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ABSTRACTS

Keynote Address:

Connecting Chaco: How Network Analysis Changed my View of the Chaco World

Barbara J. Mills

University of Arizona

A decade or so ago, I began a project (with several collaborators) to extend what the Southwest Social Networks Project had done for the post 1250 CE period to the Chaco World. Our analyses of the Chaco networks included great houses and great kivas as the nodes with shared similarity in pottery wares comprising the edges. We applied many of the same methods used in prior analyses, including dividing our sample into 50-year increments to look at how the networks changed, in this case, between 800 and 1150 CE. The resulting networks were surprising in some ways and confirming of previous research in other ways. In this presentation I discuss both the surprises and the ways that network analysis helped to confirm interpretations based on non-network analyses. Ultimately, the Chaco network project changed my view of the Chaco World and provided data for subsequent analyses and interpretations. I trace the arc of this research project over the past decade to show how cumulative data analysis can result in new interpretations. This case study illustrates several aspects of a large, collaborative project including the importance of persistence, team building, and data sharing.

PAPER ABSTRACTS

(alphabetical by first author's last name)

The Structure of Domestic Life: A Multivariate and Network Analysis of Chalcolithic Houses in Mesopotamia

Khaled Abu Jayyab, Elizabeth Gibbon, Lisa Wolff, Lianna Sternklar, Deniz Dernek, Koushan Amir-Khosravi, Emmett Kohl McPherson, Rowan Berrian, Aly El Hemasy, Brittany Mayers

University of Toronto

Archaeological discussions of social change in Chalcolithic Mesopotamia have often privileged regional settlement dynamics and hierarchical models of interaction. While these approaches illuminate shifting inter-site relationships, they tend to under-theorize the structural and relational position of the household within broader socio-economic systems. This paper re-centers the household as a fundamental analytical unit, explicitly framing it as a node embedded within evolving networks of production, exchange, and social interaction. In doing so, it explores diachronic transformations in societal organization across Mesopotamia from the Ubaid through the Late Chalcolithic periods (ca. 5400–3600 BC).

To address these issues, we compile a comparative dataset of domestic architectural and contextual variables from sixty sites (with multiple houses from each) across greater Mesopotamia. The dataset includes measures such as house size, number of rooms, inferred room functions, evidence for crafting activities, counts of ovens and hearths, and the presence of intramural burials. Leveraging multivariate statistical techniques alongside network-based approaches, we model patterns of covariance among domestic features and reconstruct relational ties between households within and across settlements. These combined methods allow us to identify clusters of household practices, trace the emergence of differentiated domestic roles, and evaluate the degree to which households were integrated into local and supra-local systems of interaction.

Our analysis addresses several key questions: whether variation in house size reflects long-term diachronic trajectories or regionally contingent organizational strategies; whether increases in household scale correspond to greater diversification in productive activities; and how shifts in the spatial organization of craft production relate to changing configurations of household connectivity within settlement and inter-settlement networks.

By integrating multivariate patterning with network relationality, this study reconceptualizes households not as isolated units but as dynamically interconnected actors. In doing so, it demonstrates how transformations in domestic organization both shaped and were shaped by broader social, economic, and spatial networks during the Chalcolithic of Mesopotamia.

John Wesley's Global Medical Networks

Sarah Ahmed

McGill University

While today, John Wesley (1703-1791) is best-known as the founder and leader of Methodism, his amateur medical practice and public health works have, for the most part, been forgotten apart from a handful of scholars. Yet Wesley envisioned his 'sick societies' to be a central feature of every Methodist community. David Hempton has called for an international, networked approach to the study of Methodist history. By the time of Wesley's death in 1791, Methodism had already become a global phenomenon, spread by missionaries, migrants, and soldiers throughout the British World. John Pritchard, M. Marquardt, and D.M. Lewis have laid the groundwork in describing the establishment of 18th and 19th century Methodist networks, but as a methodology, network analysis has remained underutilized. This approach has yet to been tried in the context of 18th and early 19th century Methodist healthcare. This approach is particularly well suited to the subject of Methodist 'sick societies' as Wesley's local lay medical officers and lay itinerant preacher-physicians were instructed to report back to central locations, either to Wesley or to local Stewards. 10,000 letters passed between Wesley and his correspondences, and that some lesser-known Methodists were equally prolific. Using the correspondences of John Wesley and his itinerant preachers, I will reconstruct 18th century Methodist medical networks, demonstrating their scope and operations, particularly in Britain, Ireland, and the Canadian Maritimes.

The Affordances of the Amazonian Floodplain in the Late Precolonial Period (CE 1000–1600)

Marcony Alves[1], Carl Knappett[2]

[1]University of São Paulo
[2]University of Toronto

The Amazonian region has long been portrayed in scholarship as a limiting environment for pre-Columbian cultural development, due to its poor soils and low protein availability, which were thought to constrain population density. The floodplain of the Amazon River, in particular, has been characterized as highly productive—owing to abundant aquatic resources and the continual renewal of fertile soils—yet too unpredictable for sustained management and dwelling. Recent research, however, has shown an unpredictable extensive landscape modification and the construction of earthworks across the Amazon. In this presentation, we argue that Amazonian floodplains were effectively managed through deep ecological knowledge, expressed in the complementary use of diverse environments, patterns of seasonal mobility, and the formation of regional interaction networks.Drawing on archaeological surveys and excavations in the Lower Amazon region, as well as the analysis of ceramic and lithic materials, we identify the circulation of non-local raw materials and finished artifacts across distances of up to 400 km. We contend that the traditional emphasis on soils and agricultural productivity has obscured the central role of Amazonian rivers and their seasonal dynamics as key drivers of mobility, exchange, and shared ritual practices identified in the archaeological record.

Connecting the dead: kinship, mobility, and social networks in Neolithic dolmens of South-Western France

Ana Arzelier[1], Alycia Menuge[1], Delphine Linard[2], Marie-Hélène Pémonge[1], Fanny Mendisco[1], Mickaël Legros[1], Arnaud Blin[3], Marie-France Deguilloux[1], Muriel Gandelin[2,4], Vincent Ard[2] & Mélanie Pruvost[1]

[1]UMR 5199 PACEA, Université de Bordeaux, CNRS, Pessac, France
[2]UMR 5608, TRACES, Université Toulouse - Jean Jaurès
[3]ArScan UMR 7041, Équipe AnTET, Nanterre, France
[4]INRAP, Centre Archéologique de Villeneuve-Lés-Béziers

South-western France represents a major center of European megalithism, characterized by a high density of monuments and marked architectural diversity. While recent work has refined the chronology and social interpretations of dolmens as dynamic, multi-functional monuments, their role within broader social and biological networks remains underexplored. In particular, collective burials, reused over centuries and housing commingled human remains, pose significant challenges for reconstructing patterns of social organization, mobility, and kinship. This study integrates archaeological, osteological, and biomolecular data to investigate how megalithic communities were structured and interconnected across space and time. Drawing on palaeogenomic datasets generated within the framework of the ANR LINK project, combined with radiocarbon dating and archaeological evidence, we explore the relationship between genetic relatedness, funerary practices, and material culture in collective burials contexts from south-western France. By adopting a network-based perspective, we compare biological networks (kinship, ancestry, mobility) with cultural networks inferred from monument architecture, funerary selection, and cultural patterns. This approach enables us to assess how collective burials functioned not only as funerary spaces but were deeply rooted within wider social landscapes, mediating relationships between communities, territories, and lineages.

Our results aim to provide a multi-scalar understanding of Neolithic and Early Bronze Age societies, highlighting how megalithic monuments materialized both social identities and biological connections. More broadly, this research demonstrates the potential of tightly integrating palaeogenomics and archaeology to reconstruct past human networks and to reassess the role of monumentality in shaping social interaction and connectivity.

Connecting Nahua Gods: Network Analysis in the Study of Pre-Hispanic Religion

Agnieszka Brylak

University of Warsaw

Recent scholarship on Nahua religion has emphasized that pre-Hispanic Central Mexican gods cannot be understood as discrete or stable entities. Instead, they appear in historical sources as complex configurations of names, attributes, and visual elements whose meanings varied depending on ritual, linguistic, and graphic contexts. Names associated with Nahua gods include personal names, calendrical names, titles, and epithets. Many of these designations could refer to more than one god, while individual gods could be associated with multiple overlapping identities. This fluidity has long complicated attempts to reconstruct a stable Nahua "pantheon."

This paper explores how network analysis can help investigate the relational structure underlying this system. Building on previous historiographical studies as well as semiotic and cognitive approaches to Nahua graphic communication, the research models relationships between gods' names, attributes, and graphic components attested in pre-Hispanic codices and early colonial sources. Alphabetic and visual elements are treated as relational data connected through co-occurrence within textual and graphic contexts.

The resulting network allows to explore patterns of association among various elements constituting gods' identities, highlighting clusters that link different configurations of Nahua gods across sources and contexts. Rather than attempting to determine a fixed number of gods, the analysis focuses on reconstructing the relational framework through which gods were identified, combined, and transformed. By integrating qualitative interpretation with computational modelling, this approach demonstrates how network analysis can contribute to the study of complex historical systems of belief and to broader discussions on the role of network science in digital humanities research.

Networks of Ancestrality: Funerary Assemblages and Elite Self-Fashioning in South Italy and the Adriatic

Emma Buckingham

University of Missouri, Columbia

How did indigenous communities in South Italy and the Adriatic negotiate intensified connectivity during the era of early Greek expansion? This paper uses network theory to analyze funerary assemblages from seventh- and sixth-century BCE contexts to reassess longstanding interpretations of colonial interaction. I examine how grave good assemblages articulate patterns of selection, association, social signaling, and belonging across local communities, moving away from narratives that treat Greek objects as straightforward markers of ethnic identity, acculturation, or resistance. Building on a relational database of material from excavated tomb contexts, I model networks based on patterns of object co-occurrence and shared assemblage composition to identify recurring associations across sites, regions, and chronological horizons. I argue that these networked patterns reveal strategies of elite self-fashioning grounded in locally specific claims to status, locality, and ancestrality. In this sense, the oft-cited model of "hybridity" only goes so far. Greek imports and Greek-style objects certainly circulated widely, but they were only one strand within broader constellations of objects drawn from multiple sources, including local traditions and references to a community's past (whether real or imagined). In this sense, funerary networks do not map colonial influence but rather expose how indigenous elites mobilized new connections to reinforce internal hierarchies and rearticulate authority during a period of urbanization and social change. By shifting attention from ethnicity to relational practice, this paper argues that network analysis offers a powerful way to recenter indigenous agency and move beyond binary models of adoption or resistance in Archaic Mediterranean transethnic settings.

From living practices to ancient networks: ethnoarchaeology for the reconstruction of Roman unguent and incense production

Alice Capobianco

Universität Genua and Universität zu Köln

Reconstructing ancient scent economies requires moving beyond isolated artefacts toward relational frameworks that integrate materials, practices, and people. This paper explores how ethnoarchaeological observation can inform network-based interpretations of Roman unguent and incense production by documenting living communities of practice and material workflows in contemporary artisanal contexts.

Field-based studies of traditional perfume-making in Kannauj and argan oil production in Morocco are combined with ethnoarchaeological research on incense harvesting, processing, and circulation in Arabia Saudita, Oman and other countries. Together, these cases provide detailed insights into operational sequences, knowledge transmission, labour organisation, and raw-material procurement. Rather than serving as direct analogies, they are approached as heuristic models for identifying relational patterns — spatial, social, and technical.

These observations are integrated with archaeological, textual, and archaeometric evidence relating to Roman unguents and incenses in the Roman period. Residue analysis and contextual data are combined to conceptualise scent production and use as a multi-layered network linking substances, containers, production spaces, exchange routes, and communities of practitioners.

By foregrounding qualitative reasoning alongside scientific data, this contribution demonstrates how ethnoarchaeology can function as a methodological bridge between material analysis and network theory. It argues that Roman practices surrounding unguents and incenses are best understood not as linear chaînes opératoires, but as dynamic assemblages shaped by mobility, resource availability, ritual requirements, and shared technical traditions. More broadly, the paper highlights the potential of integrating living production networks into archaeological network studies to address fragmented datasets and to recover the social dimensions of ancient scent technologies.

Cities as networks: using network analysis to explore the development of urban networks at Middle Bronze Age Levant.

Fiona Coward[1], Nina Maaranen[2]

[1]Bournemouth University School of Health, Environmental and Medical Sciences/IMSET;
[2]Finnish Institute in the Middle East/University of Warsaw

The emergence of urban communities marks a step-change in human societies. Just a few thousand years since the emergence of the first truly urban communities, nearly half of the human population now lives in cities, and biological and social adaptations to urban environments and communities will become increasingly important to manage in sustainable ways in the future. Traditional archaeology has already established a clear timeline to the emergence of sizeable settlements and the material signatures of urban lifeways, and demonstrate clearly that urbanization is more than simply aggregation: urban communities in the past, as in the present, were fundamentally networked phenomena – complex networks of increasingly socially and economically interdependent inhabitants, as well as nodes in wider regional and global networks of communication and trade and interaction, whether as city-states in their own right or as parts of polities ranging from chiefdoms to empires.

In this paper we will explore the ways in which network methods can be used to investigate the process of urbanisation at potentially multiple scales of resolution, utilizing archaeological data from Middle Bronze Age (circa 2000-1550 BC) Levant spanning a period of rapid urbanisation and expansion of regional-scale trade networks. Burial practices from this region and period of rapid change leave a rich dataset consisting of osteological remains (both human and animal) and the associated material culture, and in conjunction these offer an invaluable opportunity to explore the ways in which the multiplex socio-bio-material networks of these early urban communities developed over the course of this critical period in human history.

Avar networks. Analysing burial customs to model regional networks

Tamás Czuppon

Hansagi Museum and Pázmány Péter Catholic University, Hungary

This research focuses on the Carpathian Basin in Europe during the Avar Khaganate which existed from the 6th century AD to the 9th century AD in the Carpathian Basin and formed its history during this time. The aim of the research to detect how social and material culture structures have changed in a certain area during a certain time through burial custom changes and even what kind of connection can be seen between the cemeteries in these times. The data come from 40 cemeteries and from circa 8000 graves. The data from the cemeteries and graves is multi-level and multi-relational, containing information about the grave and about the past peoples life. I use this data to create block models based on structural and regular equivalence, which I further analyze to model the roles and positions of the society represented in the network. Incorporating the social analysis of roles and positions to this network allows us to see beyond descriptive summaries and analyze the communities at a greater depth. This research is a social network analysis to investigate individual and social interactions and the process in which these are embedded in, structured by and constitute, broader social structure.

The research uses a database of material culture too from these sites of these periods to establish indices of material culture similaraties or closeness for sites. My results preliminary suggested that, at the inter-site level, social networks became larger from 6th century AD to the 8th century AD. Moreover the average strength of relationships between sites and the overall density of the networks both increased.

Moving gods and elusive temples in Late Babylonia

Rocío Da Riva

University of Barcelona

Cuneiform texts from Late Babylonian (IV-I centuries BCE) temple archives and libraries are an important source of evidence about religious networks, as they contain data on festivals, their frequency and participants (both human and divine), and the sites where the ceremonies took place. These temple texts are first-hand sources to study aspects related to movement and connectivity and to analyse the interface between the spatial grids (cities, temples, and other sacred spaces) and the social agents who participated in movements between cultic places. However, despite their relative abundance (we have now a corpus of some 150 texts), the sources also pose a series of issues and challenges that seriously hinder their full exploitation. To begin with, the formulation of the texts makes it difficult to fully appreciate the complexities of the ceremonies that they describe. Also, most tablets are fragmentary, which further complicates their reading and comprehension. In other words, we are faced with texts that contain incomplete data. In order to overcome the challenges posed by this type of documentation and its state of preservation, it is necessary to develop a research protocol, adapt the method to the nature of the sources and the type of corpus, and build a solid, flexible model. In this presentation, I will use a number of case studies to illustrate the challenges that come when deciding to study material of this sort.

People, Place, Palace: Integrating Spatial and Social Networks within the Middle Bronze Age Palace at Mari (Tell Hariri, Syria)

Kristina Donnally

University of Pennsylvania

This paper will reconstruct the social systems of the palace at Mari (ca. 1760 BCE) through the integration of spatial, archaeological, and textual data. Mesopotamian palaces were far more than the residences of kings. These institutions were also densely inhabited social environments—complex ecosystems in which sometimes hundreds of individuals of different socioeconomic statuses, genders, ages, and professional roles lived, worked, and interacted on a daily basis. In order to reconstruct the complex social systems of the palace, I employ an integrated methodological framework that combines spatial analysis of the excavated building, archaeological study of the artifacts (including sealings and tablets) found in each room, and network analysis of the palace textual records. My project sits within the theoretical frameworks of spatial archaeology and social history and utilizes network analysis as a tool to integrate disparate data sets together. The results of this study reveal that the social organization of the Palace at Mari was primarily organized around role and that factors such as gender, kinship, or age had far less impact on the social structures. Labor was organized into discrete groups around set tasks and the spatial layout of the palace reflects the same organizing principles. This paper presents results that provide a critical corrective to previous interpretations that centered gender as the primary social organizing factor and further provides a methodological approach for integrating spatial, archaeological, and textual data into social-historical studies.

Modeling Alphabet Diffusion and Community Interactions in Ancient Italy with Spatiotemporal Hawkes Processes

Tom Francis, Mohammad Rehan

University of California, Los Angeles

After the Etruscans adapted the Greek alphabet with regional variation, these alphabets spread and were further adapted by speakers of over a dozen languages in ancient Italy, producing local admixtures of alphabets within settlements ([1–3]). To systematically trace this activity across ancient Italy, we created a georeferenced, time-tagged dataset of the more than 13,000 representative inscriptions (8th to 1st centuries BCE; over 20 distinct alphabets labeled; see Fig. A1); we then modeled pan-Italic networks of inscriptional production with a marked spatiotemporal Hawkes process recently used for modeling social networks ([4–6]). The model estimates background spatial production probabilities, and inscriptional triggering of other inscriptions. We also infer an alphabet-to-alphabet expected excitation matrix summarizing conditional spatiotemporal dependence and connectivity among inscription events across alphabet types. Our results show strong spatiotemporal heterogeneity in the latent generative process underlying inscriptional production (Figs. A2–A6). Four results stand out. First, most inscriptions contribute little to subsequent inscriptional production, while a smaller subset exerts disproportionate influence on later inscriptions. Second, disproportionate influence on later inscriptions is not confined to major epigraphic centers: some regions function as persistent production centers, whereas others show episodic, spatiotemporally conditioned periods of heightened inscriptional influence. Third, inferred dependence is strongest within alphabets, with weaker cross-alphabet effects overall; Among the alphabets, North Etruscan and Latin show especially strong self-excitation. Methodologically, our model provides a quantitative framework for inferring persistence, influence, and connectivity through inscriptions. These inferred dynamics serve as a proxy for studying the nexus of pan-Italic population networks.

Beyond the Macro: A Graph-Based Approach to Model Material-Social Intersections in tomb QH35p of Elephantine (Egypt).

Luisa M. García González

University of Jaén

Tomb QH35p is situated within the necropolis of **Qubbet el-Hawa** (Aswan), the primary resting place of the local elite of the southernmost province of Egypt during the middle Bronze Age. **Elephantine**, the capital of this region, functioned as the natural frontier with ancient Nubia. Its strategic position ensured its central importance in Egypt's political landscape, turning into a critical node and fostering distinct socio-cultural particularities that are manifested in its material culture.

After systematic excavations by the University of Jaén since 2015, it has been revealed that tomb QH35p was not a simple tomb but a sophisticated **funerary complex**, emerging as one of the most compelling hypogea of the site. It featured approximately 20 undisturbed in situ burials with their associated funerary assemblages. This paper moves beyond traditional macroscopic descriptions of its archaeological finds to explore the intersection of material and social networks within the tomb's complex making use of the Network methods. By treating artifact types and individual burials as "nodes", and cooccurrence as "edges", this study addresses to model these relations as graphs to elucidate further complex social dynamics. Furthermore, the in situ nature of the finds allows for a rare opportunity to deal with data completeness, providing a high-resolution benchmark for funerary network modelling.

Ultimately, this **graph-based approach** demonstrates how the material "links" within QH35p reflect the broader socio-political fabric of a frontier community, proving the efficacy of Network Research as a robust analytical tool in Archaeology to decipher the complex agency of the Egyptian society.

How Similar is "Similar"? Bridging Theory and Method in Ceramic Network Analysis

Paula Gheorghiade[1], Tom Brughmans[1], Michele Coscia[2], Nikolaos Salamanos[2]

[1]Social Resilience Lab, Aarhus University)
[2]Michele Coscia and Nikolaos Salamanos (IT University of Copenhagen)

This talk discusses how material culture similarity has been theorized in archaeological, and anthropological literature and how it has been mobilized in the reconstruction of past social networks. Comparison of ceramic data is foundational to archaeological reconstructions of past social processes, with typological and classificatory traditions playing a key role in the kinds of relationships that archaeologists reconstruct from their data.

Nevertheless, similarities observed from ceramic data do not inherently encode or reflect any kind of social interaction regardless of how they are conceptualized. The connections or relationships deduced from similarities in the archaeological record are not an "inherent property" of the record itself, but rather situated disciplinary constructs. Artifact classification, typology, data quality, and changes in theoretical perspectives all impact how similarity is conceptualized, and conversely, the types of social relationships that are inferred from the surviving evidence.

In this presentation, we will use practical examples, specifically problematizing observed patterns from ceramic data and inferred social and relational phenomena and various approaches to ceramic classification, definitions of similarity, and inferences. The goal is to highlight the archaeological assumptions as well as the biases and limitations of the data archaeologists rely on for these reconstructions. We argue that despite the theoretical diversity in archaeology and anthropology, this diversity is not reflected in the analysis and application of methods in archaeological network research. It is precisely within the translation of similarity scores into network representations that we observe gaps in methodology. For example, none of these approaches address the many biases that exist in incomplete, highly sorted archaeological data. Practically, archeological network practice is not exploiting the full potential of network inference analysis, often relying on simple thresholding, dropping connected pairs below a certain edge weight.

To constructively enhance our knowledge of past human interactions, we propose a new Bayesian framework that inverts current practice by starting with an agent-based model of an archaeological theory that generates networks which are fitted to empirically observed material culture similarity networks.

Understanding the Viziers of Egypt's Early Middle Kingdom through Social Network Analysis

Emma Glenister

University of Pennsylvania

The vizier was the highest-ranking official of the administration of ancient Egypt's Middle Kingdom (~2050-1700 BCE). In contrast to other periods, however, a lack of direct textual evidence for the vizier's specific duties means that scholars have a very limited understanding of what these men actually did. In order to remedy this gap, this paper will conduct a network analysis of the viziers of the early Middle Kingdom (~2050-1880 BCE) in order to understand with whom the viziers worked. Through analysis of the titles and roles of the men who appear in inscriptions alongside the vizier, it will be possible to understand the scope of the vizier's duties and authority. For example, men with titles like "overseer of the crew of the ruler" and "overseer of the house of the (legal) court" are known to appear in monuments with the vizier Intefiqer, implying they worked for him in some capacity. These networks will be extended to the third degree where possible in order to create the best possible understanding of the reach of the viziers. Particular focus will be placed on the networks of early Middle Kingdom viziers like Intefiqer and Montuhotep (during the reign of Senwosret I) and Bebi and Dagi (during the reign of Montuhotep II) who are particularly well-attest and whose networks can therefore tell us the most about the position of the vizier and how it changed over the nearly two centuries under study in this paper.

Travellersim Redux: Generating Networks from Archaeological Data

Shawn Graham[1], Pedro Trapero Fernández[2]

[1]Carleton University
[2]Universidad de Cádiz

Sometimes, when we want archaeological network data for analysis, we have to roll our own. Twenty years ago, Graham and Steiner published 'TravellerSim', an agent based simulation that implemented an even earlier gravity settlement model (Rihll and Wilson 1987), using site distribution data from the Tiber Valley and mainland Greece to grow 'socially-connected settlement structures from distribution map data'. The resulting output of the model could then be analyzed with social network tools to say something about 'importance' of sites and the emergence of territories. At the time, the results seemed to make archaeological sense. How has that model held up? In this paper, we re-implement the model from scratch in Netlogo 7.1 as well as in the Python package 'mesa'. We then attempt to validate the results by using a completely different method, exponential random graph models (ergm; Brughmans, Keay, and Earl 2014), on the grounds that if different models return similar results, something more fundamental has been discovered. Finally, we deploy both Travellersim-Redux(gravity) and Travellersim-Redux(ergm) on archaeological data from Spain and discuss how these models illuminate and/or complicate the archaeological interpretation of the lower Guadalquivir region. Generative approaches to network analysis for history and archaeology are comparatively rare; approaches that also foreground reproducibility and replicability (which are not exactly the same thing) are similarly hard to find. When all three concerns drive the work, the result is extraordinarily rich.

Missing Sites, Shifting Centers? Evaluating Network Robustness in Akkadian Landscape in Southern Mesopotamia

Fatemeh Javanmardi

Universität Bern

This paper presents a proximity network-based analysis of settlement systems in southern Mesopotamia during the Early Dynastic (ca. 2900–2350 BCE) period, conducted within the framework of the HyMes project (https://hymes.ch). The study evaluates the centrality of sites and assesses the robustness of observed network structures despite incomplete archaeological data. Using spatial datasets of known sites, networks are constructed to model inter-site connectivity based on geographic proximity. These networks are analyzed using standard centrality measures such as, betweenness and closeness, understood here as a proxy for interaction intensity within the settlement system. However, archaeological datasets are inherently fragmentary, and smaller sites are especially prone to underrepresentation due to survey bias and preservation conditions, raising concerns about the stability of inferred network hierarchies. To address this, the study employs a sensitivity analysis that simulates data loss through the removal of small sites. Site selection is implemented using weighted random sampling without replacement, where weights are derived from site size as a proxy for archaeological visibility, assigning higher probabilities of removal to smaller sites. This process is repeated across multiple iterations to generate a range of perturbed network configurations. By comparing baseline and simulated networks, the analysis evaluates the stability of centrality measures and identifies which sites retain central positions despite the systematic loss of minor settlements. This approach enables an assessment of robustness of the available data of Akkadian period, contributing to methodological discussions on uncertainty in archaeological network analysis and offering new insights into the organization and resilience of early Mesopotamian settlement systems.

Economic and Military Drivers of the Worship of Asclepius in Roman Dacia: A Quantitative Approach

Sebastian Kheml

Centre for the Digital Research of Religion, Masaryk University, Brno, Czech Republic

The Danubian provinces of the Roman Empire offer fertile ground for spatial modeling research due to their economic importance, including metal and salt mining, quarrying, and timber extraction, as well as the strong military presence, which left abundant epigraphic and archaeological evidence. The province of Dacia illustrates this particularly well. Although it remained under Roman rule only from 106 to 271 CE, its rich mineral resources, especially gold, made it a key economic center. Yet the two Dacian wars (101–2 and 105–6 CE) greatly diminished the local population, creating an urgent demand for labor and thereby prompting large-scale migration from across the empire. These settlers brought diverse cultural traditions, including religious practices, producing a complex mix of identities traceable through epigraphic records. However, the shared need for medical care formed an important cultural meeting point, evident in the presence of both healing cults, particularly those of Asclepius and Apollo, as well as medical professionals.

In this paper, I examine the relationship between major economic activities, particularly mining, and military infrastructure in shaping a distinctive cultural and religious landscape. Special attention is given to healing cults likely venerated by soldiers, veterans, and miners involved in metal extraction, all of whom faced considerable health risks. The presence of veterans and healing cults is approximated through inscriptions in the Epigraphic Database Heidelberg, while mining activity is digitally documented in the OxREP database. Rather than relying on a standard network-based GIS approach, such as betweenness centrality, this research combines formal spatial proximity analysis on a Roman transportation network (Itiner-e database) with statistical tests, including Spearman rank correlation and bootstrapping.

Mapping Chinoiserie: A Data Modelling Approach to Chinese Cabinets in the Court Architecture of the Holy Roman Empire, ca. 1650–1800

Ke Ma

Ludwig-Maximilians-Universität München

Chinese cabinets are a category of decorated interior in early modern European courts, characterized by Chinese-style objects, imported materials, and associated decorative systems. First introduced into the Holy Roman Empire through dynastic marriages connected to the House of Orange, this decorating practice gradually evolved into a distinct interior tradition with its own decorative vocabulary in court settings, with ca. 80 identifiable examples by around 1800. The furnishings of these cabinets survive to different degrees, ranging from relatively well-preserved interiors with their structures and collections largely retained to rooms that are no longer extant and can only be tentatively reconstructed from fragmentary traces and historical records. Studying these rooms requires drawing on heterogeneous sources and material evidence, including surviving architectural elements, collection ensembles, inventories, expenditure and building accounts, as well as historical plans and photographs.

This paper proposes a data model centred on the individual cabinet room as its primary unit of analysis. It captures the spatial and material organisation of each room in a layered structure, using schemes and motifs to identify recurring patterns. It also extends into archival materials through relationship extraction and event modelling, retrieving personal connections and historical processes such as acquisition, inheritance, travel, and visits. Implemented as a Neo4j property graph database, the model structures entities and relationships from heterogeneous sources within an extensible graph environment. This makes it possible to query and compare relational patterns systematically, thereby supporting the analysis of collecting practices, courtly connections, and processes of dissemination and variation.

“Should I Stay or Should I Go?”: Tracing Migration Routes and Travel Concerns in the Hellenistic Period through the Oracular Tablets of Dodona

Virginia Martos Armenteros

University of Toronto

The thousands of lead oracular tablets discovered at Dodona in northwestern Greece offer valuable insight into the concerns of the ancient Greek society, among which travel emerges as a central theme. The questions addressed to Zeus and Dione show not only the destinations and routes of ancient mobility, but also the risks, uncertainties, and anxieties associated with it.

Based on this, the paper is structured in two parts. First, it reconstructs a network of the most frequently mentioned destinations in the Dodona tablets in order to trace potential migration routes during the Hellenistic period and explore the connections underlying them. Second, it analyzes the range of concerns expressed by the consultants of the oracle regarding travel, including modes of transportation, purposes of journeys, and route selections, among many others.

By combining network analysis with a close reading of these inquiries, this study aims to underscore the potential of oracular sources for investigating connectivity in ancient Greece. More broadly, it seeks to move beyond abstract network structures of nodes and links to recover the lived experiences of the individuals who shaped them, highlighting both patterns of mobility and the emotional dimensions that accompanied them.

Human-avian hybrid communities within socio-material-ecological networks: the case of Çatalhöyük

Camilla Mazzucato[1], Riccardo Alba[1], Dan Chamberlin[1], Ramazan Parmaksiz[1], Lisa Yeomans[1,2,3], Beatrice Demarchi[1]

[1]Department of Life Sciences and Systems Biology, University of Turin
[2]The Globe Institute, University of Copenhagen
[3]University College London

In their 2006 paper "Etho-ethnology and ethno-ethology," Dominique Lestel and colleagues define hybrid communities as those composed of humans and animals "sharing meaning, interests and affect" within a shared environment (Lestel et al., 2006:156). This study employs network methods to reconstruct and investigate such hybrid human-avian communities at the Neolithic site of Çatalhöyük (7100–5950 BC). Throughout its long occupation, the site displayed a complex and dynamic relationship between humans and birds; avian species were both hunted for subsistence and deeply integrated into Çatalhöyük's symbolic world. To capture this complexity, we employ morphological analysis on bones and proteomic techniques on eggshell remains, revealing the presence of birds that would otherwise be invisible in the archaeological record. We then utilize network analysis to synthesize diverse associations between houses, material culture, and avian remains. This approach creates heterogeneous, multilayered models that incorporate past avian communities alongside various avian traits. By constructing microscale intra-site networks, we explore the social geography of human-avian dynamics and communities of practice at specific points in the site's history. In doing so, we acknowledge the fundamental interdependence of environmental and social domains, viewing these categories as imagined divisions rather than lived, material realities.

Mapping Romanization: Social and Spatial Networks in the Peligna Valley

Antonio Merola

Università degli Studi Aldo Moro di Bari

This paper examines the intersection of spatial and social networks in the context of the Romanization of the Peligna Valley (Abruzzo, Italy). The study is based on approximately 400 funerary inscriptions from the archaeological record of the valley, spanning the late 4th century BCE to the 4th century CE. This corpus provides evidence for reconstructing relationships among individuals, families, and gentes during a crucial longue durée of interaction between Italic communities and Rome. Drawing on this epigraphic corpus, the research analyses different types of ties, including marriage alliances, kinship relations, work-related connections, and spatial associations linked to origin, commemoration, and social visibility. These data were used to construct a series of social graphs and dynamic network models, processed and visualized through the open-source software Gephi. The results reveal that Romanization in the Peligna Valley was not a uniform or purely top-down process. Instead, network analysis highlights differentiated patterns of interaction, with some individuals and family groups acting as highly connected nodes within broader social and spatial frameworks. The results of this study also show the formation of clusters based on kinship, professional ties, and shared places, as well as changes in the density and structure of relationships over time. These patterns make it possible to identify mechanisms of integration, local strategies of adaptation, and the progressive reconfiguration of social identities. The paper argues that the combination of epigraphic evidence and network analysis offers a particularly effective method for investigating ancient social change.

Networks in Motion: Modelling Interactions in the Bronze Age Central Mediterranean

Giulia Michienzi

University of Bari Aldo Moro, CNR ISPC

Starting from the Early Bronze Age (ca. 2200 calBC - 1650 calBC), the central Mediterranean experienced a significant expansion of maritime routes. The consolidation of short and long-distance networks fostered both the circulation of raw materials and prestige goods, as well as the intensification of social interactions, as widely attested by the increasing number of shared features in the material record of local communities. This study investigates the interaction networks across Sicily, the surrounding islands, and Calabria, from the EBA to the MBA3 (ca. 2200–1300 calBC) primarily through the lens of Social Network Analysis (SNA), while adopting a multidisciplinary approach. The selection of analytical proxies is in fact grounded in the social sciences, incorporating perspectives from political economy, ethnography, and anthropology, to interpret how social, economic, and ritual exchanges shaped local connectivity. Concurrently, the SNA models are enhanced by the integration of multivariate statistics and geostatistics; the latter, specifically through the spatial analysis of terrestrial and maritime mobility, enables a comprehensive understanding of how environmental factors and geographic constraints might have driven interactions.

The Formation of a Network of Political Allegiance, Social Relations, and Magnate Influence in the Polish-Lithuanian Commonwealth during the First Half of the Eighteenth Century- preliminary research

Anna Penkała-Jastrzębska

University of the National Education Commission, Krakow

The objective of the project is to reconstruct a network of political support—encompassing political allegiance, social relations, and magnate influence—in the Polish–Lithuanian Commonwealth during the first half of the eighteenth century, using methods derived from complex network analysis. The paper seeks to determine how private assets—their scale, structure, and composition—were translated into social and political capital in the Commonwealth during this period.

Its aim is to undertake a comprehensive examination of the formation of patron–client networks, the establishment of political alliances, the reconfiguration of social ties, and the creation of channels of advancement for political allies. The study analyzes the process of reshaping networks of support and the configuration of political forces in the Polish–Lithuanian Commonwealth in the first half of the eighteenth century, in order to demonstrate how the positions of patrons and their clients within these networks—measured in terms of centrality and brokerage—shifted over the course of sustained political activity. It also seeks to identify the consequences of wealth accumulation mechanisms and the consolidation of social capital.

The application of complex network methodologies enables not only the identification but also the dynamic visualization of political support networks operating in the Commonwealth during the first half of the eighteenth century. By conceptualizing individuals and families as nodes and relations of patronage, alliance, or dependence as ties, this approach allows for the reconstruction of the underlying structure of political relations and facilitates the analysis of changes over time, illustrating how such networks were established, maintained, and transformed.

Re-evaluating stratigraphic relationships at Gravina di Puglia through network analysis

Adrian Proestos[1], Stephen Smith[2]

[1]McMaster University
[2]University of Toronto

This study re-evaluates the stratigraphic relationships and depositional histories of contexts excavated at Botromagno, near the modern town of Gravina di Puglia in southeastern Italy, through the application of archaeological network analysis. The analysis draws upon the excavation reports and associated documentation produced by Alastair Small and his team during excavations conducted at the site between 1965 and 1974. Botromagno represents an important archaeological site for understanding the development of communities in southeastern Italy during the later first millennium BCE, yet the interpretation of individual contexts is complicated by the complex chronological and stratigraphic relationships recorded during excavation. To investigate these relationships, this project has developed a database of archaeological finds dating broadly from the fifth to the third centuries BCE. The dataset includes diagnostic ceramic classes such as Red-Figure, Gnathian, and Black Gloss wares. Rather than treating the chronological assignment of individual contexts as fixed, the project uses the relationships between artifacts and stratigraphic layers to examine how different forms of evidence contribute to interpretations regarding the use of certain areas across the site.

A two-mode network approach is employed to model relationships between archaeological contexts and artifact types. In this way, contexts and artifact categories are represented as distinct node types, with edges indicating the presence of particular artifact types those archaeological layers. This structure allows for a re-evaluation of the excavation reports to examine whether identification is consistent based on ceramic assemblages is accurate as well as to assess if a network approach can help fill in gaps in cases where interpretation of strata was not deemed possible. Rather than replacing conventional stratigraphic or ceramic analysis, network analysis is used here as a means of testing and interrogating the relationships established through the original excavation reports. This paper concludes with a consideration of the how network analytical approaches can be applied to on-going excavations.

Pottery Decoration and the Interaction Sphere of the Yarmoukian Culture in the Neolithic Levant: A Network Analysis Approach

Yulia Prozorova

University of Toronto

Pottery featuring distinctive incised and painted decoration is a characteristic attribute of Yarmoukian material culture, providing evidence for inter-community interaction and delineating the extent of the Yarmoukian cultural zone in the Neolithic Levant. However, comparative analyses of decorative elements among Yarmoukian pottery assemblages remain limited, and little is known about the shared decorative framework and possible connections between these earliest pottery-producing communities. This paper addresses this gap and presents preliminary results of a network analysis of ceramic decoration data from twenty Yarmoukian sites. By treating ceramic decorations as relational proxies, the analysis examines both the stylistic affiliations and the structural configuration of the Yarmoukian "interaction sphere." The study employs a two-mode network framework based on the co-occurrence of decorative patterns within individual assemblages. The projected networks are then analyzed to evaluate their structural signatures. The results shed light on the topology of the decorative repertoire network, reveal potential connections among sites, and identify major nodes within the reconstructed site network that may have functioned as centers for the generation and dissemination of the Yarmoukian decorative tradition.

Archives of Migration and Disrupted Connections during Northern Chile's Industrial Mining Expansion

Francisco Rivera

The Archaeology Centre, University of Toronto

At the end of the nineteenth century, Chile annexed part of the previously Bolivian Atacama Desert and began a steady process of capitalist expansion driven by numerous extractive mining industries (silver, saltpeter, copper, sulfur). The small Indigenous Community of Ollagüe, at the border between Chile and Bolivia, was part of this intense process of demographic and socioeconomic changes. The construction of mining camps around Ollagüe increased, generating significant demand for products, services, and labor. With the emergence of industrial growth, the region thus witnessed an increase in migration and population. Migration files recently discovered at the Universidad Católica del Norte archives document Bolivian migration to Chile from 1888 to 1946: 335 Bolivians arrived at the Ollagüe customs office seeking jobs in the mining industry and crossed the international border. In this presentation, I share the results of the archives systematization. I used Gephi software to visualize information from unedited migration files, showing the movement of workers and their families (origin and destination) in the region. This study reveals how indigenous communities in the Andean highlands, with centuries-old social and family ties, were disrupted by the imposition of a state border, and how the traditional movement of workers across the border was regulated by a new state bureaucracy.

Possibilistic and Probabilistic Uncertainty in Modelling Exchange Networks

Ray Rivers

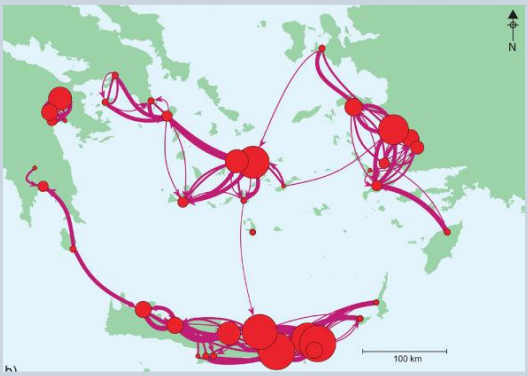
Imperial College London

Archaeological data is inevitably very patchy and models that purport to provide agency to prehistorical exchange networks encode two very different types of uncertainty.

- **Epistemic/Possibilistic uncertainty**: This is particularly the case for uncertainty in *input parameters* which arise from ignorance about initial circumstances. We make informed guesses of possible inputs which are not based on any statistical understanding.
- **Aleatoric/Probabilistic uncertainty**: This is particularly the case for uncertainty in *model outputs* which reflect the 'noisiness' of the system being modelled. This probabilistic uncertainty, with a statistical basis, is usually understood as 'contingency'.

In this talk, the possibilistic uncertainty will be expressed through 'fuzzy' numerical inputs and the probabilistic uncertainty will be expressed through Boltzmann statistical outputs.

The example that I shall give is a simplified version of the Ariadne model for Middle Bronze Age Aegean maritime networks proposed 20 years ago by Carl Knappett, Tim Evans and myself [1]. In particular, I shall consider the stability of the maritime network under stress, such as that shown below by the eruption of Thera, that we discussed later in a further paper [2].



1. Knappett, C, Evans, TS, Rivers, RJ. "Modelling Maritime Interaction in The Aegean Bronze Age", Antiquity, Vol: 82, Pages: 1009 -1024 (2008)

2. Knappett, C, Evans, TS, and Rivers, RJ. "Modelling maritime inter-action in the Aegean Bronze Age, II. The Theran eruption and Minoan palatial collapse", Antiquity 85, 329, 1008 - 1023 (2011)

The Social Reach of Roman Elite Men (350-430 CE): Letter Collections, Ego-Network Comparison, and Static Network Simulation

Adam Schor

University of South Carolina

How can we use meager surviving records of elite social interactions to trace and model larger patterns in late ancient Roman society? This paper explores two linked methodologies for studying social connectivity through extant letters.

The Roman Empire of 350-430 CE furnishes at least 14 letter collections centered on diverse authors. Large, well-studied collections include 1545 messages by Sophist Libanius, 962 by Senator Symmachus, 321 by Bishop Basil of Caesarea (plus 9 received), and 252 by Bishop Augustine (plus 56 received). Each such text features a unique mix of varied entries, assembled by compilers with idiosyncratic agendas. Usually letters name addressees; occasionally, they name couriers, recommendees, and co-signatories. Research to identify persons has provided uneven results. We can only estimate the demographic context: how many Romans held various ranks, roles, and affiliations.

This paper considers two methods of analysis. First, it discusses ego-network co-analysis, utilizing the (aforementioned) authors of letter collections. It takes similarly-sized slices of social data and compares letter-writers' known social reach (with various sorts of people). Thus, we see how Symmachus enmeshed himself among high-senatorial men, and how Libanius bridged senatorial, bureaucratic, military and local elites. Equally we see how neither Basil nor Augustine assembled as many high-placed or broadly extended connections beyond fellow bishops.

Second, the paper discusses static network simulation. It assumes additional leading sophists, senators, and bishops follow templates of minimum connectivity set according to real persons' evident ego-networks. And it ponders how simulation "results" help us to model late ancient Roman society.

Agent-Based Sailing Models as a Basis for Network Analysis: a Case Study from The Practical Mariner

Karl Smith, Linda Hulin, Max MacDonald

University of Oxford

This paper presents an application of network methods to the results of maritime movement simulations produced as part of The Practical Mariner project. Our project simulates travel using an agent-based model (ABM) that predicts how sailed vessels navigate around winds, currents, and coastlines using detailed environmental datasets. We use this model to investigate how Late Bronze Age seafarers in the Mediterranean may have come in contact with one another through short, coastal journeys – and how those interactions may have catalysed the creating of long-distance trading links.

For this analysis we have used a predictive model to select coastal 'nodes' in the Tyrrhenian Sea where mariners may have found anchorage along a shoreline we have altered to reflect sea levels in the Bronze Age. We then use our navigational ABM to simulate sailed voyages between those nodes at different times of year, allowing us to calculate seasonal travel times and the 'reliability' of those voyages throughout the sailing season. We use these travel-time and reliability scores to generate networks using anchorages as nodes and reliability of maritime travel as directed edges. We use these networks to characterise zones of interaction within the Tyrrhenian and to evaluate our node-selection methodology. By repeating this analysis for different sets of nodes, we move closer to understanding how seafarers might have understood the risks and opportunities along the coastlines of the Bronze Age Mediterranean.

Looking at hoards through networks: First results of the network research on early medieval depositions in the Middle Dnieper Area

Inga Utkina-Wöhrl

Freie Universität Berlin; GWZO, Leipzig

At the turn of the 7th and 8th centuries AD, numerous metal objects were deposited in the ground in the Middle Dnieper region. As these deposits had no recognisable burial or settlement context, they are referred to as hoards. These hoards consist of a mixed inventory of mostly non-ferrous metals, primarily in the form of jewellery such as brooches, belt sets, arm and neck rings, and various pendants. Based on the types of objects, the Dniepr hoards show connections ranging from the Pontic Steppe region in the southeast and the Pannonian Plain in the southwest to the Baltic region in the northwest and the Central Russian Ridge in the northeast. Research of this early medieval hoarding phenomenon has focused particularly on a possibility to distinguish between 'profane' and 'ritual' motivations for these actions. In my project, I consider hoards to be part of past local practices, which results in the deliberte selection of material for deposition. Analysing this material with the methods of network analysis, enables the focus of the research to shift from motivation to modelling the interactions of responsible communities and social groups. Using similarity and co-occurrence networks, my PhD-Project aims to identify and evaluate the regional and supra-regional interactions of the groups of people who deposited these objects. In this paper, I am going to present and discuss the preliminary results of my ongoing work.

Integrating Diachronic Road Networks and Archaeological Survey Data in the Roman Hinterland

Steven van Ens

University of Groningen and Macquarie University

Over the past 50 years, archaeological surveys have uncovered a wealth of Roman rural sites in Central Italy. These farmsteads, villas, and settlements provide detailed data for the economic development of the Roman countryside. Conversely, Roman roads in the vicinity of ancient Rome have a long research history, often focused on routes and typology, but are generally less well understood. While both topics inherently touch on one another, as roads connect these places with each other and the larger Mediterranean world, they have often been studied in isolation.

This paper presents ongoing PhD-research into the interconnection of this ancient road network and the development of the ancient Roman countryside. The project, which is part of the Roman Hinterland Project (RHP), a database integrating several large archaeological survey projects, aims to utilize a diachronically reconstructed Roman road network in combination with the survey data from the RHP to approach the economic development of the Roman hinterland in a new way. By analyzing the developing road network in conjunction with the RHP data using network analysis techniques, the research will show how the organic development of this road network influences where sites are situated and/or how wealthy these sites are able to become, and conversely, how sites influence where roads are built due to local demand.

The paper will present the project, discuss the work done so far in collecting and dealing with the fragmentary nature of the road data, and present ideas for the analysis of the resulting dataset.

POSTER ABSTRACTS

The View from Beaver Hall: Joseph Frobisher's Estate and Social Networks in Early Nineteenth-Century Montreal

Robert Crotts

McGill University

The dinner diary of Montreal merchant and fur trader Joseph Frobisher (1748-1810) illuminates the business and political networks that were active in Lower Canada and the British Atlantic as a whole during a time of accelerating economic transition. The diary however omits mention of the servants, cooks, bakers and artisans who contributed to making Frobisher's busy social schedule possible and entered into his network in their own unique ways. Drawing on Frobisher's voluminous estate documents, this essay examines the wealthy merchant's embeddedness in a broader network of working-class and artisan, as well as elite, Montrealers. This broader network was experienced differently by working-class vs. elite and by French vs. English-speaking participants–the lines of credit and professional opportunities offered to participants were stratified according to both ethnic community and social class. At the same time, diverse segments of Montreal's population entered via this network into unexpected combinations, as a lawsuit filed jointly by Legislative Assembly members, London merchants, dressmakers and unskilled laborers against the executors of Frobisher's estate makes clear. My essay uses the Frobisher estate documents to suggest how social network analysis within the discipline of history can be supplemented by considering how links within networks were qualitatively experienced and what kinds of constraints and possibilities networks presented to participants, especially in contexts of social transformation.

Present but Unseen in Timurid Iran

Shaghayegh (Poppy) Ghasemi

University of Calgary

Where are the children?

This paper starts with that question. In both images and texts from Timurid Iran, children are rarely completely absent, but they are almost never shown as independent actors. I argue that this is not accidental. It reflects how social relations are structured and how they are represented.

Instead of treating figures as separate individuals, this study looks at how relationships are formed and displayed. It draws on both visual and textual materials and focuses on elements such as position, scale, proximity, and narrative context. These elements show how relations like authority, dependence, and belonging are organized, often in stable patterns of center and margin.

Across these sources, children appear mostly in relation to others, within households, at court, or in moments of movement. They are part of the scene, but not in control of it. Their role is defined through dependence rather than action.

This creates a tension. Children are present, but not fully visible as subjects. I suggest that this kind of absence is not simply a lack of evidence, but a result of how relationships are structured and made meaningful. By focusing on these patterns, the paper offers a way to approach forms of dependent life that are often overlooked, even though they are central to how social worlds hold together.

Representation Matters: Visibility of the Foreign in the Iconography of New Kingdom Egyptian Queens

Rosemary Ott

University of Toronto

During the New Kingdom Period of ancient Egypt, the pharaohs prioritized building their reputation as a strong, newly reunified empire among their Aegean and Near Eastern neighbors, using their resources and manpower to conduct military expeditions and develop trade relationships further beyond their borders. With this shift in priority, it was only a matter of time that Egyptian evidence bore the results of this larger-scale interconnectivity, which included the development of the so-called "International Style". This style is characterized by floral and faunal motifs that mix elements from a variety of regional iconographic practices, making them universally accessible to different audiences. However, a more in depth examination of this blending is necessary to improve our understanding of the relationship between culture, politics, and worldview at a local and globular scale.

This poster aims explore this stylistic phenomenon, focusing on the evidence of exchanged iconographic concepts in representations of Egyptian queens from the 18th and 19th Dynasties. Consideration will be given to the stylistic and figural features of these images, their various contexts (archaeo-geographical, socio-cultural, etc.), and their accessibility to different audiences. By analyzing the relationships between these factors, this research aims to identify two network arcs: 1) the local adaptation of iconographically coded concepts of power transmitted through cross-cultural affiliation; and 2) the reception of such representations by Egyptian and non-Egyptian individuals. Together, these perspectives could attest to a shared—or, at least, globally understood—conception of the power and agency of queenship within the broader ancient Near Eastern worldview.