

Social Network Analysis and Connoisseurship in the Study of Athenian Potters' Communities

Eleni Hasaki – Diane Harris Cline

Introduction

This article presents a Social Network Analysis (SNA) of the collaborations between Athenian potters and painters of the 7th–5th centuries BC as established by Sir John D. Beazley in the first half of the 20th century AD. In his foundational connoisseurship studies, Beazley identified more than 1.000 potters and painters for over 20.000 black-figured and red-figured vases. His attributions, often critiqued for the opacity of his methodology, have remained largely unchallenged and yet are still central to stylistic analysis of these pots. Our project, entitled *Social Networks of Athenian Potters*, is the first to apply Social Network Analysis to visualize, quantify, and evaluate these associations and interconnections, moving beyond linear lists of painters and potters and encouraging scholars to obtain a synoptic view of the Athenian Kerameikos. The visualizations of the SNA reframe artisans into their roles as facilitators, bridges, and innovators.

Beazley, Connoisseurship, and the Athenian Ceramic Industry

The connoisseurship of Attic vase painting of the Archaic and Classical periods is synonymous with the career of Sir John Davidson Beazley, Lincoln Professor of Classical Archaeology at Oxford University. His pioneering research on Athenian vase-painters needs no lengthy introduction.¹ Over a series of articles in the first decades of the 20th century and often incorporating other scholars' attribution studies, he accomplished the Herculean task of attributing several thousands of Athenian pots decorated in black and red figure techniques to over 1.000 hands that he identified. He summarized his results in two fundamental works, *Attic Red-figure Vase-Painters (ARV)* and *Attic Black-figure Vase-Painters (ABV)*.² Although Beazley was a highly-gifted visual person himself, the volumes have no illustrations nor diagrams to show relationships between artists or the overall organization. Surprisingly no table of contents is included and dates are rarely mentioned.

Beazley shifted the focus from the vases of painters who signed their works to unnamed artists, by discerning distinctive habits to identify the hands of various unrecognized artisans and attribute unsigned pots to them. Without openly stating it, he applied what is called the "Morellian-type" connoisseurship studies, already utilized in Renaissance art, where idiosyncratic renderings of figures (such as faces, hands, feet) capture the essential style of an artist. His kaleidoscope of names for these previously unrecognized artists was most often based on the museum collection of their most representative

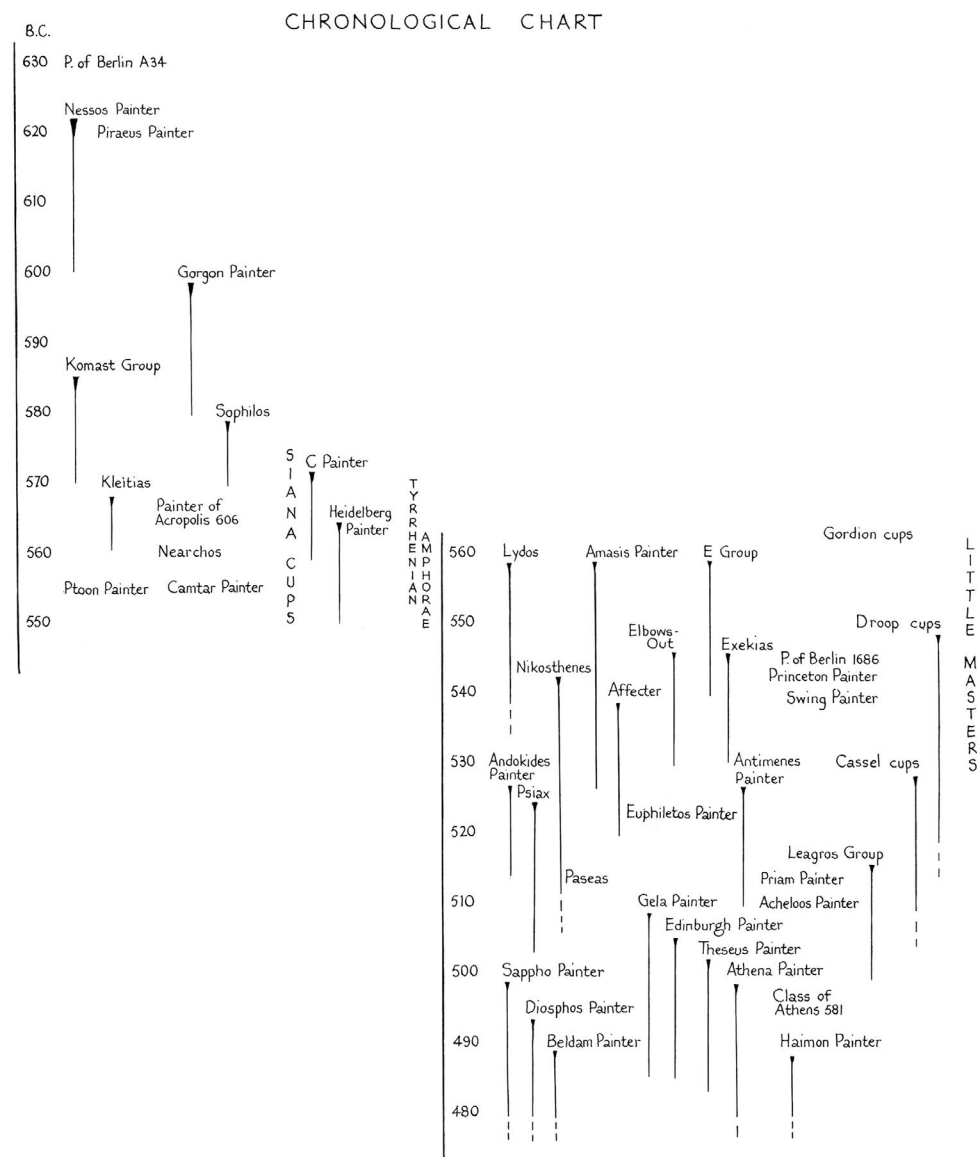


Fig. 1: Chronological chart of Athenian black-figure vase-painters.

vase (“The Painter of London B 76,” ABV 85), on their preferred iconography (“The Theseus Painter,” ABV 518–521), or on a peculiar feature (“Elbows Out,” ABV 248–251). All names were presumed to be male, as are all the surviving signatures of potters and vase-painters, although women must have played a support role in specific tasks, such as painting subsidiary decoration.³

It is easy to confuse his stylistic personalities (574 entities: 406 artists and 168 groups for the black figure) with actual people and as a result, Beazley’s large number of “hands” (many of them relying on tiny samples)⁴ led to reconstructions of industrial scale potters’ quarters. It is ironic that his reconstructed *Kerameikos* (potters’ quarter)

led scholars to believe that the Athenian vase-painting industry was of grand size, when his original intention was precisely to correct the previously-held view, especially in French academic quarters, that imagined a “Kerameikos as a ‘small industrial empire’ where a few masters who took the trouble to sign their works had command over a whole host of decorators who were inevitably of lowlier status.”⁵

Beazley admitted that in several cases he may have identified as two distinct hands what were really just different phases of a single painter’s career, so there may actually be fewer artists than we have considered.⁶ Moreover, one must not forget that the period under consideration spans more than a century.

The archaeology of ceramic production had not advanced much when Beazley was constructing his connoisseurship-based “potters’ quarters” in the pre-World War II years. In a contemporary article, B. F. Cook could list only ca. 60 sites with kilns known from ancient Greece from all periods, whereas today that number has expanded tenfold.⁷ Beazley used the term “workshop” only once in ABV, and then only in passing,⁸ and we do not have a clear idea how he envisioned a potters’ quarter at work. In some cases, spatial imagery seemed to guide his web of artists’ relationships: the Painter of “Oinochoai with Large Lips” was thought to work “next door to the Class of Vatican 440” (ABV 442). Proximity in the potters’ quarter was likely integral to a painter’s stylistic development.

Scholars investigating the scale of pottery production in Archaic and Classical Athens have employed a number of different approaches. They have studied the iconography of potters at work,⁹ have estimated the annual output of painters and the length of their careers,¹⁰ have calculated extent of physical workshop space,¹¹ and have gauged the size of the workforce as well as the number of kilns each workshop could operate efficiently.¹² The ancient evidence is now used often in tandem with ethnographic parallels and ethnoarchaeological data.

The emerging consensus is that a typical pottery workshop was a family-based enterprise, working full-time, year around, with small business capital. With their modestly-sized kilns, they operated on short production cycles and avoided risky business strategies. The mass quantity of Athenian ceramics that reached the Mediterranean ports ought not to be seen as mass production by a few workshops operating at an industrial scale, but the aggregate result of many small units.

The Social Vocabulary of Beazley’s *Attic Black-Figure Vase-Painters*

After reading ABV cover to cover, at the macro level we saw an interconnected social world of potters and painters tied to each other through vase shapes and artistic styles. We believed this presented a great opportunity to explore this world further by treating the people and their pots as a data set for Social Network Analysis (SNA). How did Beazley envision the social world of the Athenian Kerameikoi? In ABV, Beazley used

social vocabulary to identify the different artistic communities, such as “Lydos and his Companions” (ABV 107) or “The Antimenes Painter and his Circle” (ABV 266). Beazley saw before him individuals who were physically or artistically near to each other, who painted in the manner of others, or were as intimately close as family members could be. Beazley called the Antimenes Painter and Psiax “brothers” (ABV 266), at least in connoisseurship terms, while we also learn from signatures that two Little Master Cup Potters, Tleson and Ergoteles (ABV 162,178), were literally brothers, who signed their names with the patronymic to emphasize their proximity to their famous and successful father, the potter Nearchos.

Beazley used over thirty different qualitative terms in all to relate his derivative painters to major artists.¹³ His most common pairing would be “Painter X” and “Near Painter X.” Another typical sequence of associations may be seen in the cluster of “The C Painter” (a painter named after the Corinthianizing works he produced), who was followed by the “Manner of the C Painter” and by “Related to the C Painter” (ABV 23–26). Phrases like “not far from”, “in imitation of”, and “follower of” also occur more regularly than a phrase used once, such as “next door to”. While one might wonder what the difference meant to Beazley between “not far from” and “near”, we interpreted them as a link, if two entities were linked by Beazley in any qualitative way, we accepted that as a pair.

While a family-based apprenticeship is implied in the father-son specialty in Little Master Cups, in other cases, Beazley was more explicit about direct learning and training.¹⁴ For example, he described the Swing Painter as the teacher of the Princeton Painter (ABV 132) and declared that the Eucharides Painter must have been the pupil of the Nikoxenos Painter (ABV 173). A community of practice develops in all these ways, with artists influencing each other either directly through formal apprenticeship or indirectly through oblique transmission.

His language shows that he had an intertwined community of practice in mind. Beazley put the people – potters and painters – front and center, because their activities and interactions led to the development of the styles and shapes of Attic black figure vase-painting. Artistic styles and shapes may tell us something about the social relationships inside communities of artists. To connect artists who did not sign their pots, we made the assumption that contemporary potters or painters who were working in the same style or making the same shape of pot must be aware of each other, either directly or obliquely. Maybe they saw each other’s work in the agora or at the port. Vase shapes often linked these groups of artists, as innovations were adopted and passed forward.

Social Network Analysis (SNA) and Beazley’s Athenian Potters’ Quarters

To model these communities inside the Athenian potters’ quarters, we embarked in our project *Social Networks of Athenian Potters*. We decided to use SNA, which has its roots

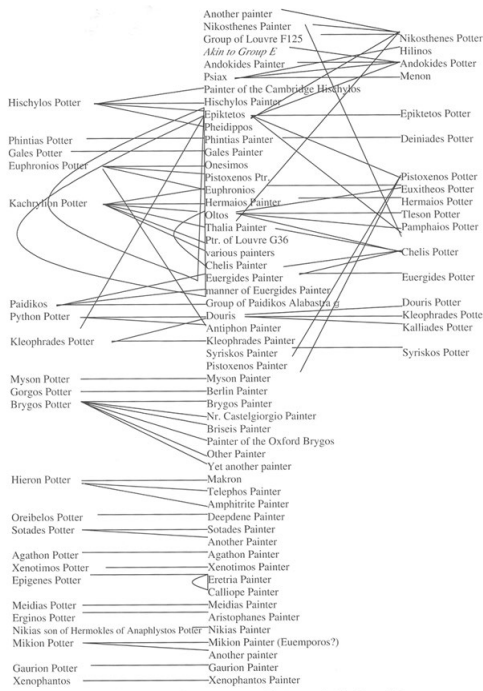


Fig. 2a: Old method of visualizing collaborations among potters and painters of Athenian red-figure pottery.

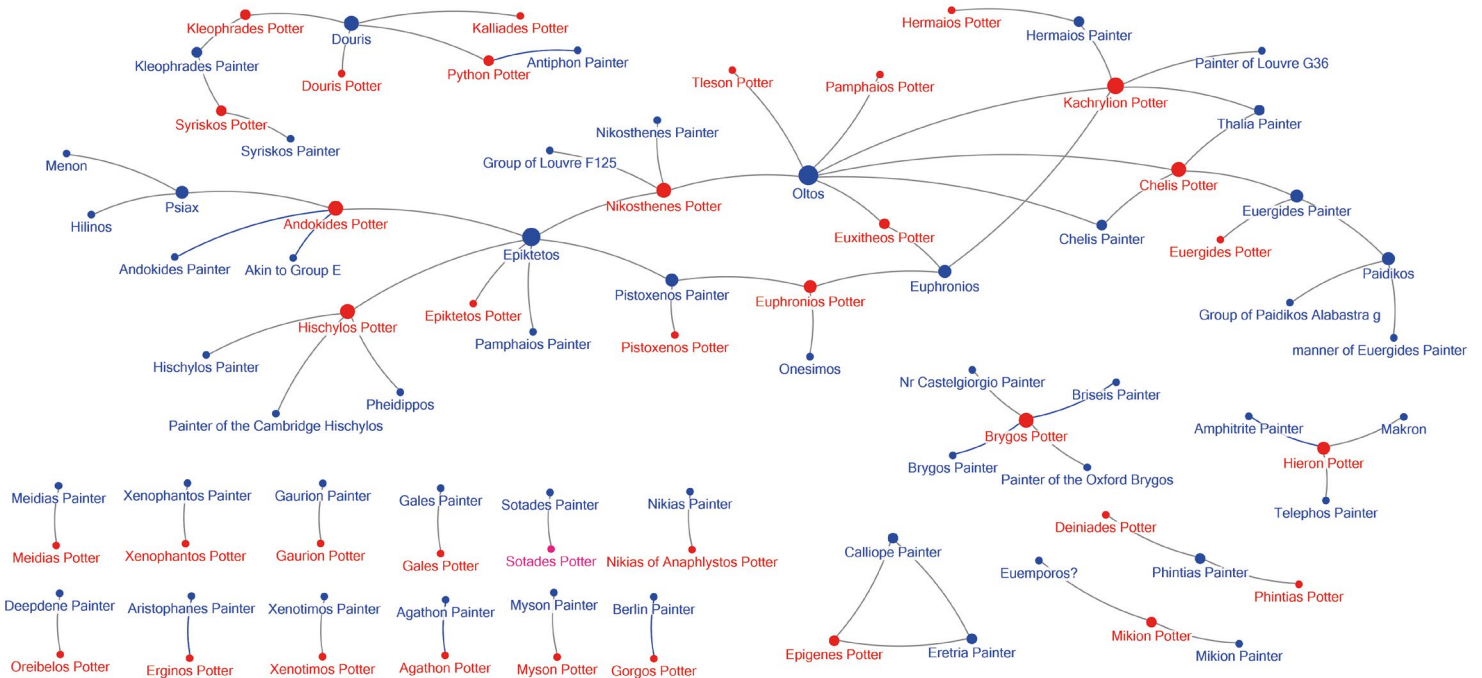


Fig. 2b: New method of visualizing collaborations among potters and painters of Athenian red-figure pottery.

in the combination of mathematics, graph theory, and sociology. Basically SNA is the study of relationships between entities (people, artifacts, institutions). Researchers in dozens of fields use it, and there is a shared language with common tools and methods.¹⁵ Increasingly SNA is being applied in many fields in the humanities, including archaeology and history, and is an analytical technique in the toolbox of the Digital Humanities, the application of quantitative methods to traditional humanities topics.¹⁶

SNA is ideal for visualizing in their entirety large communities of artists. Previously, Athenian vase-painters were only visually put together in simple timeline graphs without any reference to their relationships. For example, Boardman's chronological chart featured only 45 black-figure artists from 630–480 BC (fig. 1).¹⁷

A wire diagram by Osborne in 2004 was the most ambitious attempt to capture the complexity of collaborations among Athenian red-figure vase-painters in Beazley's ARV² (fig. 2a). His goal to illustrate three modes of collaborations between red-figure painters and potters: a) one potter with one painter; b) one potter with several painters (or one painter with several potters); and c) many potters and many painters working together. Although the visual impression may have fallen short of its goals, it was precisely this wire diagram that inspired us to build the first prototype of applying SNA to Beazley's work.¹⁸

We took the same data from the wire diagram (fig. 2a) to generate a social network graph, a sociogram (fig. 2b). The method involves reformatting the names of collaborators into two columns as pairs (called an "edge list"). The pairs are then processed by the software, NodeXL. The network visualization is generated from the pairs of names imported into the SNA program, representing the names of the entities as nodes and the ties between them as lines called edges.

As in Osborne's wire diagram, now we can see who worked with whom, but we can also see which artists took on the role of bridges or brokers between areas of the networks. In this sample, there are 88 named artists (excluding the 6 unnamed artists) with 74 ties between them. They are not all connected, however. The largest cluster (around Oltos and Epiktetos) consists of 39 artists who are all linked together in one component, running through the middle of the sociogram. The chain above it (around Douris) has nine interconnected collaborators. There are 19 separate components, most of them (12) with just two members. By color-coding the nodes to indicate whether the craftsman was the potter (red) or a painter of the vase (blue), the scale of collaborations between potters and painters becomes readily visible.

Once we had this prototype and proof of concept, we proceeded to try to graph all of ABV. In our experiment we used the program NodeXL to apply SNA, in order to model and analyze the relationships between artists.¹⁹ We treated the relationships Beazley described in ABV between artists and the shapes of pots they made as a network. The ties between them became the data we used to visualize and analyze this network.²⁰ This type of network is called bimodal or bipartite because the pairs are not exclusively the same type of entity, like artist with artist.²¹ Instead, we sometimes have ties between like entities, but also have ties between artists and the shapes they potted or decorated.

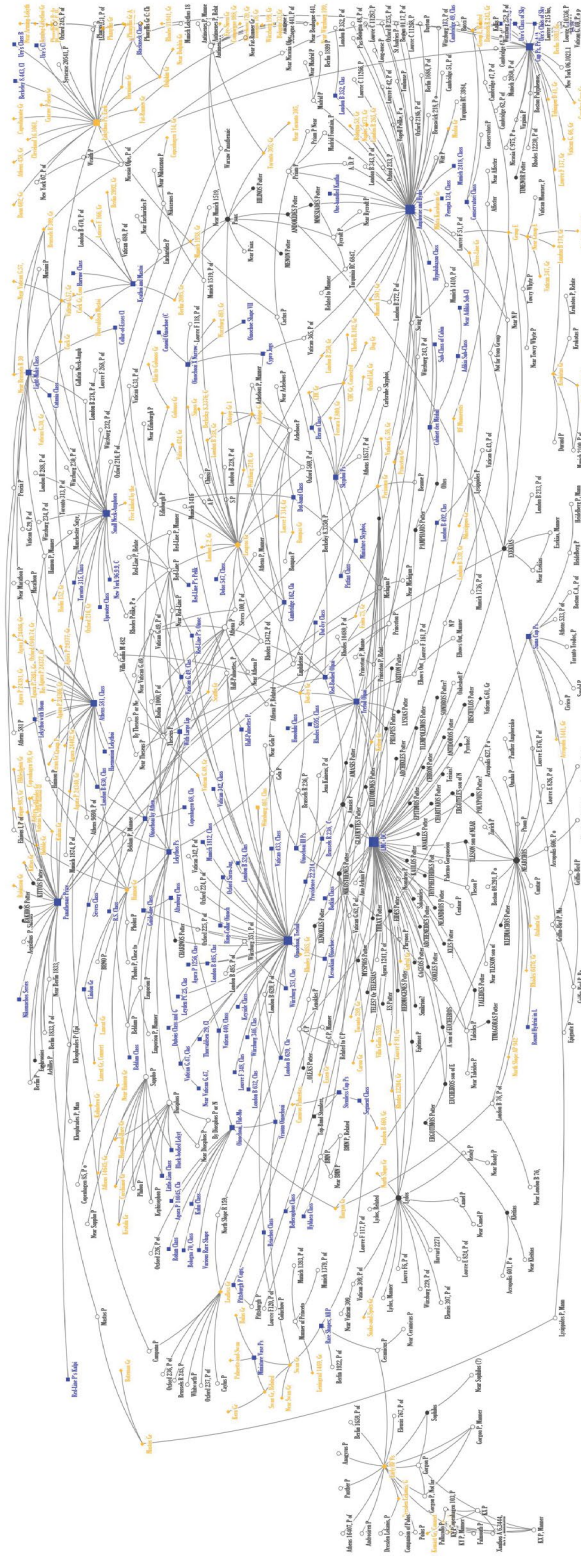


Fig. 3: The SNA Network of Beazley's ABV (incl. Paralipomena). Solid circles represent signed artists; open circles are for attributed artists; diamonds represent "groups"; and squares are for "classes" and shapes.

Classes of vases are tied to other classes or the larger category of shapes, but also to the artists who worked on similar shapes contemporaneously. Sometimes when a dataset seems bimodal, one can avoid this by making direct ties between nodes who share the common entity, such as in this case tying artists to each other when they paint or pot the same shape. We decided not to do this, since some shapes (such as amphorae) survive beyond a generation of craftsmen. In our network, an artist can be associated with a class as well as a shape, and can collaborate with a group of artists as well as individuals. This means it is actually an affiliation network, which one can understand if one imagines that the nodes were individual members of organizations tied to one or more people through membership, but in this case our shapes of pots are the organizations.

Using a statistical package included in all SNA programs, one can measure an individual person's centrality or position relative to others in the network, and describe who should be seen as part of the core and who is peripheral. The network visualizations generated can identify the possible routes of transmission of ideas, new products, and the diffusion of innovation. Once we built the model, we then looked for structural bridges, brokers, and hubs, using measures of centrality and degree, as commonly applied in SNA studies.

In a book as sweeping in scope as Beazley's ABV, it can be difficult to keep all of the connections between the potters and painters in mind at once. The SNA sociograms help us see the relationships from the network perspective, synoptically, allowing us to study unique artists in their contexts. With all artists, groups, and shapes in one visualization, patterns can be observed which can initiate a series of inquiries. We chose SNA for its ability to provide a way to keep track of and display these social relations through a network visualization. SNA is used in many other fields to look for and trace pathways for the diffusion of innovations. Here our social network analyses reframe the relative importance of artists from being based on the influence of their style or the relative perfection of their craftsmanship into a ranking by their roles as facilitators, bridges, and innovators based on their positions in the network.

Using Beazley's ABV as the source of our data, we extracted and harvested social information about the potters and painters working in the black-figure technique in 7th–5th centuries BC.²² As we looked in ABV for the ties between people working in the Potters' Quarter, we found three main categories: individuals like Exekias; groups of artists given one title (Group E); and vase shapes such as Little Master Cups.²³ We followed Beazley in relying on shapes of vases as nodes to connect artisans to each other.²⁴ We adopted Beazley's shape-centered taxonomy system to stay true to his original vision, believing that two artists of the same period would not develop this particular shape (for example, Oenochoai, Trefoil, Shapes I–II) without knowing each other's work.

We identified 701 nodes in ABV and Paralipomena consisting of artists (signed and attributed), groups, classes, and shapes. In our multimodal sociogram we differentiated the

101	EXEKIAS	Group E
102	Group E	Near Group E
103	Near Group E	Vatican 347, Gr
104	Near Group E	London B 145, Gr
105	Near Group E	Vatican Mourner, P of
106	Near Group E	London B 174, Gr
107	Near Group E	Towry Whyte P
108	Towry Whyte P	Near Towry Whyte P
109	Group E	Not far from Group E and Exekias
110	EXEKIAS	Not far from Group E and Exekias
111	EXEKIAS	London B 213, P of
112	EXEKIAS	Exekias, Manner
113	EXEKIAS	Near Exekias
114	Exekias, Manner	Near Exekias
115	AMASIS Potter	Amasis P

Fig. 4: Sample edge list of Exekias and Group E.

node types visually, using diamonds, circles, and squares (fig. 3). In this network there are currently 80 individual artists whose real names are known because of their signatures and 326 artists given names through attribution.²⁵ Furthermore, the network includes 168 of Beazley’s artist “groups”, and 127 vase shapes including Beazley’s “classes”.²⁶

The network has 863 ties (or “edges” in network terms) linking the nodes, modeling a complex web of interactions between artists working in the Kerameikos of Athens to produce ceramics of various shapes (fig. 3).

We recorded the variety of qualitative distinctions in the styles of artists, such as “near” and “in the manner of” in the edge list. In the example below we show how we recorded ties between artists whom Beazley thought belonged together (Fig. 4). The two columns should be read row by row, and the data shows there is a tie between each pair of nodes. Using the case of Exekias, an individual artist and a cluster of artists called Group E which Beazley thought were close to him, we can see the variety of ties between them. However, for the sociogram we decided to flatten out these subtle differences in Beazley’s characterizations of the ties between artists.

One look at the sociogram shows that there are some nodes which appear to be popular, that is, they are a hub for many other nodes, while others have only one connection or tie and are therefore relatively unimportant. Degree centrality is a measure of the relative number of nodes with the most ties. In the sociogram, the entities with the most ties, or highest degree centrality, are shapes and artists (fig. 5). These high-scoring nodes are lit up along with the edges tying them to others. Visually the eye is drawn to these nodes first. These high-degree scorers often serve as a hub for multiple nodes which have only this particular hub as its single tie. In this case, often the highest scoring entity in degree centrality are shapes. Single artists identified by Beazley are tied together by a shape they all make, such as a trefoil oinochoe. The likelihood that these artists would make the shape or paint the decoration independently without knowing of each other’s work is nil. They are part of a community of practice, in other words, a social network.

The shapes which connect the largest numbers of potters and painters are the Little Master Cup and Droop Cup Painters, with 61 ties. In second place, with 55 ties,

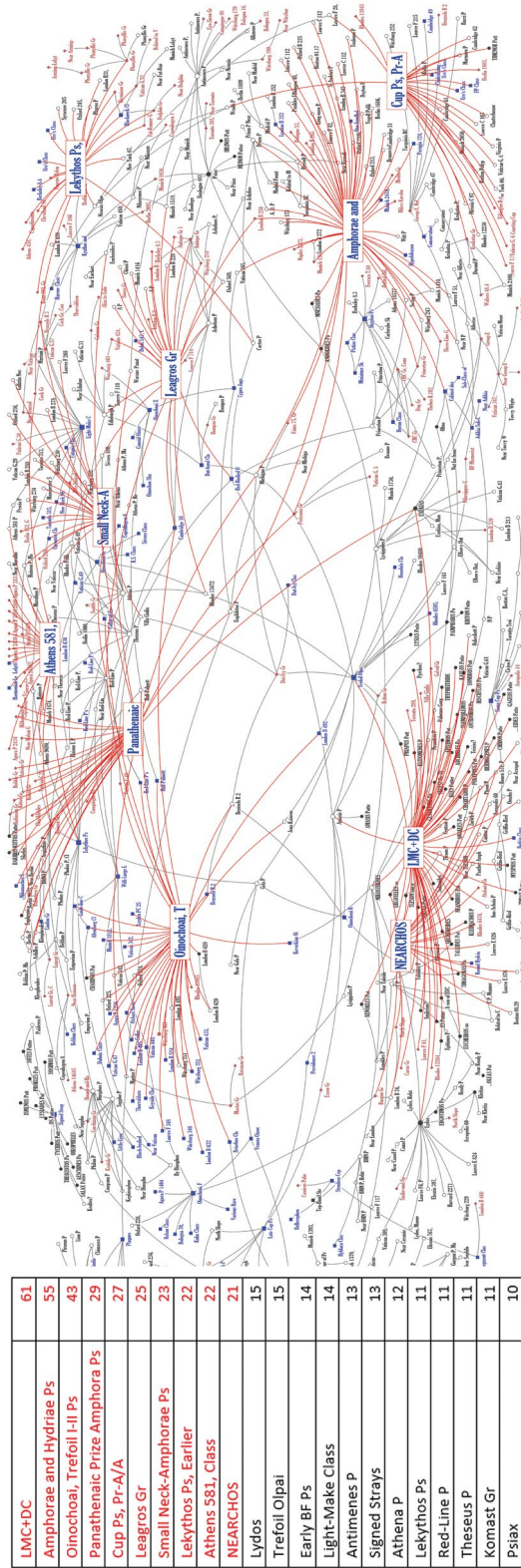
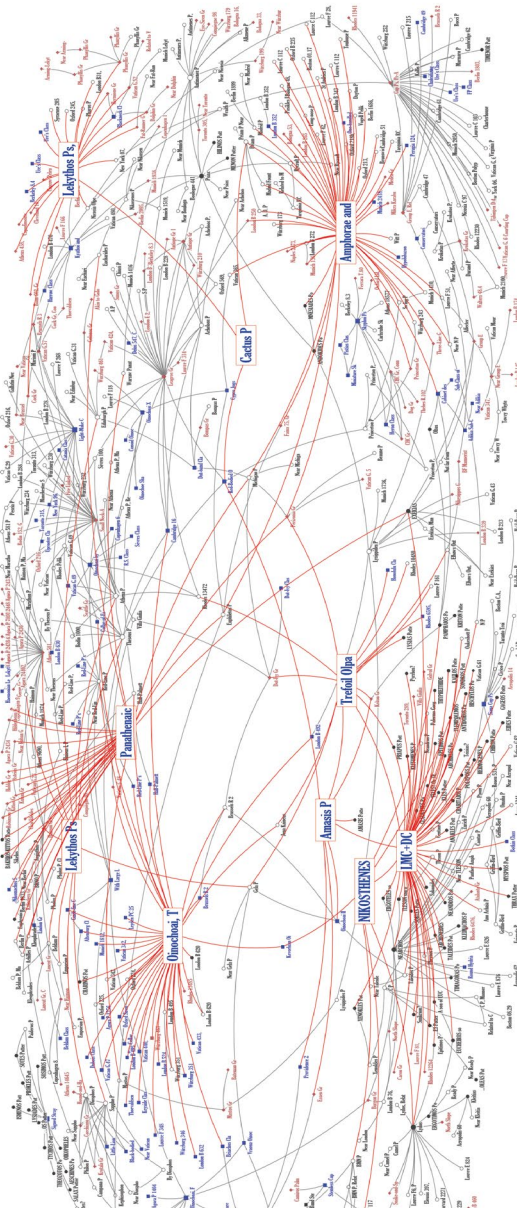


Fig. 5: Degree Centrality of ABV (incl. Paralipomena) featuring the ten nodes which have the most neighbors.



LMC+DC	69931.136
Amphorae and Hydrisae Ps	40585.814
Trefoil Olpai	38620.101
Lekythos Ps, Earlier	32679.194
Oinochoai, Trefoil I-II Ps	32224.675
Lekythos Ps	28457.429
Cactus P	24908.595
NIKOSTHENES Potter	24520.056
Panathenaic Prize Amphora Ps	22649.363
Anasis P	21864.772
Leagros Gr	21310.915
Red-Bodied Olpai	20834.843
EKEKIAS	20237.297
Gela P	19901.268
Rare Shapes; All Periods	18671.167
Wraith P	18540.306
Cup Ps, Pr-A/A	18422.000
Athens 581, Class	18154.829
Ceramicus P	16883.000
Early BF Ps	15946.500
Perizoma Gr	15896.494
Nicosia Olpse, P of	15185.604

Fig. 6: Betweenness Centrality of ABV (incl. Paralipomena) showing the most important nodes for connecting the network.

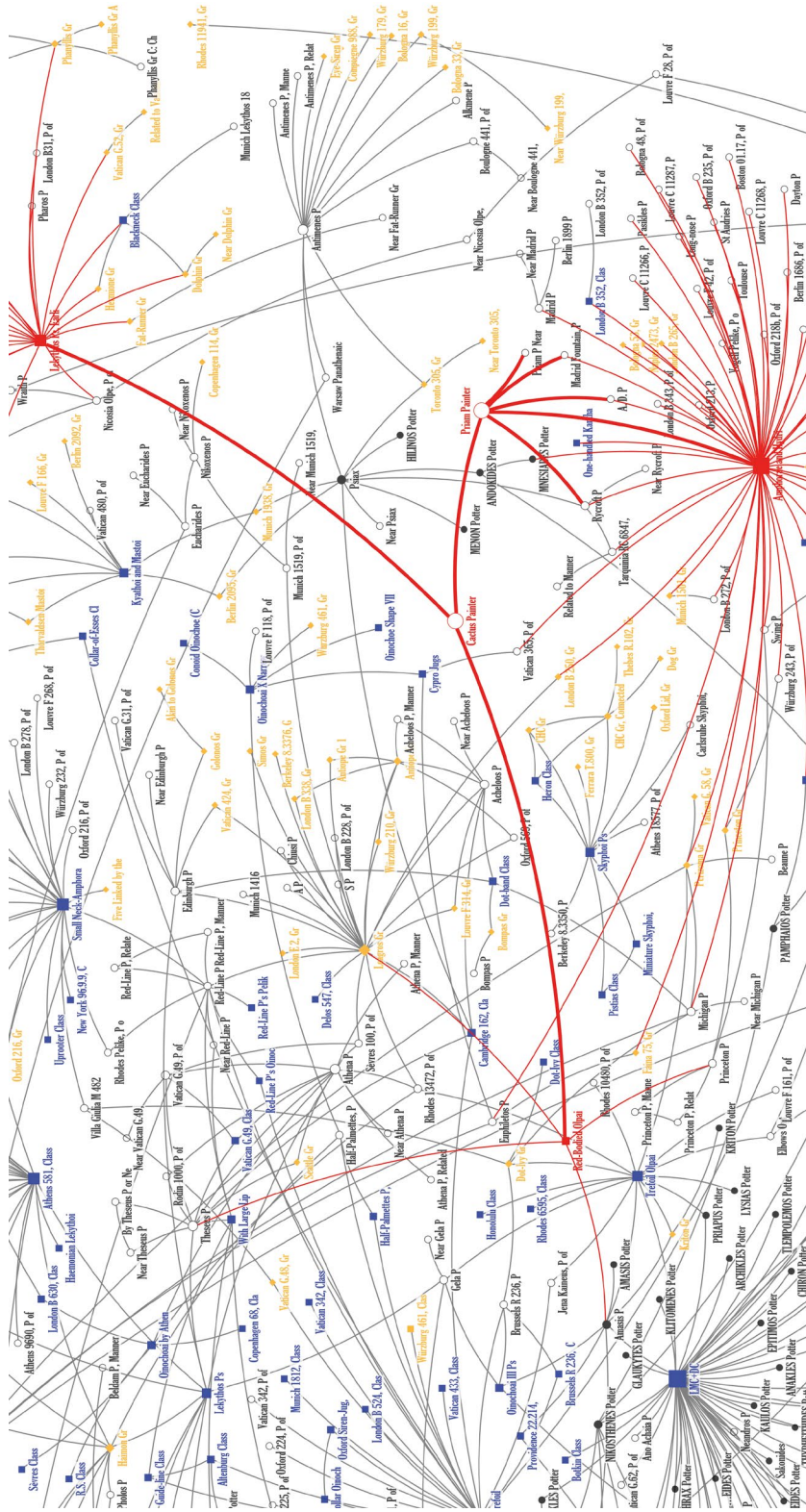


Fig. 7: Detail with Cactus Painter and his ties.

are Oinochoai Painters and then Proto A and A Cup Painters. In terms of individual artists, the top twenty with the highest degree centrality scores (those with the most neighbors) includes the potter Nearchos, Lydos, the Antimenes Painter, the Athena Painter, and the Theseus Painter. The Leagros Group and Komast Group are also in the top twenty.

Our analysis also gave us a ranking of the nodes by their position in the network as a bridge or broker, a network metric called “betweenness centrality”.²⁷ Such nodes are the shortest path between most others in the network, through which information can pass efficiently. Looking for these chains of nodes in a sociogram one can find pathways for the diffusion of stylistic influences and technical innovation. The shapes with the highest betweenness scores are the Little Master and Droop Cup Painters, Amphorae and Hydriae Painters, Trefoil Olpai Painters, The Earlier Lekythos Painters, and the Oinochoai Trefoil I–II Painters. For individual artists, those with high “betweenness centrality” scores are the Cactus Painter, then the Nikosthenes Potter, Amasis Painter, Exekias, the Gela Painter, the Wraith Painter, and the Ceramicus Painter (fig. 6).

Social network statistics are also useful for highlighting anomalies. For instance, consider the Cactus Painter, who scored the highest in betweenness centrality, but is a relatively unknown painter.²⁸ In a detail showing the right side of the sociogram, we see the pathway from left to upper right from the painters of red-bodied olpai which are in the heart of the network out towards the right side, where the Cactus painter is connected to the Priam Painter, and upwards to the earlier painters of the Lekythos shape (fig. 7). This group is relatively isolated; in fact, the only path any of them have to connect with the rest of the network is through the Cactus Painter. Likewise, taking a second hop on the path, the Earlier Lekythoi Painters could reach the Priam Painter, through whom they have direct access to the second largest cluster, the Amphorae and Hydriae Painters. The high “betweenness centrality” scores for both the Cactus Painter and the Priam Painter comes from their service as a bridge between major shapes.

Conclusions

Through this application of SNA to Athenian vase painting in the *Social Networks of Athenian Potters Project*, undertaken for the first time, Beazley’s world of artists can be seen in one visualization, in a synoptic rather than linear way. Our next steps are to add in dates and create time slices in order to filter out those who are not chronological contemporaries, so we can better study the activity inside the social networks of synchronous artists. This is important to do because in a synoptic view as we have here, it would be likely that the earliest artists are going to be less well connected and have fewer ties than later ones. This happens because these artists are elderly or deceased

by the time later artists are most active. If there are ties between the earliest artists and later ones, it would be through the common shapes they decorated, which continue beyond the generations of artisans. We also will move forward in time to incorporate the data from Attic Red-Figure Vase-Painters (ARV²) along with modern scholarship to supplement Beazley's attributions.

In sum, SNA sociograms are not an end in themselves but a way to make discoveries. They are good for finding patterns and anomalies, and also for finding good starting points in terms of prioritizing who or which group to investigate first. We use the sociograms to expand the research agenda for the study of Attic vase painting and potting. Through SNA metrics we can identify the important people, who tend to be connected to more than one shape, acting as bridges and innovators. SNA can identify artists who are worthy of study not because of the high artistic quality of the work or the large quantity of extant samples, but because of the artist's relative position inside the potters' quarter, connecting smaller clusters to the whole network. Studying the chains of linked artists and shapes leads to curiosity about specific nodes that seem to hold central positions inside their corner of the network map. Such high scoring nodes may hold the keys to how innovations flow and catch on. There are many more opportunities to zoom in and study discrete clusters and how they are linked.

Our goal for this innovative and experimental project has been to bring together connoisseurship studies of communities of practice and social network analysis. We hope the sociograms visualizing the connoisseurship-based ties that Beazley established among the Athenian artists will open up wider vistas of analysis of their Kerameikoi in ancient Athens and beyond.

Appendix I

Because of the curious absence of a table of contents in Beazley's ABV, it is not readily apparent that eighteen of his chapters (VIII, XII, XIII, XIV, XX, XXII, XXVI-XXXII, XL-XLIV) are organized around the shape of the vases and the artisans who made them. Twenty-one chapters (III-VII, IX-XI, XV, XVII-XIX, XXIII, XXIV, XXXIII-XXXIX) are focused on an individual artist's personality and those he assigned to be near him. Just four of his chapters (I, II, XVI, XXV) use chronology or decoration technique to organize the artisans he features. In the chart below, we list the ABV chapter titles with the modifications for our project shown in *italics*. We reduced the original 44 chapters to a total of 34 by merging Chapters III-V as Siana Cup Painters; and Chapters XXXIII-XXXIX as Lekythos Painters.

Ch. I: Earliest Black-Figure		Ch. XXIII: The Leagros Group	
Ch. II: Early Black-Figure		Ch. XXIV: The Nikoxenos Painter and his Companions (<i>Nikoxenos Painter</i>)	
Ch. III: Painters of Siana Cups (PSC): I, The C Painter	<i>Siana Cup Painters</i>	Ch. XXV: Black-Figure Vases by Red-Figure Painters	
Ch. IV: PSC II; The Heidelberg Painter		Ch. XXVI: Some Very Late Standard Neck-Amphorae	
Ch. V: PSC III; Others		Ch. XXVII: Panathenaic Prize Amphorae	
Ch. VI: Kleitias		Ch. XXVIII: Oinochoai, Trefoil, I: Shapes I and II	
Ch. VII: Nearchos and Others (<i>Nearchos</i>)		Ch. XXIX: Oinochoai, Trefoil or Beaked: Less Common Shapes	
Ch. VIII: The Tyrrhenian Group		Ch. XXX: Oinochoai, Flat Mouthed (other than Olpai)	
Ch. IX: Lydos and His Companions (<i>Lydos</i>)		Ch. XXXI: Oinochoai: Olpai	
Ch. X: Group E and Exekias (<i>Exekias</i>)		Ch. XXXII: Lekythos-Painters, I; Chiefly Earlier	
Ch. XI: The Amasis Painter		Ch. XXXIII: Lekythos-Painters, II: The Gela Painter	<i>Lekythos Painters</i>
Ch. XII: Little-Master Cups (and Droop Cups) (<i>LMC+DC</i>)		Ch. XXXIV: Lekythos-Painters, III: The Edinburgh Painter	
Ch. XIII: Cups Types Proto-A and A		Ch. XXXV: Lekythos-Painters IV: The Class of Athens 581	
Ch. XIV: Some Stemless Cups		Ch. XXXVI: Lekythos-Painters V: The Sappho and Diosphos Painters	
Ch. XV: Nikosthenes and Pamphaios		Ch. XXXVII: Lekythos-Painters VI: The Theseus and Athena Painters	
Ch. XVI: The Black-Figure Mannerists		Ch. XXXVIII: Lekythos-Painters VII: The Haimon Group	
Ch. XVII: The Lysippides Painter		Ch. XXXIX: Lekythos-Painters, VIII: The Emporion and Beldam Painters	
Ch. XVIII: The Antimenes Painter and his Circle (<i>The Antimenes Painter</i>)		Ch. XL: Small Neck-Amphorae	
Ch. XIX: Psiax		Ch. XLI: Kyathoi and Mastoids	
Ch. XX: Other Pot-Painters (<i>Amphorae and Hydriae Painters</i>)		Ch. XLII: Skyphoi	
Ch. XXI: Some Signed Strays		Ch. XLIII: Late Cups	
Ch. XXII: Plaques		Ch. XLIV: Miniature Vases	

Notes

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² Beazley 1942 (ARV); 1956 (ABV); 1963 (ARV²); 1971 (Paralipomena).

³ See the sole example of a woman painting the handles of a volute crater depicted on the "Caputi" re-figured Athenian hydria (Vicenza, Banca Intesa Collection, inv. C 278; Williams 2009). For potters' and painters' signatures, see Bolmarcich and Muskett 2016 with earlier bibliography.

⁴ Sapirstein (2014) estimated a total of 620 hands (counting only those who had 2 or more works assigned to them); more than half of Beazley's "hands" out of 620 have fewer than ten extant works, whereas only the fifty-four most prolific "hands" (that is ca. 8%) have more than 100 attributed vases.

⁵ Rouet 2001, 107.

⁶ ABV 330: "I now take the Priam Painter to be the same as what I once called the Painter of London B 332; his earlier phase."

⁷ Cook 1961. The WebAtlas of Ceramic Kilns in Ancient Greece (Hasaki web; atlasgreekkilns.arizona.edu; last accessed Nov. 14, 2018) includes over 600 kilns from the Bronze Age to the Post Byzantine Period.

⁸ "Oinochoai by the Athena Painter or from his Workshop" (ABV 263; Krokotos Workshop (ABV 98); Workshop of Nikosthenes (Paralipomena 435).

⁹ Chatzidimitriou 2005; Williams 2009; Bentz et al. 2010; Hasaki 2013; Hasaki 2020.

¹⁰ Cook 1959; Sapirstein 2013; Stissi 2016; Sapirstein this volume; Stissi this volume.

¹¹ Hasaki 2011.

¹² Hasaki 2002; Hasaki 2006; Acton 2014, 73–115.

¹³ Beazley's fierce critics, although never able to challenge his attributions, condemned the lack of transparency in methodology and in definition of the terms. Robertson (1982) presents them in alphabetical order, masking their frequency or Beazley's hierarchy. For a summary of criticism on Beazley and his vase-painting connoisseurship, see Whitley 1997. The responses by Oakley (1998, 1999) remain a passionate but fitting manifesto for the value of connoisseurship studies. More recently, see Neer 2005.

¹⁴ For craft apprenticeship in the Classical world, see Hasaki 2012.

¹⁵ Wasserman and Faust 2014; Watts 2003; Collar 2013.

¹⁶ For ancient history and classical studies, some samples of data sets analyzed with SNA include analysis of literary sources for Alexander the Great (Cline 2012), Socrates (Cline 2019 web), social relationships in Classical Athens (Cline 2020), and the Amarna Letters of Bronze Age Egypt (Cline 2015; Cline and Cline 2015); epigraphical evidence, such as the inscriptions of family links for Hellenistic sculptors on Rhodes (Larson 2013)

and the inscriptions of the network of theoroi for the Sanctuary of the Great Gods on Samothrace (Blakely 2016; Blakely web), relations between cults in Roman religion (Collar 2013), brick manufacturers along the Tiber (Graham 2006; Ostborn and Gerding 2016); and archaeological evidence for Roman cargoes (Leidwanger 2016), as well as prehistorical maritime networks (Leidwanger et al. 2014), and imports in Bronze Age Italy (Blake 2014). For the more recent surveys of SNA uses in archaeology, see Brughmans 2013; Knappett 2013; Brughmans et al. 2016; Mills 2017.

¹⁷ Boardman 1974, 234 f.

¹⁸ Osborne 2004, 90 fig. 6.8.

¹⁹ We used the term “artists” to maintain the focus on the social dimension of these communities of practice. Sapirstein (2014) has proposed the term “hands,” a valid alternative.

²⁰ For the software, see <<https://www.smrfoundation.org/nodexl/>> NodeXL, Gephi and UCINET are the most commonly used in historical network research. For NodeXL, see Hansen et al. 2011; for Gephi, see Cherven 2013; and for UCINET, see Borgatti et al. 2013. These excellent handbooks for users of all levels introduce basic concepts and provide step-by-step guidance for constructing and interpreting social networks.

²¹ Wasserman and Faust 1994, 291–343.

²² We updated ABV entries with Paralipomena (Beazley 1971) and Addenda (Burn – Glynn 1982). At this phase of the research we have not included later attributions.

²³ For a general survey of the Beazley Archive Online, see Kurtz 2004; Smith 2005.

²⁴ For full titles of the ABV chapters and our modifications for the SNA study, see Appendix I.

²⁵ This number includes both the attributed artists (235) and 91 derivative ones linked to signed or attributed artists with the terms “near”, “follower”, “not far from”, “close”, “related”, “in the manner of”.

²⁶ Beazley’s term “group” refers to vases related through a likeness in drawing. His term “class” is for vases he put together for likeness of potter-work – in other words, their shape (Robertson 1982, xiv–xv).

²⁷ Newman 2005.

²⁸ Beazley Archive Pottery Database lists only 8 vases attributed to him (last accessed Dec. 15, 2018)

Image Credits

Fig. 1: adapted from Boardman 1974. – Fig. 2a: from Osborne 2004 – Fig. 2b: by the authors. – Fig. 3–7: by the authors. The sociograms in figs. 2, 3, 5–7 are also available on the *Social Networks of Athenian Potters* website (snap.sbs.arizona.edu).

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