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Testing the 'Small-Site' Approach with Multivariate Activity and Network Analysis

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Abstract

A.L. Kroeber's 'small-site approach, which posits that small-scale sites can be used as touchstones for understanding materials observed at large-scale centers was never properly tested on Peru's north coast. While fundamentally sound with modifications, the original approach was limited by the inadequacy of computational tools to effectively study differing relationships between materials and activities observed in and/or absent from archaeological settings of differing scale. Although regional settlement pattern survey and the analysis of large-scale monumental centers have long been the popular means of archaeological investigation and cultural assessment in Peru, the complementary investigation of smaller-scale quotidian spaces and households is largely lacking. Combining activity and network analysis to identify differential relationships observed in well studied small-scale (Cojal) and nearby, contemporaneous, large-scale (Pampa Grande) household contexts, this paper tests the adequacy of the small-site approach for elucidating patterns that characterize complex social interrelationships.

Keywords: small-site approach, activity analysis, network analysis

Introduction

Working during an era when archaeologists were primarily concerned with the construction of trait-based artifact typologies and the definition of culture areas based on artifact assemblages and distribution, Alfred L. Kroeber put forth a brief statement on the methods of Peruvian Archaeology in which he recognized that "the matter of associations is not only fundamental in archaeological methods, but so simple as sometimes to be taken implicitly, or even overlooked" (Kroeber 1963: 64). In 1942, in an address to the Faculty of Letters of the University of San Marcos in Lima, Kroeber delivered his only general statement concerning his views on archaeological method and theory, discussing the "significance of differential associations, stratigraphy, seriation, and the advantages of studying small sites to establish units of contemporaneity before attempting to sort out the sequence of occupation at large sites" (see introduction by Rowe in Kroeber 1963). While working under the same Culture History paradigms as his contemporaries, and with some untenable assumptions concerning stratigraphy and seriation, Kroeber's small-site approach constitutes an early effort to address relational characteristics of archaeological sites of differing scales and complexity (e.g., small and large sites). Although his approach was never given appropriate consideration nor effectively tested on Peru's north coast, it remains one of few materially-oriented interaction models developed for Northern Coastal Peru.

Kroeber was the first scholar working in the Central Andes to suggest the advantages of studying small archaeological sites. Based on his careful survey and documentation of archaeological materials he observed, he presumed that because small sites possess a more restricted range of components and are likely

to be more ephemeral than their large-scale counterparts, small sites present the opportunity to examine phenomena that remain relatively unaltered by long-term occupation and interactivity. Speaking of the value of small site studies in the context of the ceramic objects they possess, Kroeber (1963) hypothesized that materials obtained from small sites can be used "...as a touchstone to segregate out the phases occurring within the material obtained from larger sites, whose populations may have been ethnically mixed or may have had wide relations to commerce, or… persisted through several stages of changing culture". Foundationally, he defined his approach as the study of the "small site of pure style; namely the ruins, rubbish or cemetery left by a small population occupying a given site for a relatively short period" (Kroeber 1963:70). Although Kroeber adopted the antiquated assumption that pure cultural forms exist and never properly defined constituents (beyond pottery styles) of small or large sites, the small-site approach provides a valuable alternative to politically-situated Peer Polity (Levy and Shalev 1989; Renfrew and Cherry 1986), or economically-grounded Core-Periphery (Frankenstein and Rowlands 1978) models for exploring relationships among archaeological sites and broader social spheres. In the present work, I explore evidence of multicrafting activities (pottery manufacture, metalsmithing and stone working) as a means by which to expose relationships shared by the major urban site of Pampa Grande and mid-scale site of Songoy-Cojal (Figure 1). In the small coastal valleys of North Coast in particular, small hamlets and villages dominate the prehispanic landscape of the first millennium making the small-site approach an important addition to the household and settlement pattern study repertoire.

For example, the study of households (or houses) is seen as an access point for understanding meaningful components of persistent social institutions (Deetz 1982; Kent 1984; Kent 1990; Nash 2009; Rapoport 1969; Rapoport 1990; Tringham 1995; see Aldenderfer 1993). While the importance of household craft production is now well established (e.g., Ames 1995; Costin 1991; Costin 2001; Feinman 1999), the study of household spatial organization is generally regarded as a better indicator of cultural differences or change, than house form or exterior alone (Hegmon 1998; see also Stanish 1989; Wilk and Rathje 1982). A critical point of concern in the Andes, however, is that houses are excavated as "homogenous containers" from which the sampling of individual parts is considered to provide sufficient data to evaluate relative differences among institutions (e.g., economy, exchange, production, diet, etc.). Although embedded in the small-site approach, as I illustrate below, household approaches lack "viable models that link house remains to lived communities, polities, and multipolity spheres of interaction" (Nash 2009:208).

At broader regional levels, the valley-wide "saturation technique" implemented by the Virú Valley project members during the 1940s remains a primary method of archaeological investigation in the Andes (Schaedel and Shimada 1982). This approach, however, suffers from the same general inability to understand relationships within and between sites, particularly those in different valleys or regions. Although originally aimed at understanding "all aspects of man's culture in a single valley" including architectural, occupational and community development patterns, as well as prehistoric religious, social, and political structures (Willey 1953), the foundational assumption that a single well studied valley could be understood as a microcosm of the entire Central Andes (Schaedel and Shimada 1982:360-61) has had a sorely homogenizing effect upon our understand of relationships between and among sites of differing scale and complexity. The widely held view of dominant and homogenous socio-political entities that persists in both household and settlement pattern studies, for example, is the result of long-standing major emphasis placed upon the study of highly visible art styles, monumental constructions and major archaeological sites (Shimada 2010). Although widely accepted settlement pattern studies presume that individual settlements and central places form an integrated whole (Kowalewski 2008), the approach overlooks the strength, weakness or types of relationships such entities might possess. Despite Kroeber's similar view that civilizations (and their material remains) were aesthetic and ideological wholes – consisting of the forms or patterns of the arts, government, law, social relations – he placed emphasis upon the differential relationships that existed among sites and civilizations that occupied them (Kushner 1969).

Speaking on the coexistence of objects or qualities which occur together on the ground, Kroeber

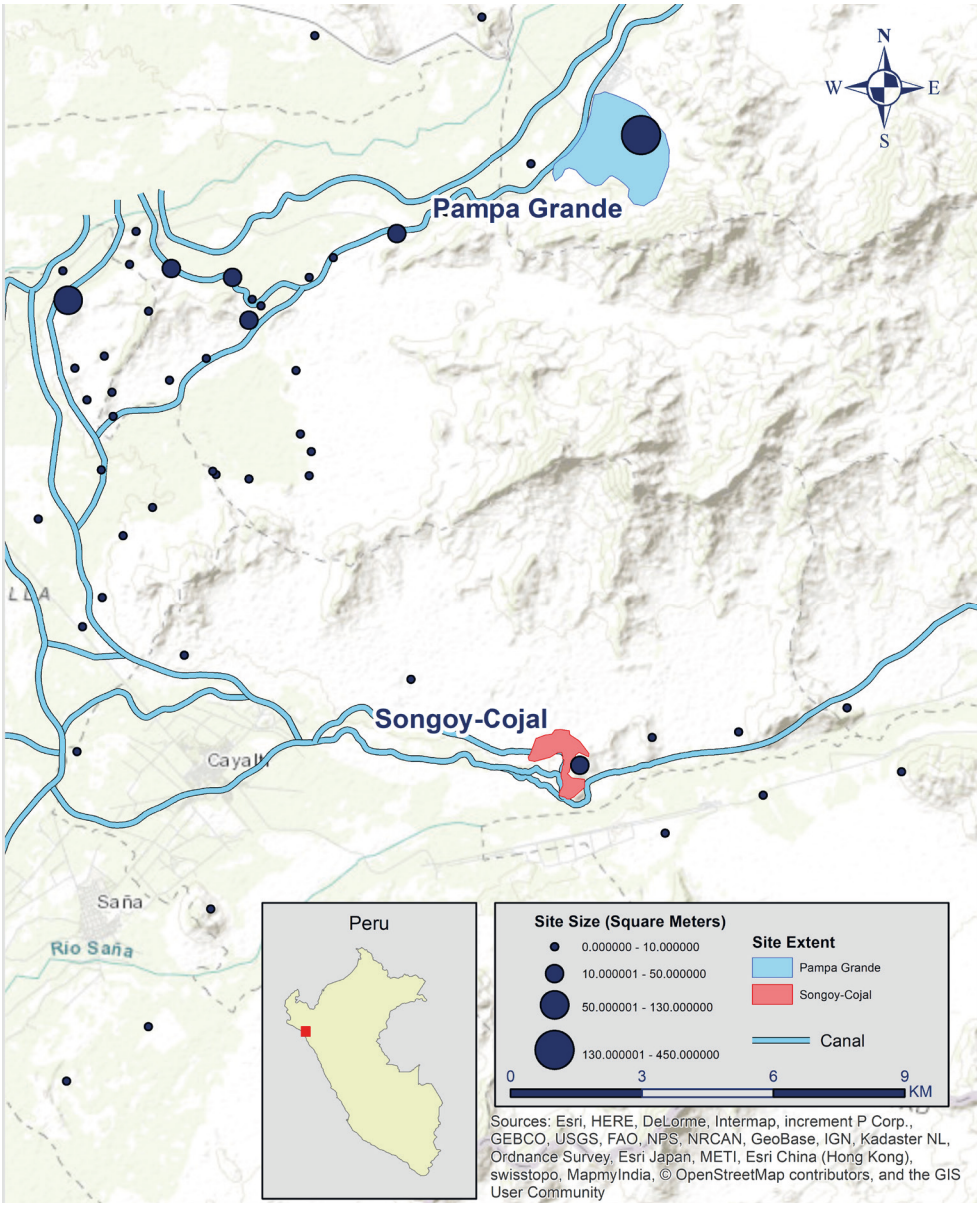

Figure 1. Regional map showing sites mentioned in the text, their extent, and relative size of these and other sites known in the Lambayeque-Zaña intervalley zone, North Coast, Peru.

emphasized the notion of interrelated part-to-part or part-to-whole (small-to-large site) relationships, proposing three testable hypotheses concerning relationships between and among north coast settlements:

> …if two classes of objects, or features of style, or other phenomena of the past, both occur repeatedly, but never in association, their very dissociation is also an objective, scientific fact, although a negative one. At times, the situation is less regular, in that phenomena A and B may occur either separately or in association; or A may associate with C, and B with C, but never A directly with B alone. In such a case, we are manifestly confronted with a partial correlation. A and B are manifestations mainly distinct in their geography or history, but also contiguous or overlapping; or, they both overlap with C. The associations, and dissociations, attain their full reliability only when they are determined with sufficient fineness [Kroeber 1963:64-65].

As illustrated below (Figure 2), the small-site approach produces a model that differs from Peer Polity and Core-Periphery models in terms of the emphasis placed upon interrelationships between and among sites. Although focusing on pottery style as a primary line of data, Kroeber's approach is expandable to

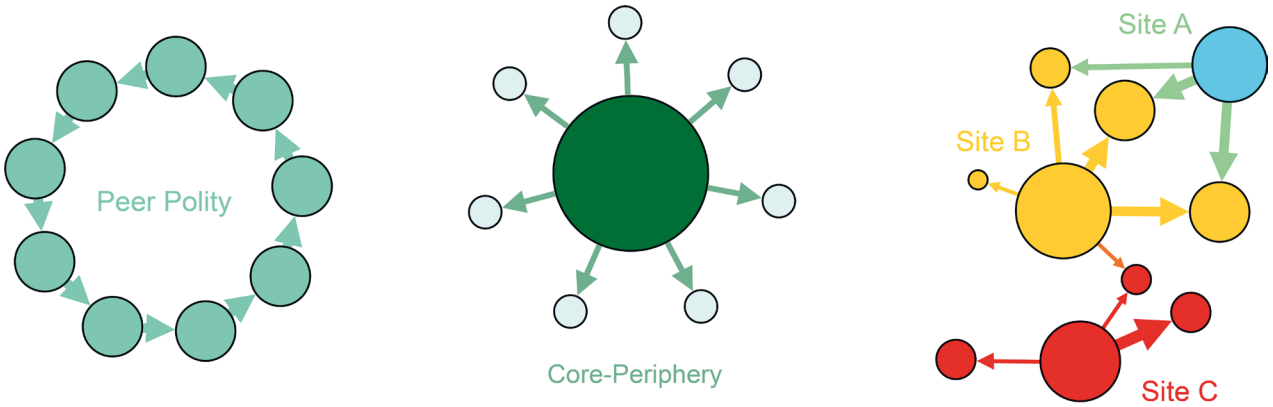

Figure 2. Generalized graphs depicting Peer Polity, Core-Periphery and Kroeber's Small-Site models side-by-side.

other lines of data. The foundational assumption is simply that the study of the more limited range of materials available from small sites, should reveal important relationships when compared to other entities.

Although relatively more complex when visualized as a network, Kroeber's model relies on only a few foundational assumptions that are applicable to a broader range of materials and social settings (see Moseley and Mackey 1972). Importantly, however, neither Kroeber nor Moseley-Mackey provided an operational definition of a "small site" or "large site". The current work sees this distinction as one of both size and complexity, small sites being generally less spatially extensive and internally complex than their large-site counterparts. Given this broad definition, the small-site approach provides an appropriate framework upon which to test the kind and strength of links that tie micro-scale household settings to macro-scale urban, religious or political centers that have long been ignored in the Andes.

Despite various assumptions and perspectives that are no longer tenable (as addressed previously), however, the main factor that undermined the testing of the small-site approach was the inadequacy of computational tools to effectively study the degree and kind of relationships that certain combinations of objects or materials imply. The recent popularity of studying social networks throughout the social sciences and in archaeology in particular (Peeples and Roberts 2013), combined with the availability of popular opensource software such as UCINET and Netdraw (Borgatti 2002; Borgatti, Everett and Freeman 2002) or PAST (Hammer, Harper and Ryan 2001) or Gephi (Bastian, Heymann and Jacomy 2009), now renders the exploration of Kroeber's model both feasible and accessible.

Using SNA to Test Kroeber's Model

The analysis of networks has long been a principal line of inquiry in archaeological investigations which aim to elucidate "patterns and processes of interaction in past societies" (Knappett 2013a:3). The effectiveness of applying social network analysis (or SNA) techniques as a concrete and quantitative means by which to test relationships among a wide variety of archaeological phenomena is now becoming more widely recognized; increasingly, archaeologists have begun to apply formal SNA approaches that are based on well-established models that have developed in the broader social sciences (see Borgatti et al. 2009 ; Brughmans 2013; Peeples and Roberts 2013 for excellent overviews). While formal conceptual and methodological models for studying various types of social networks emerged outside archaeology (Carrington, Scott and Wasserman 2005; Wasserman and Faust 1994; Scott and Carrington 2011), such techniques have effectively been applied in the context of regional interaction studies in archaeology (Knappett 2011; Knappett 2013b). As a number of recent archaeological applications effectively demonstrate, SNA is adaptable and useful to archaeologists on many levels, from the exploration of broad social, political and economic spheres at macro-regional scales when combined with GIS (Golitko et al. 2012; Mills et al. 2013b; Mills et al. 2013a; Rivers, Knappett and Evans 2013), to identify network connections at the micro-scale when combined with ethnographic

data and material culture (Mol and Mans 2013) and even in the development of agent-based computer models to understand past conceptualizations of space and explore the dynamics of information diffusion (Graham 2006). An area of research not widely studied but highly amenable to techniques used in SNA, is household-level craft production, a topic of considerable interest in my current research and of broader applicability in archaeological applications of SNA for micro-level archaeological analyses as well.

Importantly, networks have formal properties (nodes and links) that are essential for discerning how various types of phenomena are related (see Knappett 2013). In this regard, networks are not simply a metaphor for human interaction, but a precise mathematical construction used to represent, analyze, and model interactions (Phillips 2011). While not all archaeological data or methods apply, there are important advantages to SNA, including the emphasis placed upon relationships (links or ties) among archaeological phenomena rather than the study of the phenomena (i.e., sites) themselves, and the formal methods available for characterizing different kinds of networks (Mills et al. 2013b). In addition to nodes and links, concepts such as network centrality – for which a variety of measures (e.g., degree, betweenness or eigenvector centrality) have been defined (see Peeples and Roberts, 2013:3005 for an excellent summary of various centrality measures useful for archaeological network analyses) – provide measures for understanding a given node's position and importance within a social network. Despite some limitations and assumptions that are now untenable in the original form, what makes Kroeber's small-site approach useful is its local yet expandable focus (i.e., the exploration of how small-to-large site relationships might be understood and the accompanying model from which to depart).

Constructing the Network

While it is important to recognize that similar material configurations may indicate different practices in different social settings, or conversely, that similar practices may result in different material configurations at different social levels (e.g., pottery manufactured for trade or external consumption vs. personal items), and that some practices carried out in large-scale settings (e.g., ceremonies or feasting) may have been carried out quite differently at smaller scales (Shimada 1978; Shimada 2007), the investigation of how such relationships might be quantified and the degree to which certain kinds of relationships manifest, finds its place in SNA. In the present case, I focus upon household craft production activities as a way to test relationships among materials recovered from highly differentiated yet contemporaneous household contexts in both small- and large-scale settings. As mentioned above, while the importance of household craft production is a topic of much interest, the relationship between different types of craft production activities, or multicrafting activities conducted outside formal workshop settings remains poorly understood.

To better understand these relationships, I began with the construction of a simple binary affiliation network matrix (after Wasserman and Faust 1994). Archaeological compounds included in this analysis, along with associated craft-related materials that were recorded and/or recovered during surface surveys and excavations of household contexts at the north coast sites of Pampa Grande and Cojal. While the extremely large-scale urban metropolis known as Pampa Grande has been extensively and intensively studied and excavated over the past few decades, the archaeological site of Cojal consists of only a few architectural compounds, three of which were partially excavated during my recent fieldwork at the site of Cojal. Materials considered in the present work are limited to those most diagnostic of three (possibly four) very different craft activities: stone/shell pendant manufacture, pottery manufacturing, and metalworking/metallurgy. In the examples in Table 1 and Figure 3, combined evidence of each activity (or activity-related set of attributes) and archaeological context from it was recovered is shown as a binary matrix where "1" represents a positive find in a particular context (and thus membership in a craft activity), and "0" represents a negative find (or absence from a given context).

As Peeples and Roberts (2013) have recently addressed, the use of simple binary networks for exploring relationships in archaeological cases is not particularly illuminating nor does it produce data that yield straightforward results. Although the construction of the binary affiliation network matrix was

Architectural compound	Pottery mold	Overfired pottery	Polishing stone	Possible blow tube	Copper ore	Crucible (fragment)	Prills	Metal finishing tool	Grinder bowl	Grinding/ pounding stone	Ash	Heavily burnt soil	Stone pendant preform	Stone pendant
	C1	C2	C3	M1	M2	M3	M4	M5	P1	P2	P3	P4	S1	S2
CA#1	1	0	1	0	0	0	0	0	1	1	0	0	0	0
CA#3	1	0	1	1	1	1	1	1	1	1	1	1	1	1
CA#4	0	0	1	1	1	1	1	0	1	1	1	1	1	1
CA#6	1	1	0	0	0	0	0	0	0	0	0	0	0	0
CA#7	0	1	0	0	0	0	0	0	0	1	1	1	0	0
H38	0	0	0	0	0	0	0	0	0	1	1	1	0	0
TALM	0	0	0	0	0	0	0	1	0	1	1	1	0	0
D47Z	0	0	0	0	0	0	0	1	0	0	1	0	0	0
D47Y	1	0	1	0	0	0	0	0	0	0	1	1	0	0
D36O	0	0	0	0	0	0	0	1	0	1	1	0	0	0
H11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D47X	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DR	0	0	0	0	0	0	0	1	0	0	0	0	0	0

Table 1. Binary affiliation network matrix between architectural compounds and craft-related variables.

useful for identifying broad linkages between 'like' materials observed in various contexts at each of the sites studied, additional steps are necessary.

While the materials included in this study have been classified by presumed functional characteristics, the relationships among the various lines of data have important implications for how multicrafting activities and other archaeological phenomena might be better understood not only through the analysis of smaller-scale sites, but also in terms of the interrelationships among crafting institutions themselves. The attributes considered combine various lines of evidence (C-ceramic manufacturing items and byproducts, M-metallurgical and metalworking tools and byproducts, P-general processing tools or byproducts, S-stone pendant manufacturing and byproducts) considered relevant (or potentially so) for carrying out crafting activities. When grouped and weighted categorically, the various lines of information reveal important ties that were not immediately visible in the binary graph above.

The new categorical groups craft production related variables were weighted independently using Jaccard's coefficient, and then visualized according to those ties, rather than ties between individual variables as in the preceding graph. Using the similarity coefficient as a measure of the strength of ties between archaeological contexts for each category of information, it was possible to explore and distinguish among the types of relationships they share. Figures 4a, b, c and d below show the strength of various categorical relationships across the study areas.

I then re-combined the grouped craft production categorical variables, now weighted by their similarity indices, to explore the overall of strength of ties among the craft-related data, using a simple measure of degree centrality, defined as the sum of weights for each node's ties to all others (e.g., Opsahl, Agneessens and Skvoretz 2010), in this case, the ties among architectural compounds for each of the four groupings of craft production evidence which were then used to generate a graphical map depicting the relationships across architectural compounds at both sites (Figure 5). Here, it is possible to identify the relative importance or prominence of various architectural compounds (e.g., in terms of the craft production activities carried within them, as well as to identify precisely which practices (pottery manufac-

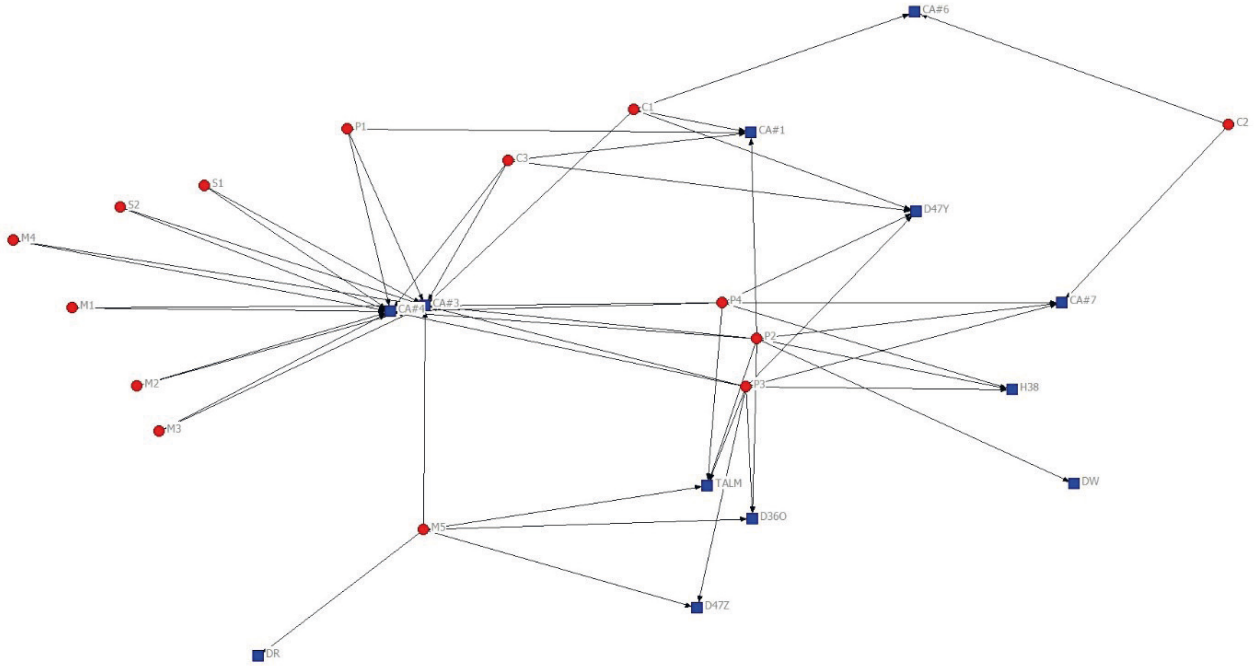

Figure 3. NetDraw (Borgatti 2002) graph based on the network affiliation matrix.

ture, metal crafting and stone working) were shared across small- and large-site boundaries.

Small-Site Approach Operationalized

Through the implementation of the SNA approach to test Kroeber's foundational ideas, it was possible to identify and expose various relationships that were not previously accounted for and or previously studied at the sites of interest. Initially, the distinctive shape of the binary graph is intriguing, given the nature and location of first order ties relating evidence of practical crafting activities to associated archaeological contexts. At first inspection, the binary graph appears to suggest the highly distinctive character of the two sites under study. However, when visualized in the weighted graph series it is possible to readily identify where and how linkages are reflected in the data.

While the fundamental link (or ties) between ceramic production materials across the sites and compounds was generally expected, the strength (or weakness) of certain crafting linkages across the two sites, was not. The relatively stronger ties for processing materials, suggests that crafting practices were carried using similar tools and in similar ways at both sites. This has broader implications for understanding the nature of relationships between craft producers, patrons and consumers living or working in the study areas. In this regard, the applicability of SNA techniques for studying even micro-scale archaeological data has much potential for future research in the context of craft, or multicraft production studies, and for other types of micro-scale archaeological research as well.

Perhaps the most valuable potential of the small-site approach is found in its ability to resituate focus away from poorly integrated studies of individual houses or regional settlement patterns. By focusing on the relationships between communities and their practices (Meyerhoff and Strycharz 2013; Wenger 1998), through the study of small and large sites (or areas of sites) it is possible to tightly integrate datasets of different size and complexity. While this test case illustrates the utility of SNA to test ideas and proposals concerning relationships between sites, it is expandable and of potential utility for addressing a broader range of sites and regions and produce higher-resolution picture of the past than that emerging through household or regional settlement pattern studies alone. While certain relationships exposed in the current test case are not unexpected, the ability to detect differential relationship among various datasets between sites and among contexts is most appealing.

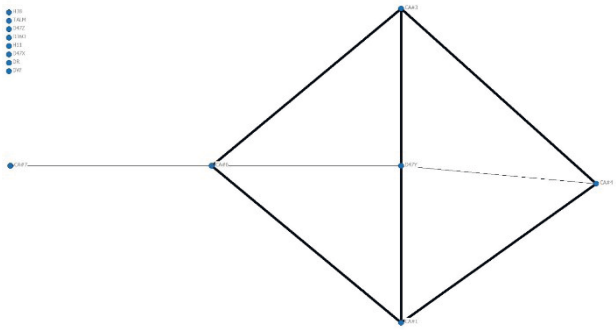

Figure 4a. Pottery Crafting Evidence (C category)

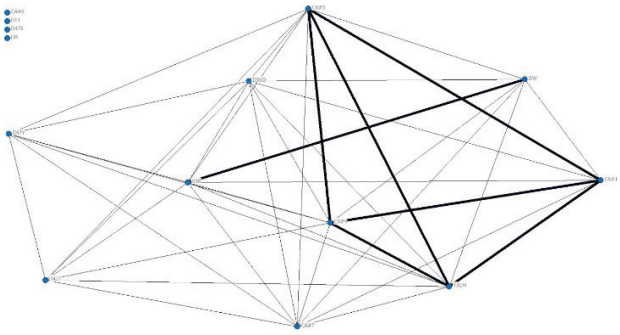

Figure 4c. Processing Evidence (P category)

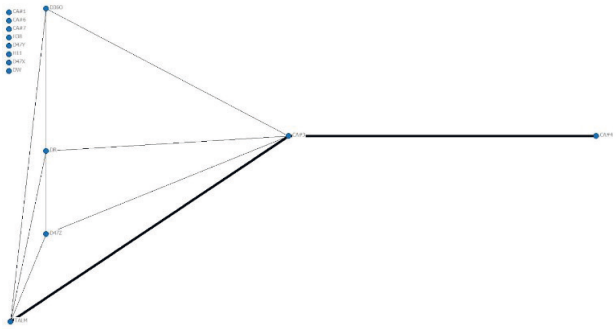

Figure 4b. Metal Crafting Evidence (M category)

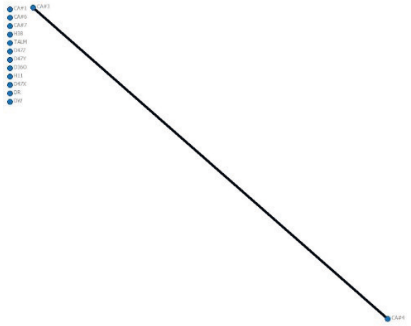

Figure 4d. Stone Working Evidence (S category)

Figures 4a, b, c and d. Network visualizations of the contextual relationships between (a) ceramic, (b) metal, and (c) stone craft production materials categories, and related (d) processing materials using NetDraw (Borgatti 2002).

Concluding Remarks

With several important refinements to the aims of Kroeber's Small-Site approach and by implementing formal techniques from social network analysis, or SNA, it was possible to effectively implement and test foundational ideas he proposed nearly a century. In this application of SNA, it was possible to expand beyond the original scope of the original method. This ability to explore the range of social contexts in which object and materials exist archaeologically has important implications for understanding social interrelationships (in the absence of written or other documented records) that existed nearly a millennium ago on Peru's north coast. While household studies are in critical need of expansion in the Andes, the future of these works lies in the ability to systematically understand relationships among micro-scale settings and broader macro-regions, which is currently limited by the inability to link the two together. With its power to resolve uncertainties concerning the relationship between household and settlement patterns studies, and to pinpoint the locus of differential, rather that direct part-to-whole relationships, Kroeber's small-site approach, presents the opportunity to effectively strategize the study of many types of social relationships between archaeological sites of differing scale and complexity using formalized techniques derived from SNA.

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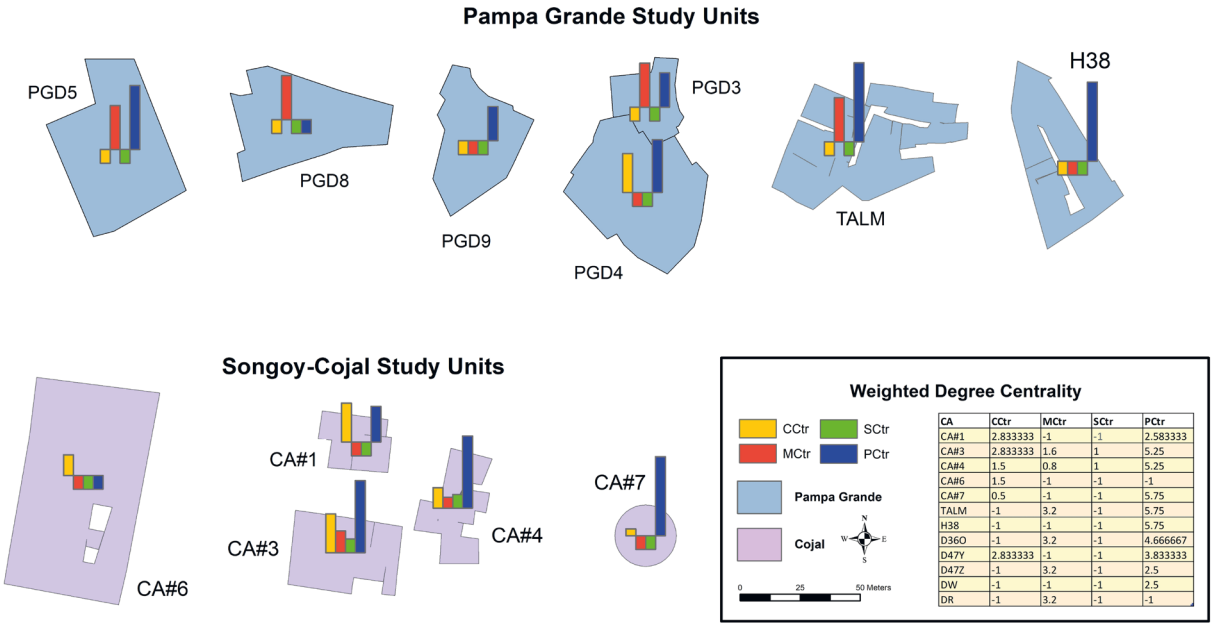

Figure 5. Study unit plan maps indicating prominence of craft-producing nodes based on weighted degree centrality measure. Longer bars indicate the potential for shared relationships in different archaeological contexts and different archaeological sites.

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