly,* Third Series 63, no. 4 (October 2006): 693–5.

80 Robert Cowan, Letter to John Gould, Goa, 25 November 1721, f. 101v; Letter to John Gould Jr., Mocha, 15 July 1725, f. 91; Letter to John Gould Jr., Bombay, 6 January 1729, f. 44v.

81 Robert Cowan, Will of Robert Cowan, Bombay, 4 January 1735, Cowan Papers, D654/C/1/1A, f. 1, PRONI, Belfast.

82 Robert Cowan, Letter to Edward Harrison, Bombay, 3 January 1729, f. 43v; Letter to Sir Matthew Decker, Bombay, 10 January 1730, f. 26v; Letter to William Phipps, Bombay, 6 January 1730, f. 5v.

83 Robert Cowan, Letter to Mrs. Macrae, Mocha, 8 July 1724, f. 2; Letter to John Gould Jr., Mocha, 8 July 1724, f. 3v.

was preferred that English woolens were sold in India to support English weavers and exports, intra-Asian powers preferred to be paid in bullion or specie.[84] This meant a great deal of England's precious metal reserves were leaving the country every year, something which caused fierce political debate in conjunction with the import of Indian calicoes.[85]

In terms of Cowan's private trade in the intra-Asian sphere, it must be acknowledged that servants purchasing key products of interest to the company, such as pepper, cloth, and coffee, was frowned upon.[86] Whilst Cowan largely avoided pepper and quality calicoes, he was heavily involved in the trade for non-quality cloth and coffee between South Asia, South China, and the Red Sea.[87] He was also concerned in the trade for precious stones, such as diamonds and Cambay beads.[88] Whereas servants such as Cowan could not ship bulk commodities, such as coffee, to Europe without being discovered and fined by the Company, gemstones were small, highly valuable, and easy to conceal. In one voyage alone, Cowan shipped diamonds to the value of 9,730:0:21 Pounds to London.[89] Whilst Cowan was greatly interested in private trade, his account of John Gould Jr., shown below in Table 1, may be used to demonstrate his multivocal commercial performance. This more fully brings the concept of Cowan's credit transfers, included amongst his commercial accounts for the years 1732–5, in South Asia into the discussion.[90]

Immediately, one can discern that large sums of money were being transmitted between the two men, with the figure of 4,395:06:0 Pounds, in particular, standing out. We know that Cowan acted as attorney for Gould whilst he was in India, and so this sum was likely connected to investment carried out by Cowan on Gould's behalf. With the knowledge that Cowan interested Gould in many of the voyages he undertook in the intra-Asian sphere, Table 1 may be seen as evidence of Gould's commercial relationship with Cowan as a networked node. Moreover, the fortunate survival of archival material such as this, in terms of both

84 Najaf Haider, "Precious Metal Flows and Currency Circulation in the Mughal Empire," *Journal of the Economic and Social History of the Orient* 39, no. 3 (1996): 299.
85 Julian Hoppit, *A Land of Liberty? England: 1689–1727* (Oxford: Oxford University Press, 2000), 275.
86 Hejeebu, "Contract Enforcement," 501–2.
87 Robert Cowan, Investment Accounts, 1732–5, Cowan Papers, D654/B/1/10B, PRONI, Belfast.
88 Robert Cowan, Letter to 'Sir', Surat, 7 September 1722, f. 176; Invoice of Cambay Beads Laden on the Oakham, Bombay, 29 January 1731, f. 54.
89 Robert Cowan, Invoice of Diamonds Laden on the Prince William, Bombay, 20 January 1731, f. 37.
90 Robert Cowan, Account Transfers to Robert Cowan, 1732–5, Cowan Papers, D654/B/1/10B, PRONI, Belfast.

Dr		John Gould Junior Esq. to Robert Cowan Esq.												Cr
		Rupees	q	r	Pounds	s	d			Rupees	q	r	Pounds	s	d
1729								**1729**							
Sept. 30	To a bill of exchange on the East India Company remitted you per Morrice	1,200	–	–	158	–	–	Oct. 1	By four chests of Claret & 4 of White Lisbone wine received by the Windham	1,057	3	60	132	4	9
1729/30								**1730**							
Jan. 25	To Captain Robert Lyell his bill on himself	615	–	27	76	17	8	Oct. 11	By 6 chests of French wine & four chests of Lisbone received by the Prince William	1,299	1	86	162	8	8
1730/1								**1731**							
Mar. 16	To cash lent Mr. Edward Owen on his bond 5 per cent interest per annum	400	–	–	50	–	–	Jul. 1	By Samuel Holden Esq. for my order to pay him	2,747	1	33	343	8	4
Feb. 1	To a bill of exchange on the Company remitted per Lethulier	3,947	1	33	493	8	4	Oct. 1	By 4 Hogsheads of French wine, one pipe of Calcavellah & 90 gallons of Burton Ale received per Stretham	1,838	2	40	229	16	6
1731/2								**1732**							
Feb. 1	To a bill of exchange on the Company remitted by the Stretham & Oakham	4,000	–	–	500	–	–	Oct. 1	By 4 Hogsheads of Claret, 1 pipe of Calcavellah & 76 gallons of ale received by the Marlborough	1,858	–	80	232	5	6

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Dr	John Gould Junior Esq. to Robert Cowan Esq.							Cr						
1732/3								**1732/3**						
Jan. 28	To a bill of exchange on the Company now remitted you by the Greenwich & Marlborough	25,000	–	–	3,125	–	–	Jan. 27	By my bill in favour of Mrs. Frances Cairnes for	800	–	–	100	–	–
									By my bill in favour of Mr. John Sherman	850	3	60	106	7	3
									By my bill in favour of Geo Atkins Esq.	338	–	46	42	5	3 ½
									By Coll John Johnson my bill in his favour per Oakham	361	–	80	45	3	–
									By Mrs. Frances Cairnes my bill in her favour per Oakham	800	–	–	100	–	–
								Jan. 28	By ballance remaining	23,210	2	75	2,901	6	8 ½
		35,162	1	60	4,395	6	–			35,162	1	60	4,395	6	–
								NB	Omitted to credit him for my bill in favour of Mr. Monier per Oakham, of this I advised him per Monmouth who was the last ship dispatched this year	200	–	–	25	–	–
															Bombay Castle the 28th January 1732/3
															Transmitted coppys of this account per Marlborough & Greenwich

Tab. 1 Account Between John Gould Jr. Esq. and Robert Cowan Esq.

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correspondence and accounts, is what enables studies like the present to reconstruct networked communities following the work into the Medici of fifteenth-century Florence. This returns to arguments regarding the agency of the scholar in denoting network nodes to construct the wider apparatus.[91] Crucially, however, the numerous bills of exchange transacted between the two men point towards a complicated financial structure in which credit was being facilitated by Gould, via Cowan, to other recipients of patronage in India.

While the alcohol trade, which Cowan was clearly involved in, is interesting in the above account, it is the credit transactions in Table 1, involving men such as John Sherman, Robert Lyell, and Samuel Holden, that stand out. These were all men with whom Cowan carried out correspondence and business in India, and their connection to the Gould network points towards another network layer orchestrated by Cowan in South Asia. Intriguingly, the information in Table 1 is also evidence of horizontal network theory at work, in which Cowan functioned in a dual role.[92] He both facilitated his patron's interests in a vertical fashion by controlling credit and investment, whilst simultaneously conducting his own trade and patronage relationships with the likes of Lyell and Holden. This was further complicated by Gould Jr. acting as Cowan's attorney for servicing Cowan's historic debts arising out of his former business partnership at Lisbon.[93] The key here is, however, that the two men were theoretically both serving the East India Company, but were also seen to act within the Presbyterian International. As such, this semiautonomous network was both enabled and reinforced by the Company and therefore returns to the above discussion of ethnic structures and the belief in them reinforcing each other. This implies a defined network relationship between Cowan and Gould similar to the description of Cosimo de Medici.[94]

How does this tie into the broader discussion of robust action in the Presbyterian International case in the Cowan example, however? As already discussed, Cowan, like many of his contemporaries, was highly involved in his own personal trade whilst simultaneously fulfilling his official Company role. The goal was to supplement their Company salary and make a fortune to return to England with, attaining the goal of what has been described as 'nabobery'.[95] Whilst it was understood that individual servants often traded privately, the idea that they may have traded to excess was also greatly frowned upon by the directors in London. Although restrictions were placed on the trade of Indian goods to Britain, and

91 Borgatti and Halgin, "Network Theory," 1169.
92 Erikson, *Between Monopoly and Free Trade,* 19–20.
93 Robert Cowan, Letter to John Gould Jr., Bombay, 31 August 1734, f. 144.
94 Padgett and Ansell, "Robust Action," 1262–3.
95 Philip Lawson and Jim Phillips, "'Our Execrable Banditti': Perceptions of Nabobs in Mid-Eighteenth Century Britain," *Albion* 16, no. 3 (Autumn 1984): 226–9.

harsh punishments applied to those who transgressed, the temptation was evident given the large profits which stood to be made.[96] This was characterized as putting the private individual interest ahead of the wider public interest of the East India Company and court of directors, an action that has been described as the individual engaging in an aspect of the rational actor theory.[97] Effectively, this theory contends that every individual conducts a personal cost-benefit analysis to determine which action is worth pursuing for their own personal benefit. This assumes that the individual, or actor, is consistent in their decision-making for personal gain.[98] Whilst it was certainly true that Cowan was acting in his own interests, and made a vast fortune as a result, it may also be said that, by conducting trade on behalf of his wider Presbyterian International network, he was also acting on behalf of his audience. This returns to the gentlemanly capitalist theory and the assertion that success and innovation may be ensured through a positive appraisal of one's actions by a given audience.[99]

4. Conclusion

The Presbyterian International, as discussed above, demonstrates the complexity and multivocality of early modern commercial networks, as well as how they connected to distant global spheres through trade, and has been strongly aligned with the gentlemanly capitalist theory. The Ulster-Scots ethnic component, together with aspects such as customs, shared memory, and barriers to entry, has been a fascinating point of discussion for the current study. The gentlemanly capitalist theory, in which regional landed interests connected to metropolitan centers to benefit from capital and political influence in the creation of wealth, has been a key part of connecting the Ulster-Scots and London networks. The alliance of the Cairnes and Gould families was a good example in this regard, with the influential Cairnes family providing Ulster connections to the powerful Gould family involved with the East India Company.

In many ways, this study is an examination of the benefits of interpersonal relationships in mitigating risks in long-distance trade. Whereas the ethnic network in this context perhaps made vertical control hierarchy seem simplistic, there was also the danger that the sheer distance involved in many trading ventures would make it difficult to understand the motives and thus lead to multivocality at node level. Essentially, this comes down to ambiguity amongst the lesser network actors akin to the rational actor theory. Furthermore, the absence

96 Hejeebu, "Contract Enforcement," 498–9.
97 Erikson, *Between Monopoly and Free Trade,* 108–9.
98 See also, Kristen Renwick Monroe and Kristen Hill Maher, "Psychology and Rational Actor Theory," *Political Psychology* 16, no. 1 (March 1995): 1–21.
99 Sgourev, "Cubism (and Picasso)," 1611.

of defined network roles allowed individual nodes to expand into each other's lives through marriage, again suggesting multivocality. This lack of definition also returns to the discussion surrounding the importance of ambiguity of action when attempting to assert control. It has been discussed that Cowan succeeded in pleasing his patrons in London by fulfilling his official role through trading on behalf of his Company patrons, whilst at the same time making a great fortune for himself. However, he did not occupy the 'top' spot in his network, as Cosimo de Medici did in his, because, despite generating ties of personal loyalty in South Asia, he was directed and provided with opportunities by landed and city interests. The example of John Gould Jr. has been proposed in this regard owing to his high multivocality and great control over lesser network nodes, such as Cowan.

The second key development in this study is an overarching ethnic network referred to as the Presbyterian International which represented, and perhaps controlled, dissenting Irish interests across geopolitical spheres in the seventeenth and eighteenth centuries. The use of robust action within such a network can be warranted owing to the myriad of interests that were active, yet seemingly also converged at appropriate times to provide the means for political agency and the creation of wealth in Europe and the colonies. This has been demonstrated through Cowan's progression from his Londonderry home to the Atlantic wine trade, and further on to East India Company service, which has in turn been linked to the gentlemanly capitalist order and the activity of a familial proto-state. In this way, family, ethnicity, and shared identity or memory have proven to be key considerations in the study of early modern commercial networks. The multidisciplinary approach of the study is supported through the utilization of elements of management science and theory, such as robust action in the analysis of the Cairnes–Gould network. This, in particular, has enabled Cowan's network connections to be more effectively examined. Additionally, the incorporation of aspects such as risk, uncertainty, and audience reception, offers exciting new possibilities for the discussion of early modern networks.

Finally, there was clearly a global aspect to the construction of commercial apparatuses like the Presbyterian International, which results from the need to view various geopolitical zones concurrently to get an accurate vision of the myriad of factors at play. Accordingly, the wider Cowan network was global in its application by sheer necessity in order to prosper. Connecting landed capital interests in Britain and Ireland, and then bolstering them with city-political and -commercial contacts, provided the means for the creation of wealth in Asia. The initial stage, incorporating the regional Atlantic wine trade, serves to draw the debate more firmly into global discussions of empire since similar actors were involved in largely similar roles in both the Atlantic wine trade and the intra-Asian trading world to simultaneously benefit their network and fulfill obligations. In terms of trading multivocality, Table 1 is a good example: whilst actors completed tasks, such as the allowance of credit, transfer of bills of exchange, and sale of qual-

ity goods, and made money, the identity of the controlling element, however, remains elusive, thus granting sufficient ambiguity to confirm the presence of the robust action theory at work.

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ZEF SEGAL

From a Local Periodical to a Global Enterprise

Ha-Me'asef, 1896–1914

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Abstract This article examines the spatial and social evolution of the network of writers in the Jerusalem-based periodical Ha-Me'asef during the years 1896–1914 as a compelling and dynamic example of transnational Jewish networks. The periodical, which was established by Rabbi Ben-Zion Abraham Koenka in 1896, was exceptional in that it aspired to reach beyond the Jerusalem social circle, from where it originated, and become the center of a global communication network. At its apex, some of the leading rabbinical figures in Palestine, the Middle-East, Europe and America became active writers. The journal eliminated the borders of the isolated spatial unit, in this case Jerusalem, and suggested in its place a new perception of 'place', which would be part of a relational and trans-local network.

By using digital methodologies, such as geographic mapping (GIS) and network mapping (SNA), this article explores the interrelations between global expansion and local networks, and in particular the effects of globalization on the role of Jerusalem. It shows that a noticeable spatial expansion of the network coexisted at first with concealed spatial divides that separated between geographical regions, such as the Levant and Western Europe. Furthermore, it identifies social groups among the participating rabbis, and ongoing changes in the internal hierarchy of the contemporary rabbinical centers, as they were reflected in the periodical. The article shows that the success of the transnational network went hand in hand with the decline of Jerusalem as its center.

C²DH LUXEMBOURG CENTRE FOR CONTEMPORARY AND DIGITAL HISTORY

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I. Introduction*

A fundamental attribute of Jewish society since late antiquity was its diasporic condition. Jews and Jewish communities were scattered throughout the known world, and whatever they needed to share had to be transmitted over non-continuous and expansive space. Under such conditions, communication networks assumed an exceptional significance: they were the means not only of creating an 'imagined community', but were also a central element in maintaining the genuine, real, community. The Jewish people were, historically, 'the people of the network' just as much as they were 'the people of the book'.[1] The introduction of nineteenth-century global journalism to the Jewish sphere added to this network and played a major role in producing stronger connections between distant communities.

In the second half of the nineteenth century, several Hebrew journals in Eastern Europe joined a growing network of Jewish journals, who published not only in Hebrew but in Yiddish and other European languages.[2] In the multilingual context of Jewish communities, Hebrew, which was not a spoken language, was not an obvious choice for a journal, compared to other options such as the Jewish jargons (Yiddish, Judezmo and Jewish-Arabic) or state vernaculars. However, one of the advantages of using Hebrew was that it bridged the geographical and cultural distances between Jewish communities. "For Jewish communities – far from their homeland, lacking central political and economic leadership, and spread throughout the world – the Hebrew press functioned as a printed-word public sphere."[3]

Much like the eighteenth-century 'Republic of Letters' or the twenty-first-century 'participatory culture' of the internet, Hebrew journals encouraged their

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1 Menahem Blondheim, "The Jewish Communication Tradition and its Encounters with (the) New Media," in *Digital Judaism: Jewish Negotiations with Digital Media and Culture,* ed. Heidi Campbell (New York: Routledge, 2015).

2 Israel Bartal, "'Mevaser U-Modi'a Le-Ish Yehudi': Ha-Itonut Ha-Yehudit Be-Afik shel Hidush," *Katedra* 71 (1994) (in Hebrew); Oren Soffer, "'Paper Territory': Early Hebrew Journalism and its Political Roles," *Journalism History* 30, no. 1 (2004); Israel Bartal, "Mi-Kahal Le-Kehilat Kor'im," in *Ein Le-Falpel! Iton Ha-Zefirah ve-Ha-Modernizatsia shel Ha-Si'akh Ha-Khevrati,* Oren Soffer (Jerusalem: Mosad Bialik, 2007) (in Hebrew); Oren Soffer, "Why Hebrew? A Comparative Analysis of Language Choice in the Early Hebrew Press," *Media History* 15, no. 3 (2009); Roni Beer-Marx, *Al Khomot Ha-Niyar: Iton Ha-Levanon Ve-Ha-Ortodoxia* (Jerusalem: Zalman Shazar, 2017) (in Hebrew).

3 Soffer, "Why Hebrew?"

readers to take an active role in the content of the journal.[4] The publication of letters or 'news items' from private writers in Jewish communities both near and far made up a major part of the early Hebrew weeklies. The Hebrew journals also influenced future writers by opening up new worlds to them, inspiring their imaginations. Issues of these journals found their way to Jewish communities all around the world, thousands of miles away from their place of publication. Consequently, these nineteenth century Hebrew journals offer a fertile lens through which we can begin to engage with the question of how transnational Jewish connections were forged and developed.

A particular case-study is that of the rabbinical periodical *Ha-Me'asef,* which was published in Jerusalem between 1896 and 1914, and which at its apex formed an international network of contributors, spanning from Tashkent in the east to Portland in the west.[5] Unlike many other contemporary Hebrew periodicals, *Ha-Me'asef* was not part of the Jewish Enlightenment literature, did not reflect much interest in political debates, and had no content independent of the letters sent by its readers/writers. Nevertheless, its role in the constitution of a global 'paper territory' (*Admat Niyar*), a shared public sphere that linked Jews from distinct communities, was perhaps even greater than other periodicals of its time.[6]

The network of contributors to *Ha-Me'asef* was extremely diverse and included older and younger rabbis, Hasidic and non-Hasidic, Zionists and anti-Zionists, those who were secularly educated and those who opposed secular education. The various contributors shared with an increasing readership their thoughts and interpretations on Talmudic literature and Halachic questions.

Two main characteristics made it the center of an international social network. First, many contributions were written as a response to previous contributions, with threads that occasionally spanned over many volumes and many months. Second, the founder and editor of the journal did not just aspire to establish an international readership, but rather to establish an international team of writers. Although the journal was studied by several scholars as a locus of halachic debates and as a central piece in the important legacy of Sephardic rabbis

4 Albert Thibaudet, *French Literature from 1795 to Our Era* (New York: Funk & Wagnalis, 1967); Dan Mairon, *Bodedim Be-Mo'adam: Li-Dyokana shel Ha-Republika Ha-Sifrutit Ha-Ivrit Bi-Tkhilat Ha-Me'a Ha-Esrim* (Tel Aviv: Am Oved, 1987) (in Hebrew); Henry Jenkins, *Confronting the challenges of participatory culture: Media education for the 21st century* (Cambridge: Cambridge University Press, 2009).

5 The periodical began as a weekly that was a supplement to contemporary newspapers such as *Ha-Tsvi* and *Ha-Havatselet.* From its third year onwards, it appeared as an independent monthly. This journal should not be confused with the late eighteenth-century German-Jewish periodical, *Ha-Me'asef.*

6 See: Soffer, "Paper Territory."

in Hebrew journalism, it was never researched as a network.[7] How did authorship to this journal transform from a local milieu into a widespread group dispersed across the world, and how did this affect the role of Jerusalem as the center of the network?

In order to answer these questions, this article focuses on the function of *Ha-Me'asef* as a network of authors, and explores the history and development of this network from the establishment of the journal until its premature demise, due to World War One. By combining distant-reading methodologies, such as geographical analysis and network analysis, together with a closer reading of the turning points in the evolution of the network, this article shows the significance of a flexible and pluralistic editorial approach, as well as the importance of maintaining local clusters of writers while creating a broad, transnational and stable network. The following section provides a theoretical and methodological background of the paper.

2. Digitally exploring periodical networks

The growing academic field of periodical-studies is a direct result of advances in digital technology in the last two decades.[8] Keyword-searchable digital archives and algorithmic mining tools have become accessible to an increasing number of researchers, and have transformed our view of journals from mere containers of discrete bits of information to autonomous objects of analysis. However, beyond the study of the periodical as a compendium of textual sources, digital analysis also enables us to trace the nature of the periodical as a social network. The periodical's complex and composite form "embodies the concept of the network on both a material level (in the juxtapositions and interconnections it generates between different texts) and on an institutional level (in the collaboration between authors, editors, illustrators, publishers, and readers, which goes into producing it)."[9] Accordingly, newspapers and journals offer researchers a perspective to engage with the question of how social and intellectual connections are forged, evolve, and diffused within a public sphere. The interest in periodical networks is

7 Edward Reichman and Fred Rosner, "The Use of Anesthesia in Circumcision: A Re-Evaluation of the Halakhic Sources," *Tradition: A Journal of Orthodox Jewish Thought* 34, no. 3 (2000); David M. Geffen, "Economic, Social and Religious Issues in American Jewish Life as reflected in the Contributions of American Jews to the Hameassef Journal in Jerusalem (1898–1914)," *Proceedings of the World Congress of Jewish Studies* (1981); Yizhak BeZal'el, *Born Zionists* (Jerusalem: Yad Ben Zvi, 2008), 296–298 (in Hebrew).

8 Sean Latham and Robert Scholes, "The Rise of Periodical Studies," *PMLA* 121, no. 2 (2006); Maria DiCenzo, "Remediating the Past: Doing 'Periodical Studies' in the Digital Era," *ESC: English Studies in Canada* 41, no. 1 (2015).

9 John Fagg, Matthew Pethers, and Robin Vandome, "Introduction: Networks and the Nineteenth-Century Periodical," *American Periodicals* 23, no. 2 (2013), 94.

seen in special issues dedicated to the topic in *Victorian Periodicals Review* (2011), *American Periodicals* (2013), and *The Journal of Modern Periodical Studies* (2014).

The periodical, defined by the composite and varied nature of its content and the corporate and shifting nature of its authorship, has a unique relation in maintaining communities of readers and writers across space. A broad understanding of any periodical and its meaning requires the integration of information on society, economy, language and ideas, gleaned from the periodical's textual content, with relevant geo-spatial information. This can be done on the basis of the mature techniques of GIS (geographical information systems). However, the social and communal networks supporting the input and output of the periodical are notoriously difficult to trace and understand. These networks can now be studied with the use of tools for SNA (social network analysis).

SNA views social relationships in terms of network theory consisting of nodes, which represent the actors within the networks, and ties, which are the relationships between the actors.[10] The resulting graph-based structures are often very complex and can be deciphered by using computational measures.[11] SNA is used to answer questions of centrality, connectivity, the diffusion of ideas, and the formation of social subgroups without reducing actors to their attributes, but rather allowing them to maintain their individual complexity. The basic idea is that nothing exists in isolation. A key characteristic of network analysis is its ability to transcend differences in scale, such that there is a place for each individual (as a node), as well as their interactions with other individuals to construct the society they occupy. As Scott Weingart notes, "networks allow us to see the forest as well as the trees, to give definition to the microcosms and macrocosms which describe the world around us."[12]

In this article, I explore the history of a particular journalistic network as a spatial phenomenon. The assumption underlying this approach is that this periodical, *Ha-Me'asef,* connected communities (or at least the religious leaders of the communities), rather than merely individuals. A relatively similar approach was taken by Charles J. Withers, who analyzed the Enlightenment as a geographical phenomenon. In his words: "The Enlightenment was national and local and international. What is important to an understanding of the Enlightenment as a geographical matter is to show how these scales of analysis work and work together and how, if taken only singly, they may produce only partial "maps" of the

10 *Social Network Analysis: Theory and Applications* (2011), accessed 26 February, 2020, https://www.politaktiv.org/documents/10157/29141/SocNet_TheoryApp.pdf.

11 Charles Wetherell, "Historical Social Network Analysis," *International Review of Social History* 43, no. 6 (1998).

12 Scott B. Weingart, "Networked Society: The Moral Role of Computational Research in a Data-Driven World," accessed 26 February, 2020, http://scottbot.net/2014/09/.

Enlightenment's geographical constitution. Better still, we might explore the relationships between such scales."[13] If I replace the expression 'the Enlightenment' with *Ha-Me'asef,* the basic idea of this article can be better understood. It is much less about 'what is written' and 'who is writing', and much more about 'where are they writing from'. Accordingly, in this research, each writer is viewed as a representative of his geographical location, and his responses to other articles are analyzed as responses to geographical locations, from where the original articles were written.[14]

In order to analyze the changing geographical patterns of publication, and the dynamics of the network, each contribution was tagged manually with its date of publication, the location of the contributor, and whether or not it was a response to other articles published previously in the periodical. Consequently, 2821 contributions, 940 of which were published as responses, which were published over 19 years in 272 issues provide a database enabling a geographical, statistical and network analysis of the journal's authorship space. These help trace and reveal the patterns and turning points of the evolving network.

As described, the database was not created by data mining algorithms or keyword search engines, and thus did not rely on the existence of large scale digitized archives, which many have described as the basis of periodical studies.[15] Despite its volume, mining the corpus for the attributes of the authors required relatively little time due to the uniform locations of the required data in each article: the location of the writer is always at the top; the writer's name is always at the bottom; and the details of the criticized article, if any, are listed in the first sentence. However, the analysis of the resultant database could not have been done manually; it was accomplished by using computational algorithms and digital representations.

However, distant-reading cannot stand on its own since it lacks the ability to explain the phenomenon. As a result, the changes in the development of the network are explained by a closer reading of the content of the articles and the biographical notes of the editor. Contemporary Hebrew journals were often one-man enterprises and the framework, as well as the survival, of the journal depended on the editor.[16] *Ha-Me'asef,* for example, was established in 1896 by Rabbi Ben-Zion Abraham Koenka (1867–1936). Rabbi Koenka was one of the leaders of the Sephardic Jewish community in Jerusalem at the time. Among others, he served

13 Charles J. Withers, *Placing the Enlightenment: Thinking Geographically about the Age of Reason* (Chicago: Chicago University Press, 2007), 7.
14 All the contributors to the journal were men.
15 Bob Nicholson, "The Digital Turn: Exploring the Methodological Possibilities of Digital Newspaper Archives," *Media History* 19, no. 1 (2013), 59–73.
16 Bartal, "Herald and Informer," 164.

as the head of "Tif'eret Yerushalayim" yeshiva, the head of the rabbinical court of the Sephardic community in Jerusalem and later on as a member of the first Chief Rabbinate Council. The story of the journal is intertwined with the life of Koenka, who dedicated 19 years of his life to helping the journal succeed. He described it in his diary: "The work on *Ha-Me'asef* from the beginning to the end was done by me alone. Writing letters and copying them, reading, criticizing, editing, proofreading, and sending articles; everything was done by me, and to this purpose I dedicated all my power, money, time, pen and energy."[17] During these two decades, he travelled around the world (Egypt, Iraq, India, USA, Algiers and Europe) in order to gain donors, subscribers and authors, not necessarily in that order. As we will see, the geography of the periodical had direct links to the biographical geography of Koenka himself.

3. The initial steps towards the establishment of a global network

The first issue of *Ha-Me'asef* was published on 12 June, 1896, and stressed its global atmosphere from the very beginning. It started with an introduction written by Koenka, in which he repeatedly declared the transnational context of the journal:

> We call upon our great rabbis and wise men of our times in the **Land of Israel and abroad** and all the generous hearts of our people **wherever they may be** to support our work in the wind, in the rain and in any way possible. We hope our wishes will come to light, be encouraged, and our journal will flourish and see fruit for the honor of **Jerusalem in particular and the Jewish people in general**.[18]

Although Koenka's original intention was to make the journal into a center of cross border Halachic debates, the introduction he wrote primarily stresses financial support and not transnational discourse. Accordingly, the first issue's subtitle was "an issue dedicated to Torah and wisdom **published with the help of** our greatest rabbis and the best and wisest of our time in the Land of Israel and abroad." Koenka's objective became clearer from the second issue, as reflected in its new subtitle, which differed by only five words: "an issue dedicated to the Torah and wisdom **of** our greatest rabbis and the best and wisest of our time in the Land of Israel and abroad."[19] International philanthropy was replaced by global communication.

17 Quoted in: Ezra Batsri, *Ha-Me'asef* 1, no. 1 (1979), 8 (in Hebrew).
18 Ben-Zion Abraham Koenka, *Ha-Me'asef,* 12 June, 1896 (in Hebrew, bold not in the original quotation).
19 *Ha-Me'asef,* 19 June, 1896, 1 (in Hebrew, bold not in the original quotation).

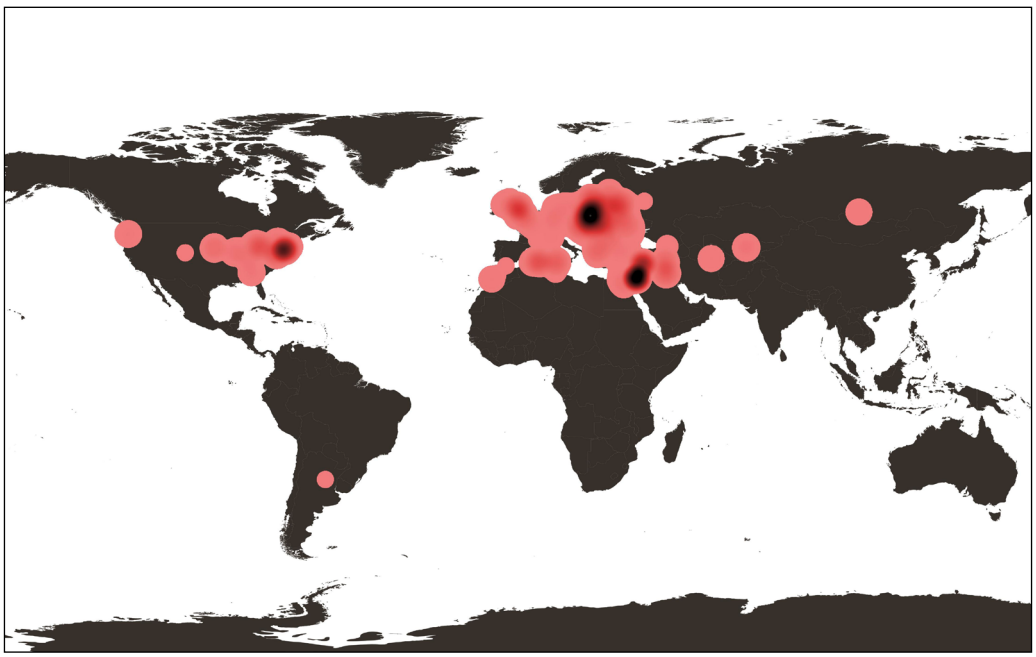

Fig. 1 A heat-map showing the density of writers for *Ha-Me'asef* between 1896 and 1914. The map was created in QGIS.

Koenka's success in retrospect was tremendous: over 19 years, authors from across the Jewish world published their articles in his journal, as can be seen in Figure 1. The network created between the authors (Figure 2) was dense, entangled and crossed borders that were previously unimaginable. In this network, two nodes that signify locations are connected if an article written in one of them responded to an article written in the other. However, the historical development and spread of this network was gradual, non-linear, and connected to the personal stories of Koenka and his writers.

At the beginning, the journal was supported by all the main rabbis in Jerusalem, and accordingly the group of contributors remained local and Jerusalem-based.[20] Most of the writers were Koenka's teachers (Yitzhak Ashkenazi and Vidal Ben Hanoch Anjil), students (Hananya Yehoshua ben Gabriel and Ben-Zion Uziel), family members (Yitshak Badhab), and many acquaintances from the Sephardic community. With the aim of making the journal friendlier to foreign writers, Koenka made some strange editorial decisions in the first couple of months.

20 Yitzhak Bezalel, "Ha-Rabanim Ha-Sefaradim Ve-Ha-Itonut Be-Eretz Israel Ba-Tkufa Ha-Othmanit," *Kesher* 37 (2008), 64–70 (in Hebrew).

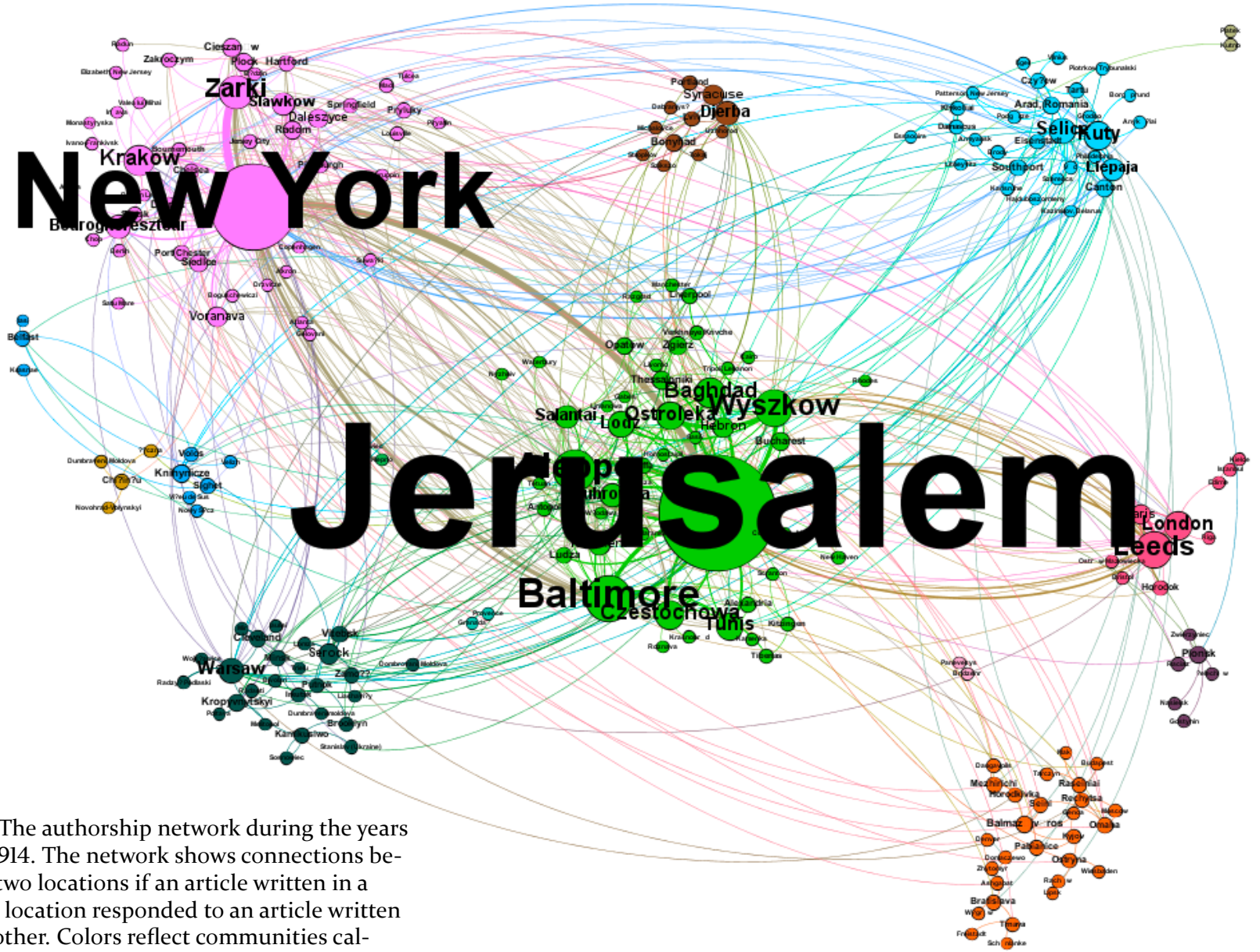

Fig. 2 The authorship network during the years 1896–1914. The network shows connections between two locations if an article written in a certain location responded to an article written in the other. Colors reflect communities calculated by the Modularity algorithm in Gephi. The graph was created in Gephi.

The first author from outside the Land of Israel was a 19-year-old yeshiva student from Baghdad named Yechezkel Ezra Ben Rachamim, who sent a letter to Rabbi Abraham Bijajo in Jerusalem without any intent of it being published. However, the letter was published in the journal's second issue with an introduction that stated "to my friend the editor of Ha-Me'asef [...] I received this letter from my friend [...] I hope you add it to your journal as I find it a good work."[21] The second contribution written by a foreign writer, who should be considered the first intentional contributor, was published in the seventh issue (24 July, 1896). Hizkiya Moshe David Israel, the chief Rabbi of Rhodes, sent a letter to the editor of the journal, which was published as the first article of the issue.[22] However, the letter did not include any halachic interpretation or new insight, but rather a few words of appreciation to the editor and a commitment on behalf of the rabbi to purchase an annual subscription. This letter bore no resemblance to any of the other articles, and its inclusion could only be explained by the desire to introduce international authorship.

The eighth issue was a turning point in the founding of a global network, since it included the first real contribution by a foreign contributor. Furthermore, from this issue onwards, every issue included at least one foreign writer. The contribution, which opened the eighth issue, was written by Rabbi Shalom Ha-De'iya from Aleppo, and described his motivation as follows: "we received the issues of *Ha-Me'asef* and were delighted at the idea stemming from our friend the rabbi editor."[23] Ha-De'iya stresses the 'idea' that motivated him to send his contribution to the Jerusalem journal and not the contents or debates in *Ha-Me'asef*. The journal was seen as something bigger than merely its contents; it was seen as a social network, rather than a journal. Furthermore, Ha-De'iya refers to himself in the plural. This was not a convention adopted by other writers, and it was not a mistake. He wasn't talking about himself as a singular writer but rather about the rabbinical community in Aleppo as a whole.[24] What he was saying was that the whole community wished to take part in Koenka's project. It is worth mentioning that Shalom Ha-De'iya was not an ordinary Aleppo rabbi, since he had many ties with Jerusalem rabbis. In fact, a year and a half later, Ha-De'iya immigrated to Jerusalem and lived a few houses away from Koenka. The same inter-personal relations that widened the group of writers inside Jerusalem also brought about the first international expansion. The journal was now officially international. The importance of geography was also accentuated by the fact that, from the eighth issue

21 Abraham Bijajo, Article VII, *Ha-Me'asef,* 19 June, 1896. (in Hebrew).
22 Hizkiya Moshe David Israel, Article XXXIV, *Ha-Me'asef,* 24 July, 1896. (in Hebrew).
23 Shalom Ha-De'iya, Article XLIV, *Ha-Me'asef,* 31 July, 1896. (in Hebrew).
24 The inner unity of the Jewish Aleppo community was also identified by other scholars. See: Zvi Zohar, "Shamranut Lokhemet: Kavim Le-Manhigutam Ha-Khevratit-Datit shel Khakhmey Haleb Ba-Et Ha-Khadasha," *Pe'amim: Studies in Oriental Jewry* 55 (1993) (in Hebrew).

onwards, the place of residence of each writer was written in the title of the article, not just at the end.

The tenth issue, two months after the establishment of the journal (14 August, 1896), was the first issue written mostly by foreigners, all of whom were from Aleppo and related to Shalom Ha-De'iya. In order to introduce new writers (and limit old ones), Koenka defined a new editing rule – "a single issue between two scholars cannot appear more than three times in Ha-Me'asef."[25] The tenth issue seemed like the beginning of a global journal and this comment was a way to legitimize limitations put upon the Jerusalem milieu of writers, who continuously recycled their internal debates.

However, the editorial notes within the journal remained extremely local. The second issue ended with a comment written by Koenka, in which he apologizes to Rabbi Rachamim Haim Oplatka for delaying the publication of his letter due to the multitude of writers.[26] The comment, in contrast to its content, doesn't indicate the contribution of many writers but rather the small number of writers and the familiarity between them, since the comment is a personal note to a particular writer. The seventh issue (24 July, 1896) includes a sentence describing ways to contact the editor. "Whoever has a thing to say to the editor can meet him on Monday and Wednesday between two and three o'clock Turkish time at Mister Elazar Meyuchas's yeshiva."[27] The meetings between the editor, the authors and the readers were supposed to take place face-to-face in Jerusalem during the editor's lunch break, information that was not relevant for an international authorship. In fact, only in October 1906 did the address appear on the front page, "Rabbi Ben-Zion Abraham Kohenka, Jerusalem". The localness of the journal was not only apparent in the fine print, but also in the actual distribution of writers during the first year. Figure 3 shows that the journal was still Jerusalem based, with a small number of foreign writers.

Gradually, authorship expanded during the first year, as the next series of maps shows (Figure 4). These changes were mostly caused by geographical proximity. There were rarely any sudden spatial leaps to distant locations; the journal's CFP moved by word of mouth until it spread across Europe. Figure 5 shows the consistent rise in the average distance between authors and Jerusalem in every issue during the first six years. The increasing distance was the result of two interrelated developments: new and distant locations were being represented in the journal, and writers from Jerusalem in particular, and Palestine in general, were losing their dominance.

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25 Ben-Zion Abraham Koenka, "Te'ana Bi-Ktsara," *Ha-Me'asef,* 14 August, 1896 (in Hebrew).
26 Ben-Zion Abraham Koenka, "Te'ana Bi-Ktsara," *Ha-Me'asef,* 19 June, 1896 (in Hebrew).
27 *Ha-Me'asef,* 24 July, 1896, 1. (in Hebrew).

Fig. 3 A heat-map showing the density of writers for Ha-Me'asef in 1896. The map was created in QGIS.

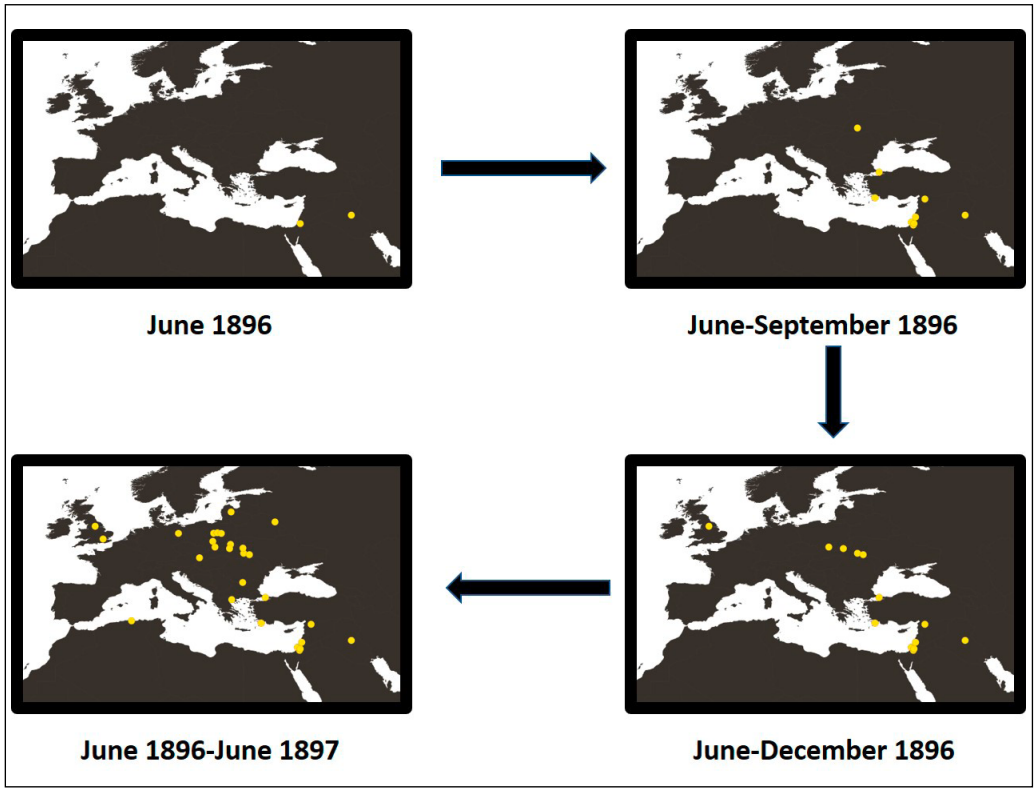

Fig. 4 Four maps showing the changing distribution of writers for Ha-Me'asef during the first year of the journal. The maps were created in QGIS.

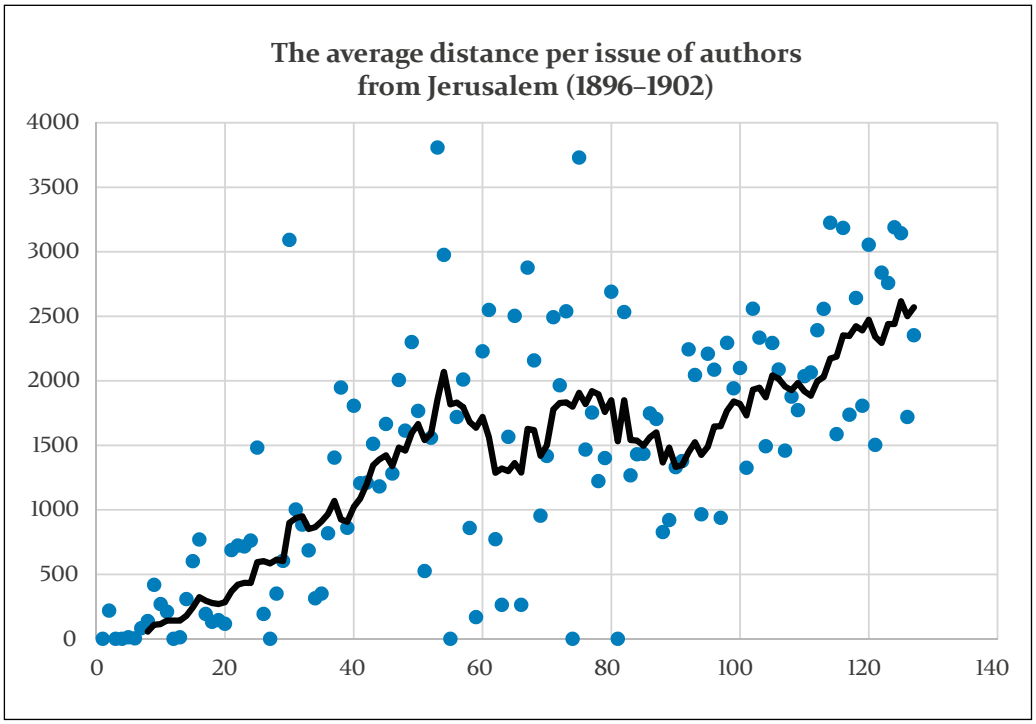

Fig. 5 A graph showing the average distance from Jerusalem (y-axis) of authors in every issue (x-axis). The black line is a moving average trend line (eight issue average) showing the general rise during the first six years.

During the first three years, 139 articles were written by authors from Jerusalem (32 percent of all the articles). In the next three years, only 96 articles were written by Jerusalem authors (22 percent). The number dropped to 34 articles between the 7th and 9th year (eight percent), and a single article in the 19th year. Koenka's international journal was a success, but its spatial expansion came at the expense of the center, Jerusalem.

4. A decentralized and ill-connected network (1898–1902)

Centrality is an important concept in the study of social networks in general, and the network of writers in particular. However, there are many different measures of centrality, each with its own definition of 'importance'.[28] *PageRank,* for example, is a metric developed by Google to measure the relative importance of

28 Stanley Wasserman and Katherine Faust, *Social Network Analysis: Methods and Applications* (Cambridge: Cambridge University Press, 1994), 169.

a webpage based on the quality and number of links to that page.[29] This metric represents the likelihood that a person randomly clicking on links will arrive at that particular page. The abstract idea of a random-surfer provides a basis for analyzing a hierarchical network, independent of the websites' contents. Consequently, in recent years, *PageRank* has become a popular metric for analyzing citation networks among journals, papers and authors.[30] That same metric can be used to measure the centrality and importance of a contribution in *Ha-Me'asef,* if we define quotations and responses as links to the original contribution. The following analysis is limited to contributions that participated in the network of responses. That is, only contributions that responded to others, or were the recipients of such responses.

PageRank measurements from the first three years testify that Jerusalem was gradually losing its superiority (Table 1). In 1896, a random reader moving from article to article by citations had a 41 percent chance of ending with an article written in Jerusalem. By 1898, the chance of ending with an article written in Jerusalem declined to seven percent. The third year (1898) was a turning point as Jerusalem dropped to fourth place. Furthermore, the declining values of the PageRank measurements reflect the decentralization of the network, since higher values reflect higher centrality.

The centrality of Leeds was largely the result of a single contributor, Rabbi Arieh Leib Mendelsson, who published 17 articles between 27 November, 1896, and 1 September, 1899. However, a closer examination of the network shows that the new centers (Leeds, Paris, and London) were not truly global centers and that the network was In fact not an elaborate and dense network which connected the various locations. Figure 6 visualizes the connections between the locations of authors in the first three years of the journal. The coloring of the various nodes

First year (1896)	**Second year (1897)**	**Third year (1898)**
Jerusalem – 0.414	Jerusalem – 0.235	Leeds – 0.207
Hebron – 0.351	Aleppo – 0.109	Paris – 0.148
Rhodes – 0.233	Baghdad – 0.08	London – 0.088

Tab. 1 The top three locations measured by PageRank metrics in the first three years. All measurements were made using Gephi.

29 See: Lawrence Page et al., *The PageRank citation ranking: Bringing order to the web,* Stanford InfoLab, 1999.

30 David F. Gleich, "PageRank beyond the Web," *Siam Review* 57, no. 3 (2015).

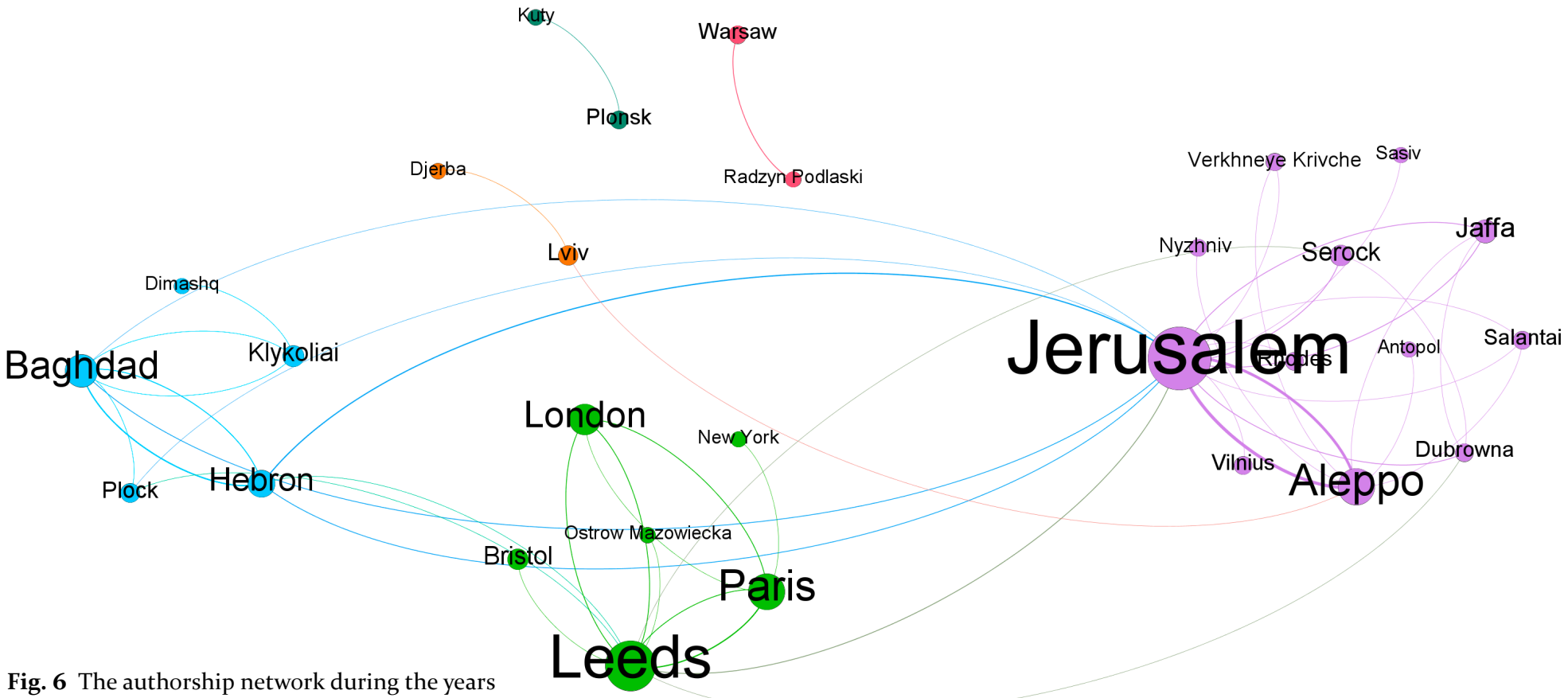

Fig. 6 The authorship network during the years 1896–1898. Colors reflect communities calculated by the Modularity algorithm in Gephi. The graph was created in Gephi.

was done using a clustering algorithm that compartmentalizes the network into sub-networks.[31] Although the network as a whole is mostly connected, some sets of nodes are more interconnected than others. Modularity identifies these subsets and decomposes the network into "communities of densely connected nodes, with the nodes belonging to different communities being only sparsely connected."[32] The image shows that there were three central groups of locations: a Middle-Eastern group consisting primarily of Baghdad, Hebron and Damascus; a West-European group consisting primarily of Leeds, London, Paris and Bristol; and a general group situated around the Mediterranean consisting of Jerusalem, Aleppo and Jaffa. The correlation between the social groupings and the geographical settings shows that the centrality of Leeds was a superficial centrality that resulted from internal West-European discourse, which did not concern the other authors.

A closer reading of the relevant articles shows that they were part of a debate regarding a particular step in the Jewish circumcision process, which deals with the sucking of blood from the wound.[33] The invention of a special glass tube for this purpose in 1898 brought about a heated west-European debate on the different methods of forming the suction. The centrality of Leeds was not a result of rabbinical importance but rather an internal debate among geographically close rabbis. Jerusalem was no longer the focal point of the network but no other true core had emerged. The network was simply too fractured along geographical lines. During the first six years (until October 1902), 97 of the 345 responses (28 percent) discussed a rabbi living less than 120 km from the location of the contributor (local citations), and 58 percent of the responses discussed a rabbi living less than 1000 km from the location of the contribution (regional citations). Despite the geographical span of the network, discussions were mostly local and the network was largely divided by regional boundaries.

5. The new continent (1902)

The next turning point occurred in August 1902. Ben Zion Koenka, the journal editor, traveled constantly around the world to raise funds for various purposes, one of which was the journal. In August 1902, Koenka arrived in the USA and lived there for a year.[34] During that year, he worked as a Posek[35] and was praised

31 On Modularity algorithms see, Vincent D. Blondel et al., "Fast Unfolding of Communities in Large Networks," *Journal of Statistical Mechanics: Theory and Experiment* 10 (2008).
32 Ibid, 2.
33 See: Leonard B. Glick, *Marked in Your Flesh: Circumcision from Ancient Judea to Modern America* (Oxford: Oxford University Press, 2007), 131–132.
34 Ezra Batsri, *Ha-Me'asef* 1, no. 1 (1979), 7 (in Hebrew).
35 A legal scholar who decides the Halacha in cases where previous authorities are inconclusive or no halakhic precedent exists.

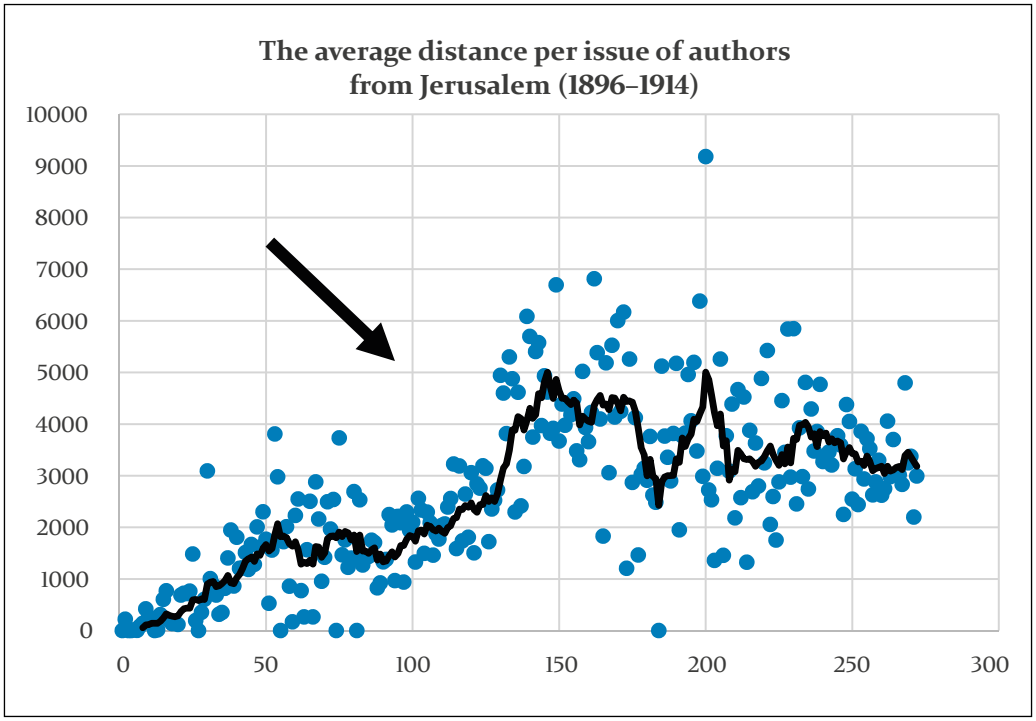

Fig. 7 A graph showing the average distance from Jerusalem (y-axis) of authors in every issue (x-axis). The black line is a moving average trend line (8 issue average). An arrow marks the sudden change in average distance following the introduction of American authors into the journal (Issue 128, November 1902).

by local rabbinical authorities. By this time, a number of American authors had already published in the journal, but these contributions were irregular, rather than a trend. Following his American voyage, the sporadic contributions became a frequent occurrence. The first issue of the Jewish year 5663 (October 1902) began with 49 greetings and recommendations written by leading American rabbis. In November 1902, three months after the arrival of Koenka in America, the number of American articles was so great that the average distance of an author from Jerusalem, as reflected in Figure 7, had increased drastically, by approximately 1500 km. This was a direct outcome of Koenka's growing influence in America.

In the following three years (1902–1904), the United States became an important center of authorship and many of the articles within the journal discussed American-oriented topics, such as the employment of non-Jews in the construction of synagogues and the usage of new technologies such as electricity and the telephone.[36] However, unlike the story of the exclusive West-European group of

36 Geffen, "Economic, Social and Religious Issues."

Leeds/London/Paris, the American contributors never formed a clique. On the contrary, the introduction of American authors broke down geographical boundaries between the regions. Between October 1902 and June 1905, the share of local citations (up to 120 km) fell to 17 percent of the total amount. This number dropped even further to 12 percent during 1905–1909, and seven percent during 1909–1914. The share of regional citations (up to 1000 km) dropped from 58 percent prior to Koenka's trip to the US, to 25 percent in the three years afterwards.

6. Maximal expansion and stagnation (1906–1909)

During 1906–1909 the network of writers stabilized and came from numerous centers in Poland and eastern USA, as well as Jerusalem. During this period, the average distance of authors from Jerusalem per issue remained roughly 4000 km, as reflected in the moving average trend line in Graph 2, and the average distance between two debating contributors was approximately 3500 km. This was the maximal geographical expansion of the network, as shown in Figure 8. However, this zenith was accompanied by a systematic stagnation and a general decline in the number of published columns (Table 2). This declined from an annual average of 157 columns between October 1903 and October 1905, to 106 columns annually between October 1905 and October 1909. The stagnation was also seen in a systematic decline in new contributors. The number of new authors in every issue declined from an annual average of 30 between October 1903 and October 1905, to 15 annually between October 1905 and October 1909. The number of new places declined from an annual average of 11 between October 1903 and October 1905, to 6 annually between October 1905 and October 1909. This stagnation was the result of two major factors: the network becoming too scattered, and Koenka himself, who suffered personally from a few difficult years.

In a notice to readers on 3 August, 1906, Koenka acknowledged that the previous year (1905–1906) had been a difficult financial year for the journal, and requested financial as well as spiritual support from his readers and writers.[37] However, Koenka's personal problems soon became a bigger issue than the journal's finances.

In July 1906, the Chief Sephardic Rabbi of Israel, Yaakov Shaul Elyashar, passed away. The political struggle over his successor affected Koenka greatly and caused him to leave Jerusalem. He wrote in his diary,

37 Ben-Zion Abraham Koenka, "Ending Comments," *Ha-Me'asef,* 3 August, 1906, 23 (in Hebrew).

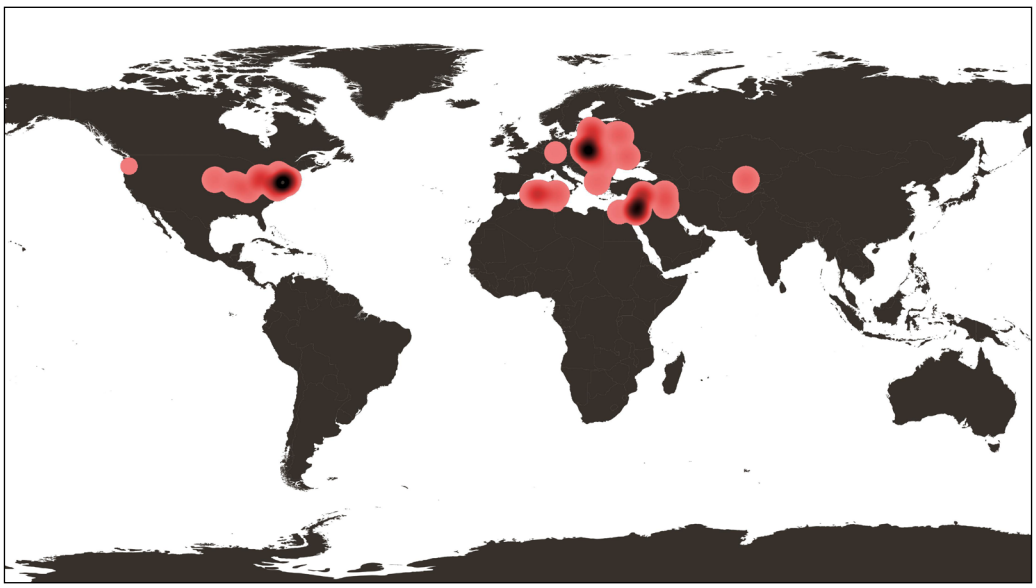

Fig. 8 A heat-map showing the density of writers for H-Me'asef during the years 1906–1909. The map was created in QGIS.

> During Tamuz 5666, the great Gaon Yaakov Shaul Elyashar, the head of all rabbis and the Chief Sephardic Rabbi, passed away, and then the great controversy over the position erupted. Almost all of the rabbis and the learned men, the elder and the younger, were divided between two factions. I, as always, did not tend to either of the two factions. Once I realized that I was getting dragged into this controversy, I understood that it would be much better for me to leave.[38]

Koenka traveled to Alexandria, Algiers and Tunis, and was later asked to serve as the Deputy Chief Rabbi of Alexandria. He accepted the offer and moved his family to Alexandria for a year, during which the journal was published in Egypt. It is obviously hard to assess the effects of these circumstances on his editorial competency, but it was most likely a time of tribulation in his life. Koenka himself refers to his troubles in a short notice at the end of the 7 June, 1907, issue:

> To all my dearest friends and loved ones who asked me privately to enjoy their contributions and respond to them in my dear *Ha-Me'asef,* I must notify them that I will not be able to fulfill their wishes as of now, although I would be glad to do so, because many different hassles surround me.[39]

38 Quoted in: Ezra Batsri, *Ha-Me'asef,* 8 (in Hebrew).
39 Ben-Zion Abraham Koenka, "Ending Comments," *Ha-Me'asef,* 7 June, 1907, 30 (in Hebrew).

Although Koenka returned to Jerusalem by the end of 1907, the general state of stagnation of the journal's network did not change. New authors and places were not introduced, and the variety of places per issue remained relatively low (Table 2). Perhaps the lack of innovation was not entirely caused by Koenka's problems, but rather by the spatial diffusion of the network. In his infrequent editorials, Koenka often uses the phrase "my friends" to describe the global network of authors of the journal. However, when he writes about utilizing the network to support the journal, he refers to geographically proximate networks rather than global ones. In the October 1902 editorial, he writes from New York about the

Year (by Hebrew year)	The total number of articles	The number of responding articles	The total number of new contributors	The total number of new places	The number of different places per issue
1896	80	18	52	8	2.00
1896–1897	223	61	81	31	3.97
1897–1898	126	51	23	11	2.83
1898–1899	137	34	35	19	2.54
1899–1900	133	28	27	16	3.09
1900–1901	176	69	28	13	3.29
1901–1902	139	57	17	5	2.91
1902–1903	111	15	35	8	2.20
1903–1904	163	33	29	14	3.43
1904–1905	152	68	30	8	3.23
1905–1906	114	47	22	6	2.34
1906–1907	99	32	12	6	2.23
1907–1908	118	59	12	6	2.20
1908–1909	93	41	13	5	2.00
1909–1910	126	27	21	14	2.69
1910–1911	188	67	43	24	4.09
1911–1912	204	77	42	27	4.83
1912–1913	226	81	55	30	5.11
1913–1914	212	75	56	28	4.89

Tab. 2 Statistical measures of authorship in each year: the total number of contributions, the total number of responding articles, the number of new authors and places per year, and the average number of different places per issue.

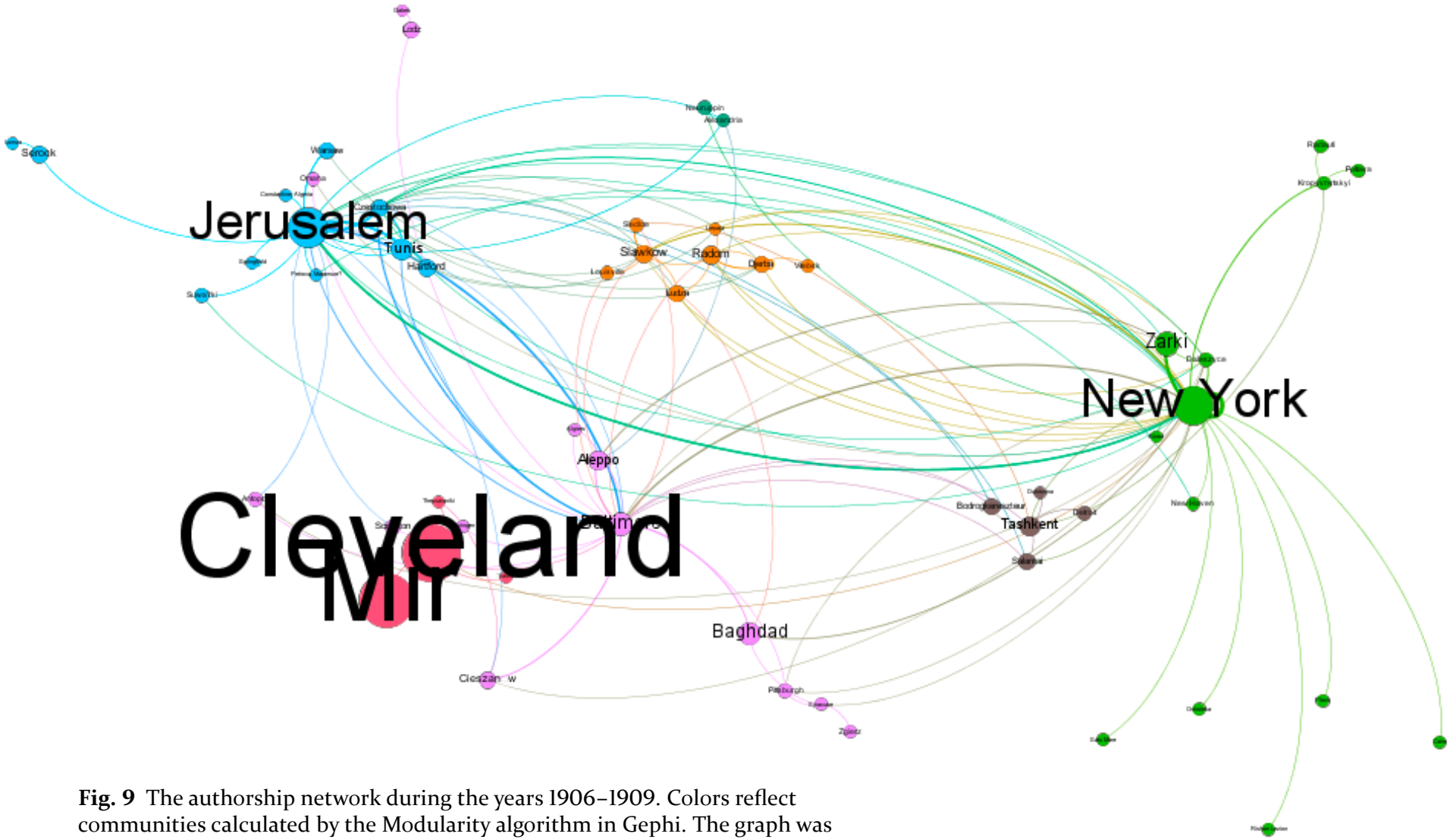

Fig. 9 The authorship network during the years 1906–1909. Colors reflect communities calculated by the Modularity algorithm in Gephi. The graph was created in Gephi.

things he plans on doing once he returns to "his friends" in Jerusalem.[40] In the August 1906 editorial, he requests all the supporters of the journal to turn to "their friends and acquaintances" for further support. In other words, Koenka understood that this global network depended on local communities. The problem in the years 1906–1909 was perhaps that the network had become so widespread that it lost its familiarity; people were less engaged without their local community.[41]

Despite the general stagnation, the network was much more extensive in its internal connections than in the past (Figure 9). There were five main groups: one surrounding Cleveland and Mir (located in modern day Belarus); a second surrounding New-York that included Daleszyce (located in modern Poland); a third surrounding Baghdad, Baltimore and Aleppo; a fourth surrounding Jerusalem, Tunis and Hartford, Connecticut; and a fifth including Tashkent, Salantai (located in modern day Lithuania) and Bodrogkereszteur (located in modern day Belarus). Regional boundaries were no longer a defining factor of this network.

7. Convergence and the return of internal dynamism (1909–1914)

During 1909–1914, the dynamic nature of the network was restored: the number of new authors reached new heights (56 in 1914), much like the number of new places, which reached 28 in 1914, the number of different places per issue (an average of 14 between 1909 and 1914 compared to 6.5 between 1906 and 1909), and the number of ongoing debates (an average of 74 annually between 1909 and 1914, compared to 46 between 1906 and 1914) (Table 2).

The new network structure (Figure 10) contained six central groups with no dominant cities, as well as dense ties between the various groups. However, geographically, the direction was reversed (Figure 11). The system converged upon a single geographic center in Eastern Europe, which consisted of many towns and cities, rather than a single center such as Jerusalem, Aleppo, Leeds or New York as in past years. This convergence was manifested in a large decrease in the average distance from Jerusalem (approximately 2500 kilometers on average) and a small decrease in the average distance between debating contributors (approximately 3000 km on average).[42] Correspondingly, the number of regional responses (up

40 Ben-Zion Abraham Koenka, "Akhrit Davar," *Ha-Me'asef,* 3 October, 1902 (in Hebrew).

41 Studies on knowledge acquisition have shown that greater geographical distance decreases knowledge transfer. See: Yukiko Murakami, "Knowledge Acquisition through Personal Networks: Influences of Geographical Distance and Tie Strength," *European Conference on Knowledge Management* (2019).

42 Neta Olevski was a geographical outlier, since he wrote six articles from the eastern city of Irkutsk during the eighteenth and nineteenth years of the journal.

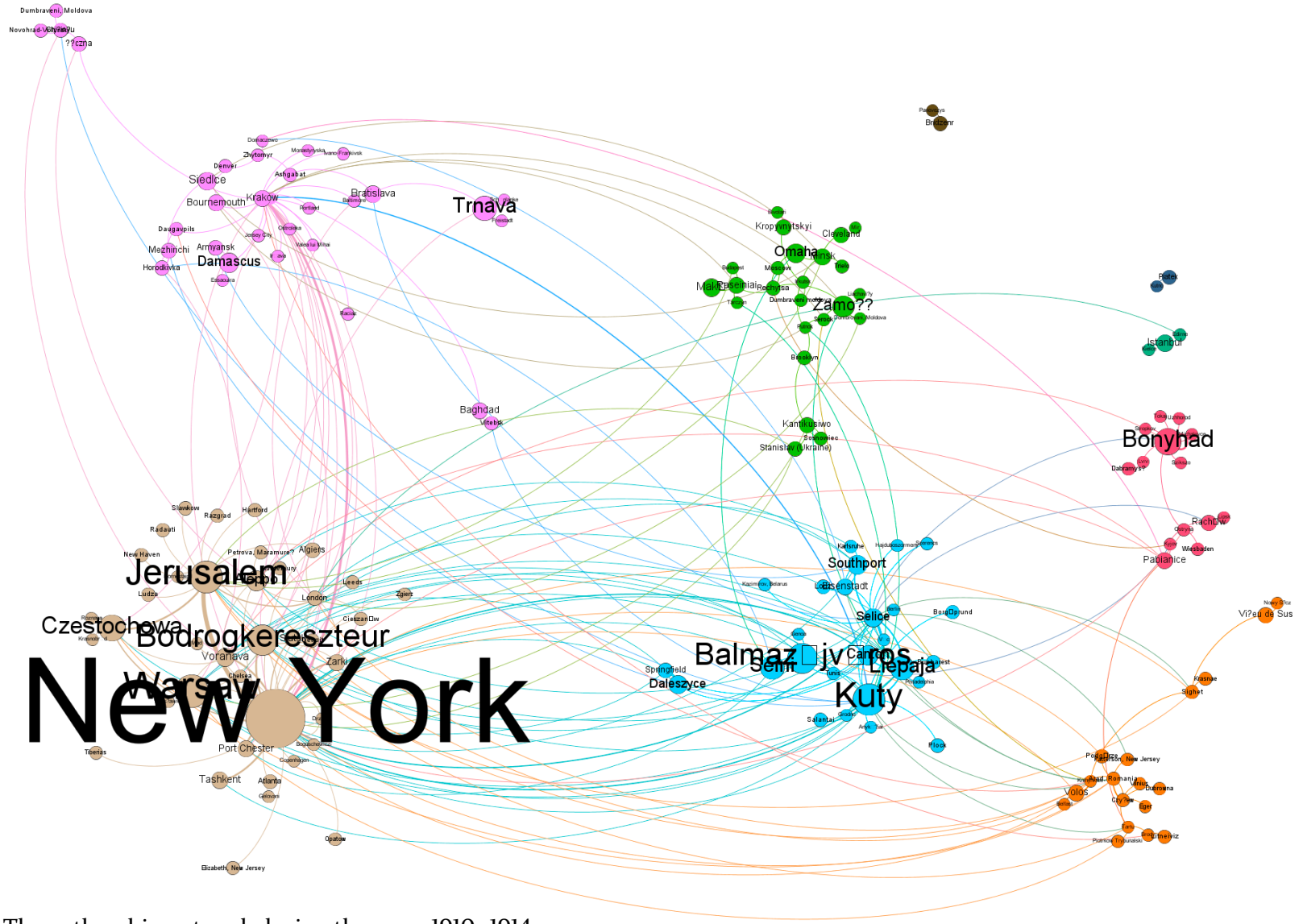

Fig. 10 The authorship network during the years 1910–1914. Colors reflect communities calculated by the Modularity algorithm in Gephi. The graph was created in Gephi.

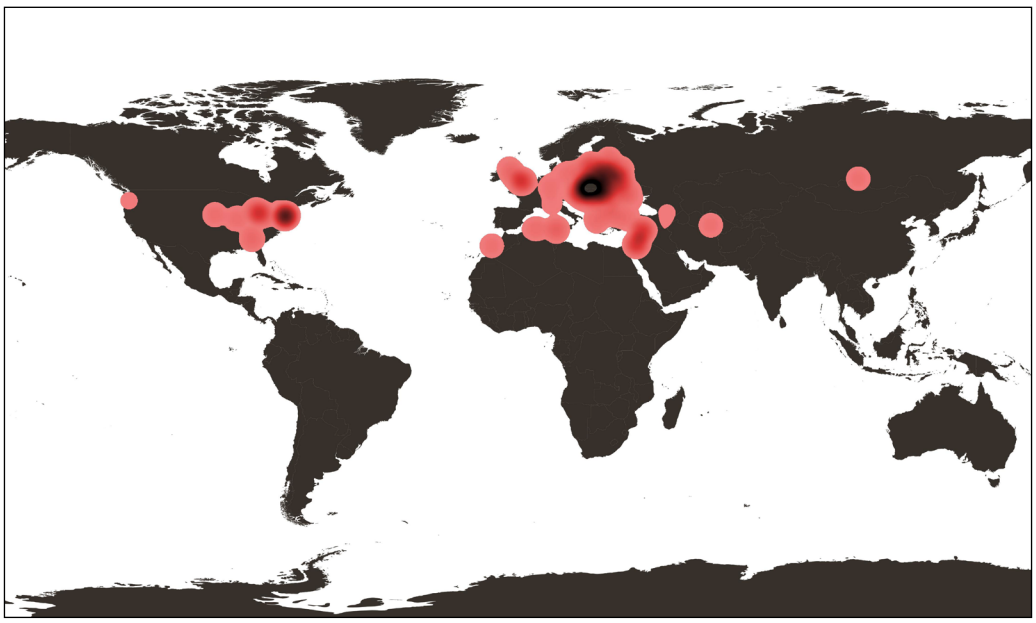

Fig. 11 A heat-map showing the density of writers for H-Me'asef during the years 1910–1914. The map was created in QGIS.

to 1000 km) rose compared to the previous four years (39 percent compared to 26 percent). Dynamism, innovativeness and variety returned due to geographical convergence rather than expansion.

8. The end of the journal

The journal ended abruptly, without warning, in September 1914. In April 1914, Koenka opened his traditional semi-annual editorial by stating that

> Here we are slowly improving Ha-Me'asef in order to enlarge it [...] and we hope that we can add appendixes in most of the coming issues...we will ask all our friends and supporters to try to distribute Ha-Me'asef among their friends and acquaintances so that we increase the number of supporters, benefactors and sponsors.[43]

There is no indication that the journal was about to be closed. However, the September issue was the last one published by Koenka. World War One, which started in July-August 1914, led to the collapse of the social network created by Koenka and his writers. Because of the war in Europe, the postal system did not

43 Ben-Zion Abraham Koenka, "Li-Menuyey Ha-Me'asef Ha-Nikhbadim," *Ha-Me'asef,* 3 April, 1914 (in Hebrew).

operate, and the connections between the editor and the authors were disrupted. In addition, money from subscribers could not arrive. By October 1914, Koenka was suffering from increasing debt. Consequently, Koenka left Jerusalem to live in Baghdad for a number of years, and the journal was terminated.

9. Conclusion

The study of Jewish journalism in general, and journals published in the Land of Israel in particular, has focused almost entirely on Ashkenazi publishers.[44] As a result, the role of journals, such as *Ha-Me'asef,* in the establishment of a global and transnational Jewish community was marginalized. Furthermore, the focus on European-oriented journals led to claims that nineteenth-century journals published in Jerusalem were generally written for the European reader.[45] However, *Ha-Me'asef* did not fit this mold. It was literally and explicitly designed as global, and rather than focusing on readers, it was focused on writers. In the editorial from the October 1902 issue, Koenka states that his mission is far from complete, since the potential rabbis who could add to his creation of the journal "are not located in a single place, but rather scattered at the edges of earth and distant islands."[46] He uses the allegory of a tree, which is planted by a single person but needs many others to provide water and cultivation, in order for the tree to blossom.

The ability of *Ha-Me'asef* to encompass such a wide and heterogeneous group of authors was the result, among others, of its strategic location in Jerusalem, as well as Koenka's editing style. During the late nineteenth century, a varied group of rabbis assembled in Jerusalem: Ashkenazi, Sephardic, Hasidic, non-Hasidic, educated, and Conservative-Orthodox, to conduct a lively inter-communal debate regarding Judaism, settlement in the Land of Israel, and the relation between these topics and the modern world. Zvi Zohar claims that between the anti-modern "Shomrei Emuney Israel" and the liberal-minded people of the Enlightenment, stood the Sephardic Rabbis, represented in the journal by Rabbi Ben Zion Koenka.[47] These rabbis did not wish to shut themselves away inside their community, but rather conduct an open dialogue with other communities, which also included the secular Jewish settlers in Palestine.[48] As a result, *Ha-Me'asef* did not try to impose a Sephardic agenda, and was never committed to

44 Yitzhak Bezalel, "Ha-Rabanim Ha-Sefaradim."
45 Bartal, "Mevaser U-Modi'a Le-Ish Yehudi," 162; Uzi Elyada, *Ha-Olam Ha-Tsahov: Leydat Itonut Ha-Hamon Ha-Erets Israelit,* (Tel Aviv: Tel Aviv University, 2015), 27–59.
46 Ben-Zion Abraham Koenka, "Akhrit Davar".
47 Zvi Zohar, *He'iru Pney Ha-Mizrakh: Halakha Ve-Hagut etsel Khakhmey Israel Ba-Mizrakh Ha-Tikhon,* (Tel Aviv: Hakibutz Hameuhad, 2001), 353–364.
48 Bezalel, "Ha-Rabanim Ha-Sefaradim," 65–69.

a specific halachic tradition. It was a place for transnational, cross-border, and cross-factional discussions.

The formation of social networks in general and social scientific networks in particular always involves the ongoing rise and fall of network centers. In order for the system to withstand the pressure of continuous changes, it must rely on flexible values that enable new groups to enter without forcing them to assimilate. This was the case with *Ha-Me'asef* in 1898–1900 with the West-European group, and later on in 1903–1904 with the American group. The great success and achievement of *Ha-Me'asef* was partially due to the fact that it never forced topics upon its writers that would be of interest to the Jerusalem community – there was no attempt to channel authors into specific styles of writing. The goal was to have an open environment that could accommodate the many voices and currents that belong to Jewish Orthodox life.

The network was not a success because of its global expansion, but rather mainly due to its ability to break previously existing geographical boundaries. Regional divides ceased being a matter of relevance to authors, especially following the introduction of American authors. The existence of internal groups, schools of thought, and 'hidden colleges' is natural, and is part of the inner-dynamics of every social network, scientific networks in particular.[49] These groups are important factors in the process of advancing knowledge and the creation of a fruitful discussion. However, in order for science, or in this case Halakhic research, to develop, it is important for these groups to consolidate on the basis of intellectual connections, not merely regional constraints and communication limitations. However, geographical expansion cannot expand to such a degree that authors lose all personal ties with the network. This is why the convergence of the system in its final stage revitalized the network.

The local periodical, which started as the dream of a 29-year-old editor who asked his students, teachers and family members to help fill the first printed issues, transformed into a global transnational network of authors. This network connected scholars from across the Jewish world, but simultaneously marginalized the Sephardic community in Jerusalem, from which it originated. The journal peaked in popularity and diversity, but the Sephardic voice that set the tone in the first few years was replaced by English/American/East-European voices that discussed different topics in a different dialect.

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49 See: Diana Crane, *Invisible Colleges: Diffusion of Knowledge in Scientific Communities* (Chicago: The University of Chicago, 1972); Christine L. Borgman and Jonathan Furner, "Scholarly Communication and Bibliometrics," *Annual Review of Information Science and Technology* 36 (2002).

On a broader level, this study demonstrates the advantages as well as disadvantages of computational and quantitative tools for analyzing the 'biographies' of periodicals. By combining distant reading methods such as spatial analysis of the journal's authors with network analysis of the ongoing discussions, as well as closer readings of the significant contributions and the editor's biography, *Ha-Me'asef* can be understood as a multilayered and dynamic phenomenon. The history of a journal is a history of communication, which is no less a history of space and social networks than it is a history of content and ideas.

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Transnational Network Formation in the Medium of Cultural Magazines

The Case of Spanish-language *'revistas culturales'* of the Modernismo and Avant-garde Periods (1891–1936)

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Keywords Cultural magazines, bimodal networks, social network analysis, network formation, transatlantic exchange

Abstract In this research article, we introduce a methodology we developed in order to collect and analyze data from 42 Spanish-language magazines which were published between 1891 and 1936. The example of the imagery found in these magazines will be used here to illustrate some of the research findings which came out of the project "Cultural Magazines from *Modernismo* to Avant-garde: Processes of Modernization and Transnational Networks". In this project, the focus was both on network formation and on the transnational exchanges established by the cultural magazines examined. Analysis is performed by establishing bimodal networks that enable the examination of transatlantic transfers between Europe and Hispanic America. Beyond the question of transfers, major insights from the project are presented, such as the observation that in the cultural field, taste dominates and limits the number of possible connections between contributors and magazines. The limitations of the chosen methodology lie in the explanatory power of centrality measures applied to bimodal networks, which provide questionable results with respect to relevant research questions. As a remedy, we propose the use of a 'cultural transfer rate' which can be calculated from the data established within the project. While this research

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project focused on the cultural exchanges facilitated by Spanish-language magazines, further research avenues that can be explored in the future, on the basis of the data provided by the project, are also discussed. The first of these avenues consists of transforming the data at hand into one-mode social networks, which would enable the analysis of the social dimensions relevant to the material, especially with regard to groups of artists and the synergies created within them. The second avenue describes how the aggregation of further data would enable researchers to trace the trajectories of individuals within the network and determine their accumulation of symbolic capital.

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1. Introduction: Cultural Magazines as Networks*

In the project "Cultural Magazines from *Modernismo* to Avant-garde: Processes of Modernization and Transnational Networks", funded by the German Research Foundation (DFG), data from more than 40 Spanish-language cultural magazines were collected. These magazines were published between 1891 and 1936 in Europe and Hispanic America, and embrace two periods, *modernismo*[1] and avant-garde. These magazines were selected according to various criteria, such as the accessibility of the journals in digital format, the variability of publication types, and their geographical and historical distribution.[2] Most of the magazines have been digitized by the Ibero-American Institute (IAI), which is part of the Prussian Cultural Heritage Foundation. Beyond the IAI, the digital repositories of institutions such as the national libraries of Spain, Chile and México provided the magazines under consideration in several data formats. Optical Character Recognition (OCR) is the exception rather than the rule in the digitized material provided by these institutions. Advanced text mining methodologies such as Named Entity Recognition (NER), topic modeling, word embeddings, or the automatic recognition of images and illustrations, can therefore not be applied. Responding to the lack of data provided by the digitizing institutions and corresponding to our specific research interests, a deep cataloguing was performed within our project. According to the principle 'who published what, when and where', approximately 31,500 datasets were collected, with one row per contribution, containing socio-biographical data on more than 3,500 contributors, information on the title and genre of the contribution, date of publication, language, translation, translator etc.[3] The term "contributor" designates an individual independently of her or his role, such as editor, writer, visual artist, translator, or other.

One of the possible network analytic approaches to cultural magazines would relate single contributions to the magazines and trace re-publications and re-uses of texts. In our case, such an approach is not easily feasible, since text mining possibilities are quite limited and the re-use of texts and illustrations was not very common in the cultural magazines under scrutiny. Unlike in newspapers,

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1 *Modernismo* is a term particular to the Spanish-speaking world for the literary aesthetics of the last decades of the 19th century, and is not to be confused with the broader term of modernism, as found in the English and North American literary tradition. See, for a brief introduction, Aching (2013).

2 See Ehrlicher, "The Corpus – Cultural Magazines from Spain and Hispanic America", in: Ehrlicher (2020).

3 The complete dataset has been published; see Ehrlicher (2020).

where news and texts were frequently re-used, in our corpus there are only a few such cases. To present some examples: Mexican poet Alfonso Reyes published his poem "Trópico" on both sides of the Atlantic, in Málaga in the magazine *Litoral* (No. 4, April 1927) and in Habana in *Revista de Avance* (No. 9, August 15th, 1927). Chilean poet-diplomat Pablo Neruda published parts of his poetry anthology "Tentativa del hombre infinito" in the avant-garde magazines *Favorables Paris Poema* (Paris, October 1926) and the ninth issue of the Peruvian magazine *Amauta* (Lima, May 1927). The magazine *Prisma,* printed in Barcelona, published a translation of Percy Bysshe Shelley's "To a Skylark" in its ninth issue (1922), while the third issue of *Amauta* (Lima, November 1926) presented another translation of the same poem, by the poet who had died more than a hundred years earlier. While these few examples impressively indicate transnational linkages between the cultural magazines of our magazine corpus, the limitations imposed by the unavailability of high-quality OCR results render a network approach focusing on a one-mode network formed out of contributions and networks less fertile as it would be in cases where these data are available.

In our approach, data collection therefore took another direction. The two terms designating our research material – the English word *magazine* and its Spanish cognate *almacén* – both have their root in the Arabic word *al-mahzan* and can therefore be understood as 'warehouse'. This is a fitting term, because the detailed cataloguing performed in the project lends itself well to the conceptualization of the modern literary-cultural magazine as a store or warehouse, in which the history of the 'commodities' which have been stored therein can be explored in the very same way as the trade that has been conducted with them.[4] Conceptualized in such a way, cultural magazines can be understood as intersections between people (contributors, translators, editors) and commodities (texts, images, literary forms, and systems of reference such as reviews).[5] Cultural magazines therefore distribute immaterial ideas about modernity and form intellectual networks which are aimed at imagined communities even beyond the narrower literary or cultural field. Moreover, technical developments, such as the introduction of facilities for image reproduction, typographical design (as

4 This concept was previously established by Ehrlicher (2014), p. 2.

5 This conceptualization lies crossways to several research areas which represent the current state of research, as there are both data-driven approaches, such as that proposed by Ikoff and Martínez (2020), or Kotin and Wulfman (2017), which do not focus on networks, as well as qualitative network research, like Bulson (2017), or Asunce Arenas (2012). The approaches to periodical networks published by Murphy (2014) or Fólica, Roig-Sanz and Caristia (2020) appear alongside the one explained in this article. Since our contribution comprises the usually separated fields of *modernismo* and avant-garde studies, it is impossible to provide an extensive overview of both research areas. Rather, we prefer to point to the very few data-driven quantitative studies that can be found within these fields, such as Reynolds (2017) or González, Fuente-Camacho and Barbosa (2018) with respect to Latin American *modernismo*.

seen, for example, in the famous visual poetry created in the avant-garde era), or the evolution of advertising graphics, bear witness to the accelerated exchange of information and commodities. This conceptualization of cultural magazines was instrumental in a data collection which included the acquisition of socio-biographical data on the contributors (sex, country of origin, years of birth and death) and a typology of the genres found in the magazines. During data collection, we classified all of the contributions in the magazines using the following seven categories: Lyricism, Fictional Prose, Drama, Review, Magazine Review, Non-fictional Prose, and Image.[6] The first three categories were derived from the established genre triad Lyricism, Epic, and Drama, a classification that has been used in the Western world for more than 2,000 years and has thus been naturalized to such a degree that it has become a common part of the social construction of reality.[7] Three further categories consider the characteristics of cultural magazines: Review, Magazine Review, and Non-fictional Prose facilitate the function of cultural magazines as societal instances for the evaluation of cultural products, and relate the magazines to discourses in the wider cultural field, be they political, philosophical, aesthetic, or other. Finally, all imagery in the magazines was allocated into the category Images. These seven categories are mutually exclusive; in borderline cases, the contributions were classified according to the most prevalent category they adhere to. Visual poetry and picture stories, for example, could both be sorted into one of the textual categories, such as Lyricism or Fictional Prose; however, only the first was classified as Lyricism, as it is the category from which visual poetry developed, whereas the latter was classified as Image, since the visual element predominates. While the classificatory work thus implied an extinction of ambivalences,[8] the resulting classification did enable a comparability between the magazines which was tailored according to the general research questions of our project. We were interested in learning how aesthetic forms were transferred across national borders, who the agents of this exchange were, and in which way network analysis contributes to a deeper understanding of cultural transfer processes. Quantitative analysis was therefore conducted in two directions: with a focus on the genre networks resulting out of the classification of contributions undertaken during data collection, and by calculating a 'cultural transfer rate', enabling us to take transatlantic transfers into account.

6 The system used to establish these categories is comprehensively explained in Herzgsell, "Categorisation as Theory and Practice: Type of Contribution", in: Ehrlicher (2020).

7 For other examples of such classifications see Bowker and Leigh Star (1999).

8 For a detailed reflection of this epistemological process see Ehrlicher and Lehmann (2019).

2. Understanding the Research Results: Three Approaches

The focus on contributors and genres already allows for the conceptualization of networks, and enables fruitful research on the transnational exchange processes that are at the heart of our project. Even the simple counting of contributions along the aforementioned classificatory lines opens up insights into the profile of magazines – be they devoted to poetry or other text forms – as well as the continual development of the layout and design of the cultural magazines during the length of their run, e.g. through the increase in the number of images (paintings, photographs, woodcuts, line drawings etc.) over time as an indicator of improved printing capacities. Each magazine has a specific profile resulting from the relative distribution of each of the seven categories. There are, for example, cultural magazines which abstain from using images at all, thus underlining the predominance of textual content and their almost exclusive focus on lyricism. Based on the periods established in the research literature on the Spanish-language cultural field, we have divided the entire dataset, comprising 42 magazines published – with two exceptions – in Spain and six Hispanic American countries,[9] as well as 5,540 contributors, into two smaller datasets, one containing 16 *modernismo* magazines (2,073 contributors; 10,340 contributions spanning the years between 1891 and 1909), and the other containing 23 avant-garde magazines (3,382 contributors; 19,516 contributions spanning the period 1920–1936).[10] The relative numbers for each category can be combined across all magazines pertaining to each of the two periods; this makes a comparison over time possible (see figures 1 and 2).

The relative percentages of each category already provide some interesting insights. The printing of dramas, for example, was not very common by the *modernismo* period; in the avant-garde era, it became negligible. The presentation of Fictional Prose in cultural magazines declined from 11.44% in the *modernismo* period to 3.71% in the avant-garde period, as did Lyricism, which declined from 24.6% to 18.9%. The largest relative increase can be noted for the two categories Non-fictional Prose and Review, which counted towards all contributions which provided commentary, information, or explanation regarding the literary and

9 The two exceptions are little magazines with extremely short runs: *Creación/Création,* which was first edited by Vicente Huidobro in Madrid (1921) and then continued in Paris (two more numbers and a supplement published in 1923 and 1924). Also Paris-based was the little magazine *Favorables Paris Poema,* which printed only two issues in total (both in 1926).

10 The attentive reader will have noticed that there are three other journals which were not included in this binary division. They are to be positioned as journals in the transition zone between *modernismo* and the avant-garde, in the ambiguous in-between of *posmodernismo,* a term first conceptualized in the highly influential anthology of Federico de Onís (2012, first edition in 1934), and a Spanish coinage which again must not be confused with its English cognate.

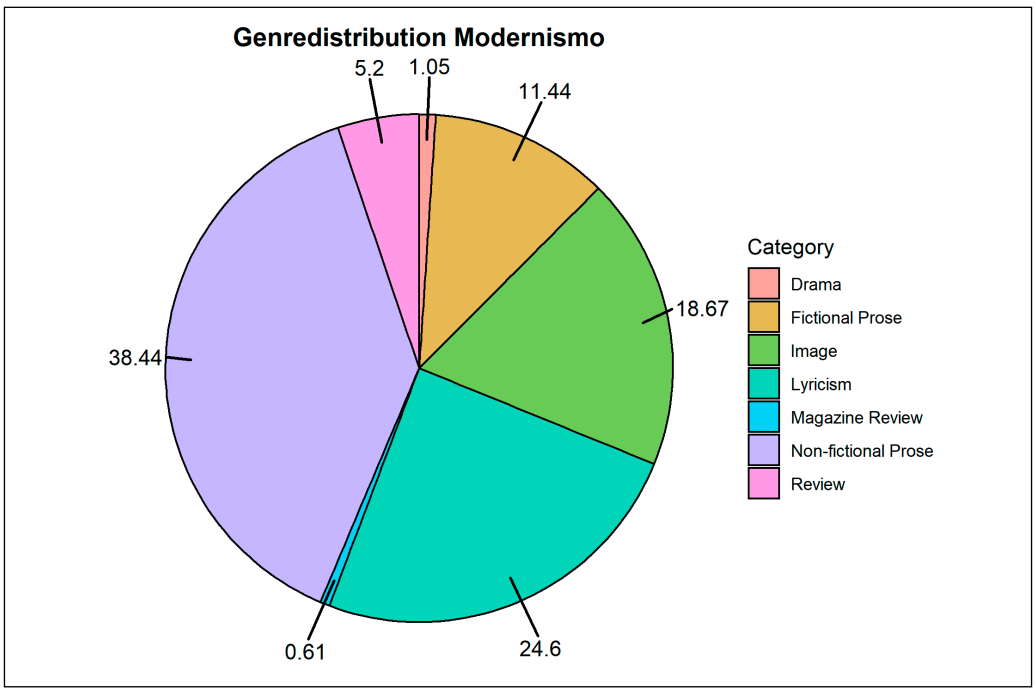

Fig. 1 Relative percentages of each of the seven categories in the *modernismo* dataset.

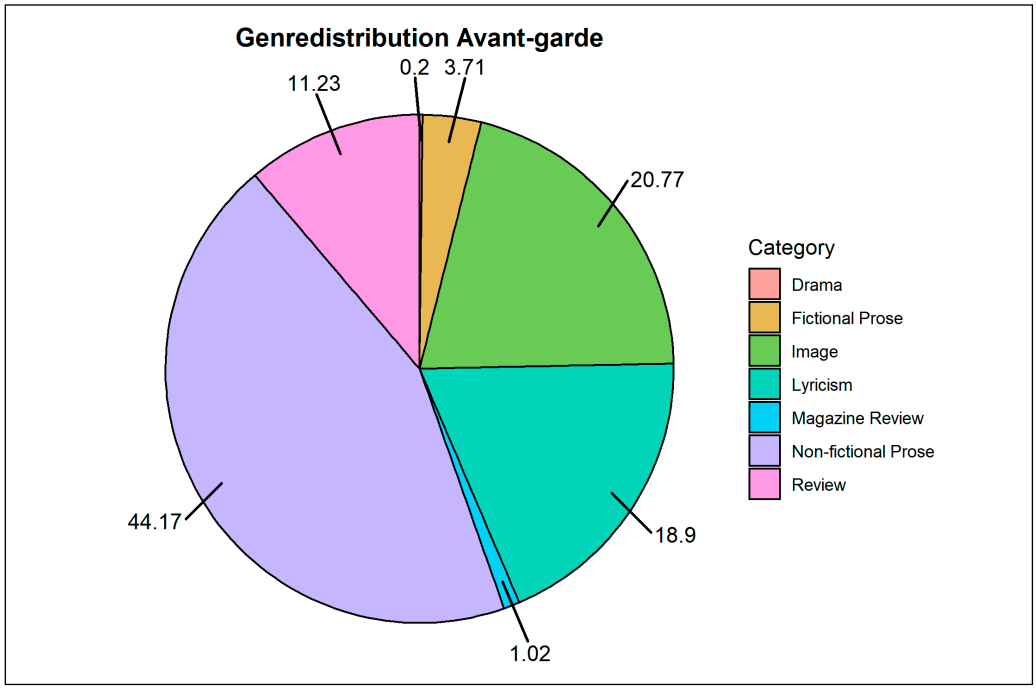

Fig. 2 Relative percentages of each of the seven categories in the avant-garde dataset.

cultural field; in this area, the relative percentage of contributions increased from 38.44% to 44.17% (Non-fictional Prose) and 5.2% to 11.23% (Review). Interestingly enough, the relative percentage of the category Image remains nearly stable; there is a slight increase from 18.67% to 20.77% between the *modernismo* and avant-garde periods.[11] Generally speaking, these numbers speak of a certain shift from original content in the categories Lyricism, Non-fictional Prose, and Drama, to those categories providing a means of exchange within the cultural and literary fields (Non-fictional Prose, Reviews and Magazine Reviews). This could be taken as a first indicator of the growing dynamics of the field of literature and the importance of printed periodical publications finding a place within it. In terms of readership, these numbers reveal that in the *modernismo* period the audience devoted their attention to reading original 'creative' content, whereas in the avant-garde period the focus was more on the societal debate around the cultural issues facilitated by the cultural magazines.

2.1 Magazines and Genres: Images in Two Periods

The classification of all 31,500 contributions from 42 cultural magazines allows us to not only establish a profile for each magazine, but also to ensure the comparability of these contributions across magazines. Genre classifications thus present intersectional features characteristic of all magazines. We extracted all the data per genre from the entire database and constructed networks out of the resulting datasets. Because it rarely occurred that the same contribution was published twice, we constructed contributor-magazine networks for each class of genre for the purpose of answering our research questions. In other words, we took all datasets pertaining to one of the seven genres as the starting point, and treated contributors and magazines as nodes, while the contribution (provided by the magazine contributor) established the edge which linked the two different types of nodes to each other. These contributions, from various individuals to the several magazines which house a genre, form a bimodal (or bipartite) network, since contributors and magazines are not of the same type – quite obviously people and paper are different. The edges on this graph can be weighted based on the number of contributions per individual to each magazine. For the purpose of this overview article, we chose the genre Images, as for readers who may not be familiar with Spanish-language cultural magazines this category is most self-evidently understood, while allowing us to exemplify our analytic approach. In order to en-

11 Since only the number of contributions was counted, rather than the space allotted to each image or textual contribution on a single page (or several pages), these relative percentages might be intriguing. Determining and comparing the share of each contribution in terms of space still presents a huge challenge, if one recalls the differing sizes of the several cultural magazines, although there may be some technical solutions to this issue in the near future.

able a comparison over time, we constructed two bimodal networks, one for the *modernismo* period (1891–1909), the other for the avant-garde era (1920–1936).

The datasets for the genre Images comprise 296 edges, provided by 276 contributors to twelve magazines from the *modernismo* period. The first insight to be read from these numbers is that there are four magazines pertaining to the *modernismo* corpus which do not contain any images. This is already a quantitative indication that these cultural magazines (*Revista Nueva, El Nuevo Mercurio, Renacimiento* and *Vida Nueva*) oriented their overall design towards the model of printed books, rather than towards the opposite pole, that of printed newspapers.[12] For the construction of the network visualization, we dismissed all contributors who contributed to only a single magazine, as this would by definition exclude them from the exchange we are interested in. The resulting edgelist consists of 38 edges with 18 contributors and eight magazines. This massive reduction was surprising, insofar as it shows that in the *modernismo* period, there were obviously many illustrators and visual artists who contributed to only one magazine. Amongst them is not only Pablo Picasso, who published 26 of his early modernist works in *Alma Española* (Madrid), but also the most prolific (in terms of the number of contributions) of the modernist illustrators in our corpus, Tomás Júlio Leal da Câmara, who contributed to only a single magazine, *La Vida Literaria*. The same applies to other prolific artists, such as Christian Franzen (30 contributions to *Alma Española*), and Inocencio Medina Vera (28 contributions to *La Vida Literaria*). While these visual artists may be known only to experts in the period of Spanish *modernismo,* it is notable that in the network comprising those who contributed to more than one magazine, there are also individuals who are still well-known today. Seven of Peter Paul Rubens' works, for example, were printed in *Alma Española* and *La Vida Literaria* (both magazines printed in Madrid), and two works by El Greco were printed in *Helios* (Madrid) and *Luz* (Barcelona). Both of these artists are good examples of the visual tradition established by Spanish *modernismo,* and of the fact that the typical modern drive towards a 'new' aesthetic did not imply a rupture with the past. According to our focus on magazines as platforms for transnational exchanges facilitated by the editors and contributors, we have decided to present the exchange network

12 When we speak of 'cultural magazines', we do not aim to refer to a fixed type of printed periodical publication, but use it as an umbrella term to name all the products which were situated between the daily and weekly newspaper press on one side, and the book market on the other. This intermedial position is, according to Frank, Podewski and Scherer (2010), one of the outstanding structural features of the 'little archive' of cultural magazines. Our quantitative analysis shows that, even before you study the concrete layout of a magazine, you can deduce by numbers its position within this intermedial space. Although this might not seem useful if you analyze just one specific magazine, it will swiftly become so if you want to 'read' 42 of them or, by extension, the hundreds or thousands that in reality formed the publication sphere of modernity.

Fig. 3 Visual artists contributing to more than one cultural magazine in the *modernismo* period.

on a world map, where each magazine is presented as a red point fixed to its place of publication, while contributors (blue points) are attached to these nodes by edges (see figure 3).

As can easily be read from the network visualization (figure 3), nearly all of the visual artists contributing to more than one magazine worked in Madrid. They seem to have been bound mainly to the cities or nations to which they belonged. For obvious reasons, it was easy for them to contribute to magazines which were printed where they lived. By contrast, there are only two artists who contributed to cultural magazines on both sides of the Atlantic: Ramón Cilla Pérez, who made a single contribution to each of the magazines *Luz i Sombra* (Santiago de Chile)

and *La Vida Literaria* (Madrid), and Albert Lynch, a Parisian painter of German-Peruvian ancestry who likewise published one contribution each in *Instantáneas* (Santiago de Chile) and *Luz* (Barcelona).[13] The exchange of imagery during the *modernismo* period was quite obviously limited to Spain and most particularly to Madrid, while transatlantic exchange proved to be the exception rather than the norm.

By contrast, in the avant-garde period we see an intense exchange across the Atlantic and between magazines. For this era, datasets for the Images genre comprise 723 edges, provided by 568 contributors to 20 magazines. As we observed for the *modernismo* period, these numbers change massively if the only contributors considered are those who have contributed to more than one magazine. This reduced dataset comprises 103 edges, established by 84 contributors contributing to 19 magazines. Only one little publication (*Sur,* Málaga) is not connected by a contributor to other magazines; this is not surprising, since there are only eight images found among the 39 contributions to this little magazine. Almost all of the most prolific visual artists contributed to more than one magazine, although there were notable exceptions, such as Peruvian artist José Sabogal Diéguez and his pupil Julia Codesido, who contributed solely to the Lima-based avant-garde journal *Amauta* (35 and 20 contributions, respectively),[14] as did Carlos Enríquez (26 contributions to the *Revista de Avance,* Habana), and Ramón Puyol (21 contributions to *La Gaceta Literaria,* Madrid). As figure 4 shows, prolific and well-known (even today) avant-garde artists participated in an intense exchange, which also crossed the Atlantic.

Amongst these visual artists is Norah Borges, the sister of Jorge Luís Borges; she is the most prolific contributor of imagery, with 89 images printed in ten cul-

13 It is worth taking a closer look at both cases, because they illustrate a tension that is typical of the aesthetics of the *fin de siècle* as a whole and thus also for the Spanish-speaking *modernismo:* the conception of a 'pure' aesthetics, apparently timelessly removed from industrial modernity, which was accompanied by a deep involvement in the processes of this modernity and its superficial aspects. Ramon Cilla Pérez, who was born in Salamanca (and usually only went by the names 'Cilla' or 'Chiflatis'), achieved his outstanding status in the Spanish-speaking world as a humorous caricaturist of the social elites and their habits; his work thus represents the 'fashionable' side of modernism, the 'up to date', or, to quote Baudelaire with his famous statement in *Le Peintre de la Vie moderne*, "le transitoire, le fugitive". At the other end of the spectrum, the paintings of Albert Lynch show female beauty in classical clothes and in deep harmony with nature, expressing the 'other side' of modern art, "l'éternel et l'immuable" (Baudelaire 1976, p. 695).

14 In this case, the production of images is not only exclusive to the magazine, but also particularly programmatic and formative for its objectives. It is only Sabogal's visual language, a series of cover images that impressively make the Aztec cultural tradition appear as an elementary force, that gives *Amauta* its unique profile, whereas the texts published therein take a more pluralistic approach. For the iconic program of *Amauta,* see Nungesser (1997).

tural magazines on both sides of the Atlantic. Furthermore, well-known representatives of the avant-garde movement such as Pablo Picasso (33 contributions to eight magazines), Salvador Dalí (25 contributions to six magazines), Joan Miró (16 contributions to two magazines), Giorgio de Chirico (eight contributions to two magazines), and Henri Matisse (six contributions to four magazines) participated in the transatlantic cultural exchange. We can also deduce from the data that, in contrast to *modernismo,* the formation of tradition was not writ large in the avant-garde period. Whereas the names of Francisco de Goya (six contributions) and Paul Gauguin (five contributions) are in the category of individuals who were published posthumously, neither of these two was printed in more than one magazine. Only three works by Paul Cézanne, who died in 1906, were printed in two magazines on both sides of the Atlantic.

It is worth taking the example of Pablo Picasso's presence in the corpus for a short excursus, in order to discuss in more detail the materials that have so far only been formally evaluated in our quantitative analyses. We will use this particularly prominent case to reflect on some fundamental methodological problems of quantitative analysis. If we compare Picasso's role in the two sub-phases of the periods we investigated, *modernismo* and the avant-garde, it becomes obvious that his presence as a visual contributor is based on quite different logics of authorship. In the *modernismo* period, Picasso was, as already mentioned, only present in one magazine – the Barcelona-based *Arte Joven* – and there with original contributions with which he directly positioned himself as a central member of the new art aesthetics propagated in this magazine. As the art director of this magazine, Picasso was not only responsible for the overall visual design, but also produced a series of drawings of writers who were also contributors to the magazine – Camilo Barghiela, Francisco de A. Soler, Pío Baroja – complemented by self-portraits of the young Picasso and a number of drawings, mostly showing young females.[15] At this moment, in his artistic beginnings, Picasso did not yet have the capital of a classic avant-garde artist; he only acquired this during his cubist phase in Paris. In the avant-garde period, however, he is present in the examined corpus of Spanish-language avant-garde magazines, but is no longer a direct contributor, rather a representative of the already consecrated early visual avant-gardes. His presence thus served as a positive role-model for the Hispanic avant-gardes when they started with their publications after the end of World War I in the 1920s, for example in *Reflector* (Madrid 1920), where we find two reproductions of Picasso's works explicitly identified as reprints. These are authorized by Paul Rosenberg and accompanied by an article by Guillermo de Torre on the painter, celebrating his famous compatriot, in his typical neologism-filled 'ultraist' idiom, as a "confluent vertex of the angular overcoming and innovating

15 For the importance of the magazine and Picasso's role in it, see Herrera (1997) and Rißler-Pipka (2013).

currents" and "precursor and epigone, simultaneously, of the boldest and most intense movements that have fertilized all contemporary painting".[16]

Picasso's example thus illustrates a fundamental problem of quantifying evaluations, which must necessarily break down the complex dynamics of cultural exchange and circulation into formally defined criteria in order to create countable units. The detection of overarching patterns (e.g. the frequency of distribution), which is only made possible through the 'datafication' of aesthetic materials in cultural magazines, must necessarily overshadow the individual case analysis, which is usually the focus of qualitative examination within the in-depth study of the semiotic dimensions of transfer processes. Any critical quantitative analysis (as we certainly claim to offer here) is of course aware of this statistical reduction and will accordingly not naively claim to provide the only possible perspective on cultural exchange. Where it discloses its data basis, however, it enables precisely such hermeneutic individual case studies as the one carried out here in all brevity with Picasso's case history, albeit on a different basis that is intersubjectively falsifiable through the accessibility of the data. Exceptions to the rule can always be found. For the avant-garde period, for example, it is true that the considerably broader and more diversified circulation of Picasso's works – compared to the *modernismo* period – testifies to his status as a contemporary classic of the avant-garde and no longer presupposed the artist's direct commitment to the journals, but only the reputation or – to use Bourdieusian terminology – the symbolic capital acquired. However, an exception to this rule can also be found in the magazine *Litoral,* namely an original contribution by Picasso in the famous October 1927 issue of the magazine dedicated to Luis de Góngora.[17] This issue, in addition to the illustration by Picasso, also features a drawing by Salvador Dalí and a cubist work by Juan Gris; it thus can be assumed that Picasso contributed an original work to the magazine not only out of sympathy for his native city of Málaga where *Litoral* was published, but also for reasons of prestige, in view of the equally important presence of the second "classic" of Cubism and the work of Salvador Dalí, the new rising star among Spanish avant-garde painters.

From our network, we can in any case draw a great number of insights. Compared to the visualization for the *modernismo* period, the density of the network is stunning. In all the network visualizations presented here, the Fruchterman-Reingold algorithm was applied to highlight the number of edges (or contributions) connecting contributors and magazines; this results in contributors participating in the transatlantic exchange being positioned in the Atlantic. With regard to transatlantic exchange, it can be observed that the second most prolific *and* transatlantically publishing visual artist of the avant-garde period was Spanish painter Gabriel García Maroto, who published 44 of his works in five magazines

16 *Reflector* 1 (December 1920), p. 11–12.
17 *Litoral* 5–7 (October 1927), p. 50.

Fig. 4 Visual artists contributing to more than one cultural magazine in the avant-garde period.

on both sides of the Atlantic. It can also be noted that the second most prolific female visual artist was Maruja Mallo, who published 2 images in the *Revista de Avance* (Habana) and 13 in the *Gaceta Literaria* (Madrid). Furthermore, the French-born Jean Charlot and the US-born Edward Weston are notable artists for their respective roles influencing the upsurge in woodcuts in Mexico (Charlot) and fostering indigenous traditions (Weston). Of course, such observations and explorations into the deep background of the published images are more relevant for art historians and other experts in the field than for an overview that aims at a methodological discussion. Nevertheless, these examples underline that the data collected within our project do provide a rich basis for further qualitative examinations. As the example of the Image category demonstrates, the broad con-

ception of the classificatory scheme does not account for aesthetic and stylistic features, but rather focuses on a distant explanation of what we found in the network structures. However, the approach developed within the project establishes the fundament from which qualitative analyses (and in the case of the textual genres, hermeneutic interpretations and close readings) can depart.

2.2 Contributors to Magazines: The Most Prolific and the Best Linked

One alternative to investigating transnational and transatlantic exchanges is to focus on the contributors as agents of exchange, regardless of the genres in which they participated. Other than the genre networks which have been formed by extracting data from our database, the focus on contributors can potentially take the entire dataset into account. Even for these two reduced datasets, analysis cannot be conducted in a straightforward manner. The main reason lies not in the volume of the data, but in the fact that a contributor-magazine network is necessarily a two-mode network, also known as an affiliation or bipartite network.[18] These are a particular type of network with two sets of nodes, where ties are only established between nodes belonging to different sets. A contributor-magazine network has to be a bimodal network, given that magazines serve as communication channels and aesthetic platforms for the contributors and editors, and contributors and printed matter are not of the same type. In a way, magazines bring contributors together within an issue and thus provide the chance to establish social relationships, regardless of whether or not these chances are then used by the agents. But since the 'meeting' of two contributors only takes place in an abstract sense and not, for example, as a face-to-face meeting in real-life, such constellations should not be mindlessly conflated into one-mode networks. We will come back to the question of two-mode networks later in this section.

The volume of data becomes more manageable when one takes into consideration that about half of the 3,382 contributors in the avant-garde period provided only one contribution to a magazine, and less than a third of all contributors (1,073 of 3,382 contributors of that period) provided more than two. In this sense, the inspection of the number of contributions per contributor provides interesting insights. At first glance, the graph (figure 5) seems to follow a power-law distribution. On the left side, there is a single contributor – Spaniard Ernesto Giménez Caballero, editor of the newspaper-like *Gaceta Literaria* – with an outstanding 407 contributions, followed by the renowned avant-garde writer Ramón Gómez de la Serna, with 165 contributions. In this graph, the curve rapidly flattens and ends with the classical "long tail" of contributors with only one or two contributions each. Indeed, if we also integrate all of the contributions provided by anonymous contributors (3,792 contributions) and the editorial staff

18 Borgatti (2009), p. 8281. A pre-print of this contribution is available at http://www.analytictech.com/borgatti/papers/2modeconcepts.pdf.

(1,231 contributions), this curve would follow an 80:20 distribution characteristic of power-law graphs, whereby 20% of the contributors provide 80% of contributions (in our case, 767 contributors provide 15,363 contributions, or 79%, as opposed to 2,615 contributors providing 4,117 contributions, or 21%).

A second glance at the graph with the most prolific contributors in the avant-garde period reveals why such a chart (and the network resulting from it) is not easy to read. Firstly, in this regard, the functions and social roles of the contributors are mixed. Besides the prolific editor Ernesto Giménez Caballero, we find editors Jorge Mañach (105 contributions), Guillermo de Torre (99 contributions), Bernardo Ortiz de Montellano (71 contributions), José Carlos Mariátegui (57 contributions), and Evar Méndez (52 contributions). Secondly, we also find editorial staff to be amongst the most prolific contributors: men such as César M. Arconada (147 contributions, mostly to *La Gaceta Literaria*), Mexican Jaime Torres Bodet (52 contributions, mostly to *Contemporáneos*), and Israel Zeitlin (the latter better known under his pseudonym César Tiempo, who was naturalized as Argentinian in 1924 and part of the editorial department of the Argentinian magazine *Claridad*). The third group of prolific contributors is formed out of avant-garde artists with high symbolic and social capital, such as Ramón Gómez de la Serna (165 contributions), visual artist and art critic Norah Borges (90 contributions), and Norah's brother Jorge Luís Borges (80 contributions), to name but a few.

An inspection of the table of most prolific contributors reveals some consequences for network analysis as well, since the number of contributions form the weight of the links between contributors and magazines. Crucial in this regard is the fact that editors tend to publish their contributions in their own magazines (as do editorial staff in the magazines they work for). Ernesto Giménez Caballero, the editor of *La Gaceta Literaria,* is a good example here. Out of our total corpus, 403 of his contributions were published in *La Gaceta Literaria,* while his other four documented contributions were published in the magazines *Amauta, Litoral, Martín Fierro,* and *Revista de Avance.* As editors or editorial staff, these persons occupy a privileged position. Because of their high symbolic capital, they are invited to publish in other magazines as well, thus receiving symbolic credit from others. Such agents are well connected in the network as a whole, in spite of the greatest proportion of their contribution being focused on a single magazine. For this reason, the people showing up in the graph documenting the best-connected contributors linked to avant-garde magazines show the same mixture of diverging social roles (figure 6).

In this regard, with contributions to eleven magazines, the best linked contributors are Spanish avant-garde artists Gerardo Diego and Ramón Gómez de la Serna, followed by Argentinian siblings Jorge Luís and Norah Borges, then Uruguayan writer Ildefonso Pereda Valdés. Notable in this graph are also the French artists Jean Cocteau (contributions in eight magazines), Paul Éluard and Paul

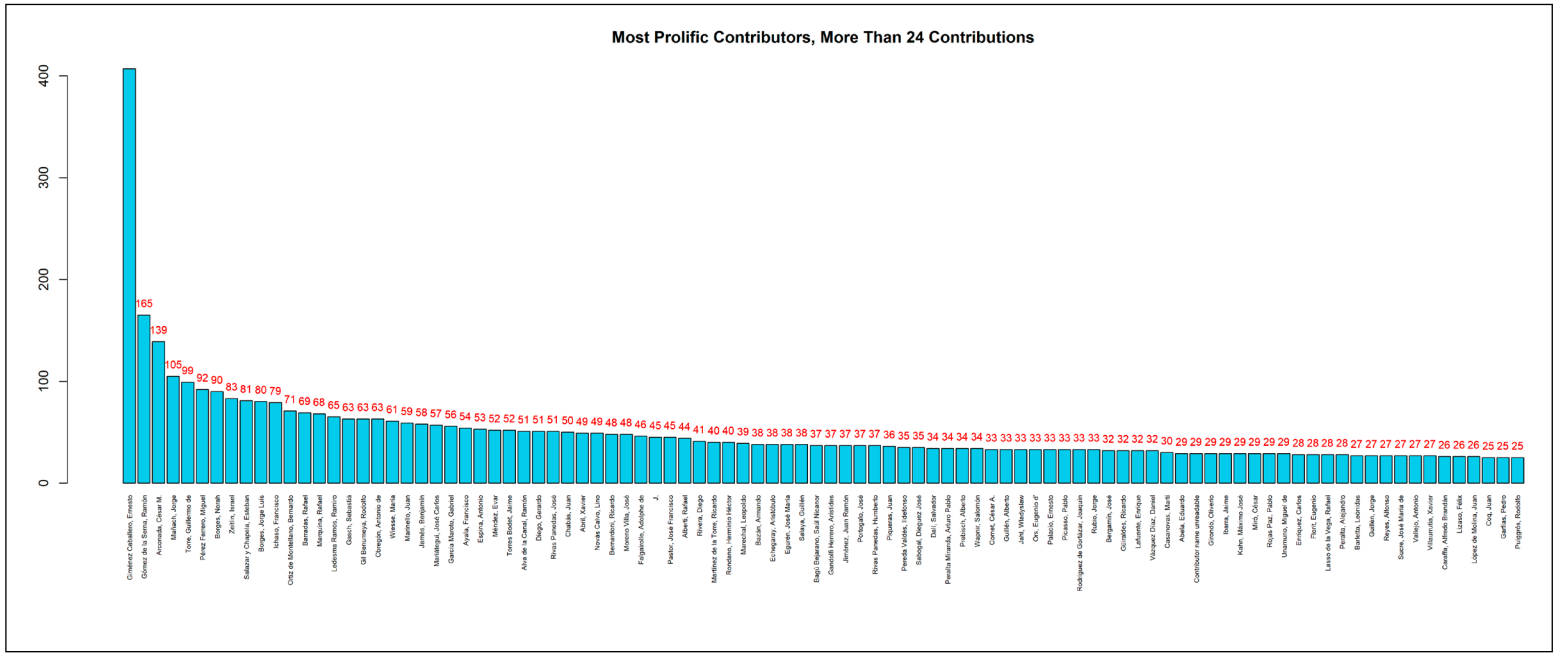

Fig. 5 Number of contributions per contributor in the avant-garde dataset (23 magazines, 19,516 contributions).

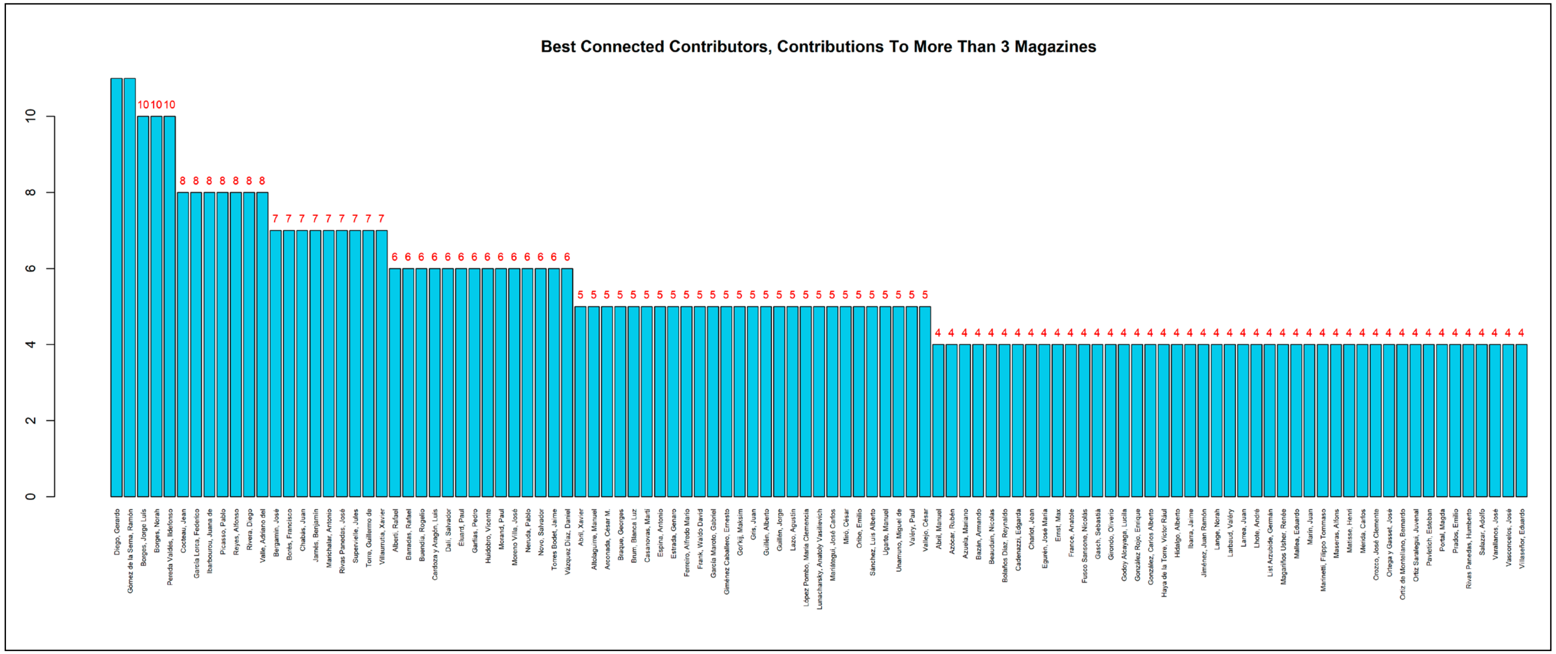

Fig. 6 Number of magazines to which a contributor contributed in the avant-garde period.

Morand (six magazines), as well as Georges Braque and Paul Valéry (five magazines). Furthermore, some of the visual artists were able to distribute their work amongst a range of magazines: Norah Borges (contributions to ten magazines); Pablo Picasso and Mexican artist Diego Rivera (eight magazines); and Uruguayan painter Rafael Barradas and Salvador Dalí (six magazines) being the most prominent examples. Editors like Chilean poet-diplomat Vicente Huidobro (six magazines), Ernesto Giménez Caballero and José Carlos Mariátegui (five magazines) can also be found. Best linked does not necessarily imply prolificity: Ildefonso Pereda Valdés had his 35 contributions distributed over eight magazines, while Spanish poet José Moreno Villa published 48 contributions in six magazines. An extreme case of this can be seen with Spanish poet Manuel Abril, who published only nine contributions in four magazines.

Moreover, it should be noted that this graph definitely does not follow the rule of power-law distribution, as did the graph for the most prolific contributors. While prolificity is relevant for the weight attributed to an edge in a network, the number of links (or edges) in a network is decisive for the determination of hubs. Albert-László Barabási has become famous for the identification of scale-free networks, in which the degree distribution follows a power law. He notes:

> Power laws mathematically formulate the fact that in most real networks the majority of nodes have only a few links and that these numerous tiny nodes coexist with a few big hubs, nodes with an anomalously high number of links.[19]

Other than Barábasi's examples – for which the Internet is ultimately the model, whereby every node potentially can link to every other node – the data from which the networks of cultural magazines are formed do not adhere to power laws; there are no 'hubs' linked to half of the magazines to which they could have potentially contributed. The reasons for this may theoretically lie in the construction of the magazine corpus, since it may have technically been impossible for the contributors to make contact with a majority of contemporary magazines, especially with regard to the time period under examination (1891–1936), when mail across the Atlantic was slow and travelling expensive. But beyond our corpus of historically bound and geographically distributed magazines, we would like to formulate a more general hypothesis concerning the logic of cultural networks: we generally doubt that networks in the cultural sphere adhere to the power-law distributions characteristic of the Barabási-Albert model. What drives us to formulate this hypothesis is the simple fact that, in the cultural field, *taste* dominates and thus limits the number of possible connections between contributors and magazines. Taste refers to subjective judgments of harmony or disharmony that lead to group inclusion or exclusion. Because publication involves an aesthetic decision, not every contributor is welcome to publish in every cultural magazine.

19 Barabási (2009), p. 70.

Rather, Bourdieusian *distinction* prevents the acceptance of a publication in every contemporary magazine, which are therefore distributed and differentiated between the several artistic groups and factions in the cultural field of a given time. For these reasons, such networks cannot be scale-free in the sense that Barabási conceptualized them; even for the hubs in the network, it is not possible to scale their links up to the vast majority of magazines.

A second major methodological insight comes from the structure of the contributor-magazine network and its conceptualization as a bipartite graph. Two-mode networks are characterized by nodes in one mode being reachable only through a node from the other mode. This trait of two-mode networks imposes certain limitations with regard to their analysis. Basically, there are three approaches.

(a) The first approach is to treat the bipartite graphs as one-mode graphs and apply the standard analytical tools of social network analysis.[20] In our case, this would lead to having the major magazines, with their hundreds of contributors, taking the highest-ranking positions in most of the centrality measures (eigenvector, closeness, betweenness etc.). Certainly, this is not a desired outcome, and in general it is for this reason that two-mode networks are rarely analyzed in their original form.

(b) The second approach is to analyze each mode independently using metrics that are specialized for use with two-mode networks. This approach implies the transformation of the data into one-mode networks containing only one type of nodes, and then to analyze them as usual. The transformation procedure is often referred to as projection and can also be applied to weighted two-mode networks.[21] We followed this approach for the analysis of the contributor-magazine network by applying the projection technique developed by Newman.[22] Originally, Newman had studied scientific collaboration networks; the application of this projection method thus seemed to be appropriate, since the citation networks Newman deals with (scientist-collaborative group networks) resemble the data we have at hand. On this basis, we calculated degree, closeness, and betweenness centralities.[23] Since we were particularly interested in betweenness as an indicator of the potential mediation activity within the network, the table below shows the results for the fourteen contributors with the highest betweenness score.

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20 Borgatti (2009), p. 8281. See also Borgatti and Everett (1997).
21 Opsahl (2013). See also Opsahl et al. (2010).
22 Newman (2001a) and Newman (2001b).
23 These calculations were done using the package 'tnet' in R, the environment for statistical computing. See Opsahl (2009), pp. 104–122. This thesis is also available at http://toreopsahl.com/publications/thesis/.

Node	Degree	Closeness	Betweenness
Giménez Caballero, Ernesto	5	0.0051455084	2672103
Borges, Norah	10	0.004532786	2642620
Mariátegui, José Carlos	5	0.0036892506	1939933
Zeitlin, Israel	3	0.0028495031	1930251
Gómez de la Serna, Ramón	11	0.0046217184	1107634
Mañach, Jorge	3	0.0048802187	988443
Moreno Villa, José	6	0.0043899019	620540
Méndez, Evar	3	0.0034897053	613365
Abril, Xavier	5	0.0032261895	457977
Torres Bodet, Jaime	6	0.0038680435	448699
Barradas, Rafael	6	0.0042837309	363465.5
Ortiz de Montellano, Bernardo	4	0.0044222172	342158
Marinello, Juan	3	0.0037914151	340397
Borges, Jorge Luís	10	0.0042915641	321359

Tab. 1 Centrality scores for 14 avant-garde contributors, ordered according to betweenness score in descending order.

In comparison to what has been reported above, this table shows the outcomes of the analytic calculations resulting from a network with a few major nodes (the larger magazines) connected to thousands of other nodes (the contributors), and of the uneven distribution of weights through the number of publications per contributor. The calculation of centralities favors editors and editorial staff because of the high number of their contributions. Important and well-connected personalities such as Norah and Jorge Luis Borges, as well as Ramón Gómez de la Serna, have a smaller betweenness value in comparison to the prolific Ernesto Giménez Caballero, as well as other editors and editorial staff, such as José Carlos Mariátegui, Israel Zeitlin, and Jorge Mañach. The case of Israel Zeitlin is especially revealing. Most of his 83 contributions were published in the large Argentinian magazine *Claridad,* the others appearing in *Martín Fierro* and *Proa;* all three magazines were published in Buenos Aires, and because two of them are amongst the larger magazines in our corpus, Zeitlin received a high betweenness score. This example reminds us that betweenness is detached from the country or region in which the magazines were published. From the perspective of what is at the center of our research project – the analysis of transnational cultural transfers – these calculated values present strange if not distorted results. How-

ever, even if these calculations do not directly answer our research questions, they provide valuable insights, such as, for example, that there are only 72 contributors with a betweenness score larger than 0. Given the large number of contributors overall, it would not have been easy to identify this small number of contributors serving as mediators between magazines.

Beyond the calculation of centrality scores, two-mode networks imply important impediments to the application of further formal methods. To our knowledge, procedures for the calculation of cliques or communities in bipartite graphs remain undeveloped. The results of these analyses would be quite interesting for the determination of artistic groups through algorithmic calculation, compared to what classic qualitative research has revealed so far.

(c) The third approach described by Borgatti is to analyze both modes of a two-mode network simultaneously, using a bipartite adjacency matrix. Interestingly enough, Borgatti highlights that the standard ways to visualize two-mode networks also apply to bipartite graphs, and that "this bimodal visualization is often extremely effective for transmitting a holistic understanding of the whole dataset."[24] In view of what the calculation of the betweenness score presented above revealed to us about the small number of mediating artists and their detachment from the geographic location, we took the approach of visualizing the best-linked contributors on a map and compared the results for both the *modernismo* and avant-garde periods.

Figure 7 shows the eight best-linked contributors of the *modernismo* period, all of them having contributed to at least seven magazines. At first glance, the transatlantic transfer put into effect by some of the best-linked contributors becomes visible. A closer inspection, however, reveals that two of the contributors, the Spaniard Jacinto Benavente (who was awarded the Nobel Prize for Literature in 1922) and the Catalan modernist Santiago Rusiñol[25] contributed only to magazines printed in Spain. Moreover, the only Hispanic American among the best-linked contributors is Rubén Darío. More than half of his publications (55 out of 92) were printed in Hispanic American magazines. Salvador Rueda (68 publications in ten magazines), Emilia Pardo Bazan (18 publications in seven magazines), and Miguel de Unamuno (48 publications in eight magazines) represent Spaniards whose works have been published in Hispanic American magazines. Heinrich Heine (ten publications in seven magazines) can be seen as a peculiar

24 Borgatti (2009), p. 8284.

25 The terminological concepts of modernist aesthetics in the Iberian peninsula become even more confusing, since the Catalan *modernisme* – due to the specific impact of the Catalan bourgeoisie and its economic power, which is best known for the architecture of Antonio Gaudí – is not exactly identical to Spanish *modernismo,* although it is similar and therefore comparable.

Fig. 7 Best-linked *modernismo* contributors

case: he died in 1856, and was therefore translated into Spanish and printed in Spanish and Hispanic American magazines without being actively involved in the distribution and reception of his works. Thus he can be seen as a 'literary forefather' for the transnational modernist movement. To sum up, the dominance of European contributors speaks of a large transfer of modernist literature from Europe to Hispanic America during the modernist era. This affirms one of the presuppositions of *modernismo* research, that it was not really an 'American' affair. It also questions another, namely that it was only directed towards Paris as the "capital of 19th century" in cultural terms, as per Walter Benjamin.

In comparison to the graph for the *modernismo* period, the visualization for the avant-garde period in figure 8 presents quite a different picture. All of the

Fig. 8 Best-linked avant-garde contributors

five best-linked contributors have contributed to at least ten magazines *and* been published on both sides of the Atlantic. Of the five best-connected contributors, three come from Hispanic American countries (Jorge Luís and Norah Borges, and Ildefonso Pereda Valdès).[26] The integration of Hispanic American contributors into magazines printed in Europe can be seen from the share of their publications: Jorge Luís Borges had 21 of his 80 contributions printed in Spanish-language

26 This picture does not change much if the number of contributors is enlarged to the 12 contributors having published in at least 8 magazines: 6 out of 12 come from Hispanic America (Juana de Ibarbourou, Alfonso Reyes and Diego Rivera, adding to those already named above, all of whom were published on both sides of the Atlantic).

European magazines, Norah Borges contributed 55 of her 90 works to magazines printed in Spain, and Ildefonso Pereda Valdés had eight out of 35 works printed in three European magazines. These numbers not only speak of an intensified exchange between both sides of the Atlantic, but also of a more balanced transfer from Europe to Hispanic America and vice versa, when considered in the comparative context of the *modernismo* era more generally.

2.3 Cultural Transfer as a Calculated Ratio: Contributors and Magazines

The data we collected and analyzed present strong evidence for the transnational exchange that was already taking place during the *modernismo* period towards the end of the 19th century. But while the networks constructed out of the acquired data indicate that there is a lot of exchange within the corpus of magazines under scrutiny, as well as *who* the agents of this exchange are, they do not answer questions on the *intensity* of exchanges between Europe and Hispanic America. Because we were interested in learning who could be identified as facilitators of cultural transfers, and because the centrality measure 'betweenness' is not beneficial for answering this question in bimodal networks, we developed a measure which we call the 'cultural transfer rate'. This rate is based on the idea that the circulation of aesthetic ideas and forms *across the Atlantic* can be regarded as an effort of cultural transfer. Amongst the socio-biographical data we collected for each contributor is the 'country of origin'. In contrast to nationality, which can change over the course of a lifetime, the country of origin is a stable category insofar as the place of birth cannot be changed. As a first approximation for an estimation of the transatlantic cultural transfer, a ratio is calculated: the number of contributions published by a contributor on the other side of the Atlantic (as opposed to his/her country of origin) divided by the total number of contributions by this contributor. Technically, the datum 'country of origin' serves as the indicator of the cultural region (Europe or Hispanic America) to which the contributor is assigned, and the publication place of the cultural magazine serves as the corresponding indicator. Calculated for the roughly 3,500 contributors which we were able to identify, this 'cultural transfer rate' provides an approximation of the identification of persons which we have elected to call "cultural brokers", a term that has been introduced by Richard Jean So and Hoyt Long into network analysis.[27] The ratio is an approximation, given that (for example) all persons who were born in Europe and migrated early in their lives to Hispanic America will automatically receive a high ratio even if they cannot be considered as being self-evident cultural brokers. As always, numbers therefore have to be checked for their explanatory power with regard to the research question.

27 See Jean So and Long (2013), p. 172. The term itself was first used by anthropologist Clifford Geertz; see Geertz (1960).

It is not by chance that the concept of "brokerage", as introduced by Ronald Burt, is accompanied by the idea of "structural holes", spaces that exist between closed and densely structured areas such as magazines. These holes impede synergy and exchange between different fields of knowledge and innovation. The connectors between different areas fill these gaps, and "brokerage is the action of coordinating across the hole with bridges between people on opposite sides of the hole, and network entrepreneurs, or brokers, are the people who build the bridges."[28] However, both Burt as well as Jean So and Long used unimodal networks to determine the brokers within their networks. By contrast, the 'cultural transfer rate' we introduced helps to identify these cultural brokers by narrowing the focus to a small, manageable set of actors, qualifying their transfer merits by connecting them to transatlantic exchanges.

The analysis based on the 'cultural transfer rate' yielded interesting results insofar as the most prolific or best-linked authors do not necessarily have a high transatlantic transfer rate. As we have seen with the best-linked *modernismo* contributors, Nicaraguan poet Rubén Darío presented strong ties with Hispanic America, and 37 of 92 of his works in our corpus were published in Europe, which results in a transfer rate of 0.4. By comparison, Spanish journalist and poet Salvador Rueda published 35 of the 68 works in our corpus in Hispanic American cultural magazines, which results in a transfer rate of 0.51 – that is, slightly more than half of his works were printed on the other side of the Atlantic. In the avant-garde period, this decoupling of cultural transfer merits from the number of linkages becomes even more visible. Despite their travels around Europe and their known strong ties to European avant-garde movements, Argentinian Jorge Luís Borges and his sister Norah, as well as Uruguayan poet Ildefonso Pereda Valdés, exhibit cultural transfer rates of around 0.33, that is, a third of their contributions being published in Europe. The Spaniards Ramón Gómez de la Serna (165 contributions) and Gerardo Diego (51 contributions) show an even lower transfer rate, below 0.2 in the period under study (Gómez de la Serna was exiled in 1934 to Argentina). This observation is revealing insofar as it underlines that leading personalities of cultural movements – in terms of prolificity and linkedness – do not necessarily assume the task of serving as connectors between two continents. This function is clearly taken over by second- and third-tier contributors, who populate the space between magazines published on both sides of the Atlantic.

To give a rough idea of the most salient results within this overview: in the *modernismo* period, internationally lesser-known figures such as the Spaniards Manuel Reina (0.79) and Ramon de Campoamor (0.63), as well as Venezuelan Miguel Sánchez Pesquera (0.97) and Mexican Amado Nervo (0.57) complement the well-known Guatemalan writer, journalist and diplomat Enrique Gómez Carrillo (0.92), who clearly distinguishes himself in terms of symbolic, social and

28 Burt (2005), p. 18. For an explanation of "brokerage", see idem. pp. 11–13.

economic capital, or the well-linked Spanish poet and precursor of *modernismo* Salvador Rueda (0.51). In contrast to these cultural brokers, prestigious French writers and poets such as Paul Bourget (0.96), Edmond de Goncourt (0.88), Catulle Mendès (0.88), Marcel Prévost (0.85), or Émile Zola (0.5) demonstrate their importance to and influence upon the modernist movement in Hispanic America and thus of their high symbolic capital; however, since their works needed to be translated and reprinted, rather than being actively promoted by their creators, it is questionable whether they can be regarded as cultural brokers. Romantic poet and essayist Heinrich Heine, who had already died when his works were translated and republished in Spanish, was mainly received in cultural magazines in Spain; only three out of ten of his works were published on the other side of the Atlantic. In the case of deceased contributors, it is obvious that they could not have actively provided their contributions; however, it is debatable who the agents of cultural transfers are with regard to the case of translations.[29]

Similar results can be noted for the avant-garde period, during which Uruguayan Julio J. Casal (0.95, founder of the magazine *Alfar,* which was first published in Galician A Coruña), Chilean Vicente Huidobro (0.89), and Venezuelan Rufino Blanco Fombona (0.75) were active both as poets and diplomats and based their cultural brokerage on their mobility. Amongst the more prestigious artists, Spanish painter and writer Gabriel García Maroto (0.63) and writer and philosopher Miguel de Unamuno (0.52) profited from their cultural capital by contributing to several genres. Again, a range of French avant-garde artists, including Paul Valéry (0.82), Paul Éluard (0.75), and Jean Cocteau (0.71), benefited from their symbolic capital and were reprinted in Hispanic American magazines. High-profile avant-garde writers such as Guillermo de Torre (0.13), Juan Chabás (0.04), or José Bergamín (0.1), on the other hand, cannot be considered cultural brokers.

With respect to the whole corpus of cultural magazines, there is a clear functional change between the two periods of *modernismo* and the avant-garde. In the phase of *modernismo* there existed three cultural magazines with high cultural transfer rates. In the case of the magazine with the highest, *Revista Azul,* about a third of its 1.679 contributions (0.31) came from contributors originating from the other side of the Atlantic, notably from the French literature scene. The much smaller *El Nuevo Mercurio*[30] had 29% of its 285 contributions delivered by

29 Though there is no evidence for it, it is most probable that the editors of the cultural magazines took the decision on which text should be translated, since this involves an economic decision. However, in the cultural magazines themselves, no proof of the degree of involvement of the authors can be found.

30 This Spanish-language magazine, founded and directed by the aforementioned Enrique Gómez Carrillo, was published in Barcelona in 1907, although it was headquartered in Paris where Gómez Carrillo lived. Its direct model was the *Mercure de France* where the Guatemalan writer had previously been responsible for the Spanish literature re-

Hispanic American contributors,[31] while *La Biblioteca* (Buenos Aires, 390 contributions) received around a quarter (0.24) of its contributions from Europe. This picture changed profoundly during the avant-garde period, when there were only small cultural magazines with one or two issues, such as *Vida Americana* (Barcelona), *Favorables Paris Poema* (Paris), *Creación/Création* (Madrid/Paris) and *Irradiador* (México D.F.). These generally had a cultural transfer rate of 0.27 or higher; the only larger example is that of *Prisma* (Barcelona), which received 29% of its 401 contributions from contributors in Hispanic America. These examples point mainly to the international network of the editors of these short-lived publishing endeavors and thus to the social capital by which these cultural entrepreneurs distinguished themselves.

The observations made here thus lead to paradoxical insights into the functioning of this specific cultural field. Leading personalities in terms of prolificity and linkedness do not necessarily thrive as contributors on both sides of the Atlantic, even though the dense web of cultural magazines provides an optimal network for such cultural brokerage. Rather, second- or third-tier writers and poets are responsible for the transatlantic transfer, an observation that argues for a functional differentiation in this cultural field. And it is in the earlier phase of *modernismo* in the period under scrutiny that cultural magazines can be found capitalizing on the import of cultural products from the other side of the Atlantic. On the whole, the cultural transfer rate provides valuable clues to the transfer that has taken place across the Atlantic, especially in light of the large number of contributors involved in it. However, this rate does not take important factors for cultural transfer into account, such as the mobility of the contributors, their status as migrants, or the social or cultural capital of the contributors which caused editors to translate the works of such contributors. These factors, as well as the variety of roles involved in cultural transfers and their varying degree of agency, refer to the points of transition between quantitative and qualitative analysis; as such, the calculated cultural transfer rate yields valuable results for further qualitative research.

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ports. For Gómez Carrillo's literary career and the importance of magazines within it, see Ehrlicher (2015).

31 Enrique Gómez Carrillo is very clear about his intention to contribute to a renewed transatlantic exchange when he explains the goals of the *Nuevo Mercurio* in the first issue's editorial: "Its program is very simple and boils down to the following: to establish the fraternal bond between the intellectuals of Spain and those of Spanish America, who until now have lived not only not knowing each other, but even disdaining each other." Gómez Carrillo (1907), p. 3.

3. An Alternative Approach: Cultural Magazines as Contributor-Contributor Networks

While presenting some major results of our research project in terms of the transnational transfers along genres and performed by contributors to cultural magazines, we simultaneously discussed the methodological implications and impediments which we encountered during our research. A major constraint for the application of standard metrics and algorithms common in network research is the fact that the data we collected ('who published what, when and where') had to be conceptualized as two-mode networks, whereby contributors and genres/magazines form two distinct classes. As has been shown above, the analysis of bimodal networks has proven to be fruitful for the analysis of genres as instances of *cultural exchange,* which is at the heart of our project. However, *social* network methods have mostly been developed to study one-mode networks with a single, usually dichotomous and nondirectional relation; for two-mode networks, on the other hand, the analytical possibilities are limited.[32] A shift of focus towards the *social aspects* of transnational cultural exchanges would transform the two-mode contributor-magazine networks into contributor-contributor networks, thus eliminating magazines as a separate set of nodes and facilitating the possibility of fully applying social network analysis. These contributor-contributor networks could be conceived of in two ways:

a) Contributors could be linked to all of their fellow contributors within a single issue of a magazine, which would also comprise the contributions provided by editors and editorial staff. This means that instead of linking contributors with the magazine in which their contribution was published, the respective column would be filled in such a way that every contributor would be linked to every other contributor. The column containing the publication date of the magazine issue would be left untouched. In this way, every single issue of a magazine forms a small community of contributors.
b) Contributors could be linked to all their fellow contributors within a single issue of a magazine, but in contrast to version (a), the column containing dates is split into two, with one column containing the publication date of the issue and a second column containing the publication date of the last issue in the lifetime of the magazine. In this way, the community of contributors formed by every single issue persists until the end of the lifetime of the magazine.

32 Already in 1994, Wasserman and Faust noted these limitations in their standard work on social network analysis: "By and large, it is rare for methods to be developed initially and explicitly for valued relations, two mode networks, and especially multiple and longitudinal relations and ego-centered networks. [...] However, centrality and centralization measures for multiple relations have not been developed, nor have measures of centrality and centralization for two-mode networks." Wasserman and Faust (1994), p. 729.

In essence, in order to be able to analyze the social aspects of cultural magazines, we propose to broaden our approach, to re-use the data we published, and to restructure the two-mode contributor-magazine networks (which we analyzed above) into one-mode co-publication networks. In the future, such an approach would enable the application of classical metrics and algorithms established in social network research. Because in such a network design all nodes represent social actors, it would enable the investigation of the social dimensions of cultural products, such as magazines. The application of community-detecting algorithms would become possible; in our case, this could certainly lead to pertinent insights into the formation of artistic cliques in the form of groups performing co-publication. Our research group has already worked into this direction by calculating the number of contributions per contributor for each magazine. We divided the total number of contributions per magazine by the total number of contributors. This simple measure already provides insights into the production structure of a magazine, since magazines equipped with editorial staff have a significantly higher ratio of contributions per contributor than magazines published by editors with a broad social network providing the contributions. To give just two examples from our corpus: for the newspaper-like *Gaceta Literaria* (1927–1930), published in Madrid by the prolific Ernesto Giménez Caballero and his team, one observes a ratio of 5.922034 publications per contributor; for a small magazine like *Creación/Création,* published in 1921 and 1924 in Madrid and Paris respectively by diplomat-poet Vicente Huidobro, the ratio is only 1.4333 contributions per contributor. This analysis shows that publications that extend themselves over many years obviously avail themselves of editorial staff, because while small, short-lived publications can exploit the transnational network of their editors, they soon cease to exist precisely because they lack editorial staff.

Beyond these metrics, contributor-contributor networks would enable the detection of co-publication patterns across magazines, in the sense of 'who published most often together with whom', which again would support the identification of artistic cliques. Technically, this could be implemented by determining who published together with whom in every single issue of a magazine, and then summing up these linkages over the lifetime of each magazine and across magazines. Moreover, the approach described in this section would enable insights into the social structure of the literary/artistic field formed by cultural magazines, since it would carve out the contrasts between competing artistic groups, and would enable insights into the mechanisms of distinction between cultural magazines, since, as has been discussed above, not every contributor is welcome to contribute to every magazine.

Furthermore, the creation of contributor-contributor networks (including columns for publication dates) would facilitate the investigation of how hubs are established, because the *rich-get-richer algorithm* developed by Barabási

and his research team could be applied.[33] Even if the networks analyzed here are not scale-free, one might hit a motherlode by digging deep into network archaeology to learn more about *network growth* and *preferential attachment* in cultural fields; these latter two metrics have been described by Barabási as constitutive for the establishment of hubs. As taste in cultural fields is governed by social preference and is dependent on recommendation systems (hence the large number of reviews in cultural magazines), it becomes obvious that opinions and estimations published in such magazines act as essential influences on aesthetic choices – which are in turn the complements of what is termed *preferential attachment* by Barabási. With regard to single contributors, it seems quite worthwhile to follow their individual trajectories in the timeframe while they became hubs in the network, and to algorithmically differentiate between the progress made by nodes which are present early in networks and, by contrast, those of latecomers. Certainly, in the cultural field, a "Matthew effect"[34] can also be observed, where already well-connected contributors are invited to publish in more and more magazines. But as has been described above, there seem to be limitations on the increase in connectivity of individuals. Certainly, it would be rewarding to better understand these limitations and to determine whether they apply only to cultural networks of the bygone eras examined in our project, or whether they are a property of cultural networks per se.

Beyond the focus on individual artists, contributor-contributor networks could potentially uncover structures characteristic of magazine evolution. Determining the fluctuations in the assortment of contributors would on the one hand enable insights into who becomes a regular contributor to a magazine beyond the editorial team, who has to be regarded as an irregular contributor, and who has switched to another magazine. For the magazines, it would be revealing to see to what extent they depend on the presence of prominent contributors in terms of prolificity and connectedness. It would also be interesting to see whether or not the departure of these prominent contributors portends the end of the magazine's run, or which other factors contribute to the cessation of the print product. Finally, the start of new endeavors by duplicating contents and reviving productive network structures could be traced, thus throwing light on the characteristics of newly established magazines.

4. Prospects: Paths for Future Research

The 31,500-entry dataset from the 42 cultural magazines which we collated in our research project seems to be quite a weighty basis for research. A database this large is on the edge of what can be kept in synopsis by humans. However,

33 Barabási (2009), pp. 79–91.
34 Merton (1968).

the challenges we discussed in this article provoke the question of which research questions could be answered if even more data were available – and this will certainly be the case in the future. Technically, the aggregation of further data does not pose a real challenge. Since we provided VIAF IDs for the contributors wherever possible, relevant data can be collected automatically if a tool like OpenRefine were to be used.[35] Wikidata, the Gemeinsame Normdatei provided by the Deutsche Nationalbibliothek, and Social Networks and Archival Context (SNAC)[36] would be important starting points for the aggregation of data on the contributors. These data expose further social networks such as spouses, unmarried partners, friendships, family ties, and correspondences. Moreover, bibliometric data are available via APIs; their collection could add another network layer if the data on monographs and anthologies published by the contributors and editors as well as the pertinent publishing houses (which themselves form hubs in a related network) were aggregated. Since data collection more often than not tends to become an end in itself, we would like to propose here a promising path for future research, wherein the data from cultural magazines provide the starting point.

This research perspective would focus on the trajectories of individuals within the network. Analogous to the study presented by Fraiberger et al. (2018), it would be fruitful to explore to what extent the recommendation systems (reviews, literary prices, fellowships, grants, presentations at artistic fairs, publication in prestigious publishing houses etc.) can be correlated with the increase in linkages within the network, thus documenting the accumulation of symbolic capital.[37] The tracing of representative biographical trajectories through the network could facilitate estimations of prestige and the effects of its accumulation. By answering questions such as 'in which cultural magazine did artist xy publish before he was invited (or allowed) to publish in a certain other magazine?' or 'in how many cultural magazines had artist xy publicized contributions in order to publish more than 15 books afterwards?', statistical analyses of biographical trajectories could reveal insights into the mechanisms of becoming an established artist in the literary field.[38] For the investigation of literary prestige, it is poten-

35 We were able to identify 3,587 of the 5,540 contributors (65%) and compiled socio-biographical data for most of them. See https://openrefine.org/ for more information on this tool and the reconciliation services with linked open data APIs it provides.

36 SNAC provides information on the holdings of archives worldwide; social networks are then created out the available data; e.g. friendships and acquaintances can be traced via letter exchanges. See https://snaccooperative.org/ for further information.

37 In this regard, Ted Underwood's study is relevant, since he is able to show – though not from a network analysis perspective – that the fact that a book has been reviewed at all can be regarded as a predictor of a constant literary production, regardless of whether or not these reviews were positive. See Underwood (2019), pp. 68–110.

38 See Fraiberger et al. (2018) and Barabási (2018), pp. 54–73.

tially useful to introduce values analogous to what is termed "fitness",[39] which are assigned to each node in a network. These values could come, to give an example, from Bourdieu's conception of the different types of capital, such as high cultural capital (variability with respect to different genres used as a characteristic of prolific artists), high symbolic capital (being translated or reprinted), and high social capital (as is typical for editors and editorial staff).[40] In other words, the multirelational networks that result from data aggregation are in need of more measures to be introduced to fully exploit the potentialities of social network research.

What is currently not feasible is the relationization of the contents of the contributions with network positions.[41] OCR has for the most part not been performed for the Spanish-language cultural magazines which we examined in our research project, and even if they were printed in Antiqua and thus reliable results could be expected, OCR will most probably not be performed on material which has already been digitized. As a first step, it would be helpful to identify the literary works which have been reviewed in the cultural magazines, which would in turn support an analysis of the relationship between the recommendation systems and the creation of prestige, as described above. Ultimately, networks drive success and are thus responsible for the recognition of an artist. In this sense, the opinions of peers influence aesthetic choices and purchase decisions, and thus fuel the preferential attachment of which Barabási speaks. The creation of artistic prestige can therefore be understood as a collective phenomenon created within networks, measured by how a community reacts to the performance of an individual artist.

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39 Barabási (2009), p. 95.

40 See Albrecht (2002) for an example of how to reconcile Bourdieu's conception of the literary field and the different sorts of capital with network analysis.

41 See Purschwitz (2018) for such an approach.

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INGEBORG VAN VUGT

Book Review: Reassembling the Republic of Letters in the Digital Age: Standards, Systems, Scholarship

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Reassembling the Republic of Letters in the Digital Age: Standards, Systems, Scholarship, ed. Howard Hotson and Thomas Wallnig (Göttingen: Universitätsverlag Göttingen, 2019). Open access: https://doi.org/10.17875/gup2019-1146. 470 pp. Print € 55,00 (hardcover), ISBN 9783863954031.

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Scholars of the Republic of Letters have been among the strongest advocates of the digital humanities. Projects such as *Mapping the Republic of Letters* (Stanford University), *SKILLNET* (Utrecht University), *Circulation of Knowledge/ePistolarium* (Huygens Institute for the History of the Netherlands), and *Cultures of Knowledge* (Oxford University) have developed new research approaches based on network analysis, topic modelling, text mining and spatial analysis. Yet the field of digital humanities is trapped in "an endless infancy" – to use the words of Franco Moretti. It has yet to establish its theory, standards, and methodology – even the technical language needs to be refined. To face these challenges, in 2014 Howard Hotson and Thomas Wallnig received a COST Action networking grant from the European Union, which allowed them to assemble a team of over 200 experts from 33 countries. This book is the result of this collaborative effort.

For the purpose of this review, I will dwell mostly on observations relevant to historical network research. The Republic of Letters lends itself to network analysis because it consists of people (nodes) connected by letters (edges). As described in section III.1 of *Reassembling the Republic of Letters,* an estimated 2 million letters from the 16th to the 18th century are scattered throughout the globe. Thanks to digitization, many of these letters have been made accessible on the internet, and their metadata assembled into online catalogues. Yet several challenges confront the historian who wants to harvest data from these catalogues. The main problem is that most catalogues provide information about the letters of one person – the ego – while neglecting the other members of the network – the alters. Technically, these catalogues are known as "data silos" and translate into separate ego-networks. Instead, the Republic of Letters consisted of different overlapping networks. In chapter IV.5, therefore, Ruth Ahnert and Sebastian Ahnert advocate for the creation of a "meta-archive" integrating data from different catalogues.

The creation of a meta-archive, however, is not without problems. The most significant problem is the standardization of epistolary metadata. Libraries and archives use different terms and categories to describe their collections of letters (chapter III.1). Moreover, epistolary metadata – place, dates and people – can be expressed in multiple ways, resulting in records that are often ambiguous, incomplete, and uncertain. For this reason, the second section of the book – "Standards: Dimensions of Data" – proposes a number of shared principles for modelling epistolary metadata in a way that would ease data sharing and, consequently, network analysis.

A specific problem affecting epistolary metadata is the disambiguation of people with the same name. To solve this problem, Ruth Ahnert and Sebastian Ahnert have developed the *Disambiguation Engine,* a tool specifically designed for network analysis (chapter III.2). The *Disambiguation Engine* allows the user to move quickly between the different occurrences of a name to decide from the context if it refers to the same person or not. At the same time, Ahnert and Ahnert

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warn against the perils of over-disambiguation, advocating for an "under-connected rather than an over-connected network, which is preferable to erroneously exaggerating a person's significance" (231).

One of the strengths of *Reassembling the Republic of Letters* is that the authors are transparent about the limits of their models and are not afraid to talk about their failures. Working with digital tools involves a great deal of trial and error. Researchers at the Huygens Institute, for instance, used the tool *ePistolarium* to search for words expressing confidentiality in the letters of Hugo Grotius (chapter III.4). However, as they found out, Grotius and his correspondents relied heavily on implicit language when speaking in a confidential manner. In studying concepts as elusive as confidentiality, we still need to look closely at the letters. Text-analytical methods such as topic modeling are not yet capable of reading between the lines.

In the epilogue of the book, Hotson and Walling write that "high-level innovation is now too demanding for a single project, institution, or even country to undertake alone: instead, it will belong in the future to networks of projects and institutions pursuing the most ambitious objectives collectively." (459) At the same time, scholars such as Joris van Zundert ('If You Build It, Will We Come?', 2012) deem large infrastructures to be "intellectually prohibited places" for ideas or approaches that do not fit the preconceived model. This is why *Reassembling the Republic of Letters* proposes to distinguish between core metadata and supplementary data. To ensure interoperability, core metadata – sender, recipient, date, origin, destination, and source reference – should be modelled in the same way. These guidelines, however, do not apply to supplementary data, which include information on the materiality of the letters (e.g. letterlocking), prosopography, genres and topics, among others.

Between 2014 and 2018, *Reassembling the Republic of Letters* offered a forum for experts in various disciplines to work together and build a common understanding of the digital humanities. Collaboration between the DensityDesign Research Lab at the Politecnico di Milano and the Stanford Humanities Center was key to developing network tools such as Palladio, as well as giving rise to a permanent Humanities + Design Research Lab at Stanford University (307). Datasprints with both humanists and computer scientists produced outcomes "that could never have been achieved otherwise" (307). These experiences show, once again, that collaboration and communication are pivotal to the future of the digital humanities. To interpret the results of quantitative research, historians must acquire knowledge of the tools and methods, while keeping an eye out for close reading.

I hope that digital librarians and project managers will listen to the message of this book and open the doors of their online catalogues, allowing historians to freely gather data from them. Only then will we live up to the promise of metaarchives.