Variation in the structure and role of religious institutions: Examples from pre-Columbian America

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Short Title

Religious institutions in pre-Columbian America

Key Words

Evolution of religion; congregation size; in-group; social complexity; pre-Columbian America.

Abstract

Research on religious behavior has stressed its character as a cognitive complex that evolved during the Pleistocene to incentivize prosocial behavior and serves roughly similar population management roles regardless of social context. To explore this idea, we reconstructed religious institutional structure for three pre-Columbian societies using a key feature or religious organization: the basal congregation size—a critical axis of population management and for the creation of shared communal identities. Results show that in places where populations could fission to avoid intra-community conflict, religious institutions show no real evidence of internal community management. In locations where large towns meant more internal conflict, religious institutions mapped themselves over the extended family, creating small congregations that provided the mid-level organizational tiers necessary to support larger communities. Finally, for populations organized into regional polities, religious institutions used large ritual assemblies and conspicuous paraphernalia to invoke our Pleistocene cognitive predispositions for altruistic and cooperative behavior towards close-kin, but re-directed them towards the large, non-kin religious community. This variation highlights the malleable and reactive nature of religious institutions, which interact quite differently with their constituent members or their cognitive predispositions depending on the social needs they look to resolve.

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Introduction

The ubiquitous predisposition for religious belief and independent development of animistic and shamanic complexes throughout the world suggest that a human inclination towards religious behavior resulted from some selective advantage it conferred under hunter-gatherer lifeways during the Pleistocene. In recent decades, much research on how and why this predisposition developed has centered on the idea that a cognitive complex prone to provide agency to the natural world may have given humans—a social species whose early ecological niche focused on understanding and predicting causal relationships—a way to potentially assign motive to those environmental and ecological phenomena whose cause could not be readily predicted or understood (Culotta 2009, 785). Complex or inexplicable phenomena such as erratic ecological changes or the vagaries of daily life could be tentatively treated as causal and attempted to be predicted by symbolically embodying them as the motivations of supernatural agents (Kelemen 2004; Boyer 2003; Barrett 2000; Atran and Norenzayan 2004), who were essentially synonymous with the unseen forces creating change in the observable environment (and conceptually given form as ancestor ghosts, spirits, anthropomorphized or zoomorphized deities, etc.).

At the same time, a separate yet parallel trend in research has stressed that cognitive tendencies for religious thought could be used to great effectiveness to pressure unrelated individuals to be altruistic or cooperate when forced to live in large communities, providing a critical coagulant for the rise of more complex types of human societies such as the chiefdoms, states, and empires that appeared during the last few thousand years of human social evolution. The precise manner in which religion is argued to facilitate social complexity varies much in the academic literature but two important ways include religion's role in generating costly signaling to prevent free riding (in which individuals gain the benefits of group membership without paying their respective maintenance costs) (Sosis 2003; Sosis and Bressler 2003) and providing sets of moral codes (Boyer 2001) alongside ritual reminders that supernatural agents perpetually watch over participants and can exert punishment or retaliation for behaviors that disrupt an ideal social order (Norenzayan and Shariff 2008).

While the former of these research trends aims to clarify the usefulness of a cognitive complex as a fitness trait that may have been selected for since as early as the appearance of the genus *Homo*, the latter investigates how some features of that complex may have interacted with humans social institutions of the very recent past. Often, however, elements of these two ideas are conflated, particularly when suggesting that the main selective pressure behind the evolution of religious cognition in the distant past was the direct encouragement of moral or prosocial behavior. For example, in a recent summary of the academic literature, Boyer and Bergstrom (2008, 119-120) note instances of this conflation where research on present-day populations is carried out to

understand the reasons behind the early evolution of a cognitive predisposition to believe in imagined agents who are concerned with human moral behavior.

To this point, it is important to stress that throughout the length of the Pleistocene, maintaining social cohesion was not a novel hurdle that needed to be overcome. As pre-Neolithic foragers, humans evolved in mobile bands of close relatives where group cohesion and cooperation was ensured through familial ties and intense social monitoring, which pressured individuals to be highly sensitive of their reputation. In such small groups, conflict was kept in check primarily through concern for reputation loss, fear of group punishment and ostracizing, and finally, community fission (Carneiro 1987; Yang et al. 2018; Henrich et al. 2006). Any cognitive tendencies for altruism, enforcing reciprocal behavior, and punishing those who free ride that evolved during this time are probably strongly attuned to living with closely related family members in small groups (Yang et al. 2018; Gintis et al. 2003; Henrich et al. 2006; Fehr and Fischbacher 2003).

Notably, Dunbar (2003, 165) has pointed out that neo-cortex volume in relation to the rest of the brain is a good predictor of mean group size for simian and hominoid taxa, and that in humans it predicts we evolved to maneuver within a social environment of roughly 150 individuals (in reality, this figure likely represents the central tendency in a range of group sizes of between 100 and 200 people). Not only do communities of foragers and early horticulturalists rarely exceed this number, but researchers note that people's networks of close acquaintances in present-day societies will often not exceed it (Hill and Dunbar 2003, 65; Dunbar et al. 2015; Arnaboldi et al. 2015; Dunbar 2016), suggesting some general cognitive constraint on human network size. This has been interpreted as a ceiling on the brain's ability to monitor group members adequately beyond those thresholds, above which rising anonymity may allow individuals to escape close social monitoring. In small-scale societies, this would cause reputational concern between group members to decrease, not only removing a critical suppressant of antisocial behavior, but also increasing free riding (Norenzayan and Shariff 2008, 61; Henrich et al. 2006; Gintis et al. 2003). Increased anonymity, and the antisocial behavior it facilitates, is likely one of the main reasons behind a rise in community friction in traditional societies above a certain size, which ultimately culminates in village fission, and is similarly likely responsible for keeping pre and early Neolithic communities to their small size.

A cap on the size of early communities probably also resulted from the intrinsic relationship between increased population, interaction, and conflict. As a community's population grows linearly, interaction between its members grows geometrically (Bandy 2004). This means that if conflict is a simple factor of the amount of interaction in a given group, it will also grow geometrically, and there will be a steep rise in conflict above a certain number of people, rapidly hindering the ability of the community to function and once again encouraging fission.

Robert Carneiro (1987, 100-101) was amongst the first to note that since community quarrels inevitably arise out of disputes between pairs of individuals, village splitting can be better predicted by the exponential growth in pairs of individuals (which grows by the power of squares) than by the linear growth of people in a community. Again, authors regularly place the number at which village splitting occurs at roughly between one to two hundred individuals (Dunbar and Sosis 2018; Casari and Tagliapietra 2018).

Because of constant community fission, foraging and horticultural societies from the Pleistocene to the Neolithic rarely had to contend with scenarios that forced them to live in close quarters with large groups of people who they did not consider their close relatives and whose behavior they could not closely monitor. While biological or psychological propensities for religious thought may have reinforced this type of group structure as the natural cosmological order, supernatural encouragement of prosocial behavior expressly focused on dictating normative rules for conflict resolution, altruism, or cooperative behavior would have been unnecessary to keep these types of communities functioning. Several large cross-cultural analyses corroborate this view including a comparative review of group size and religious beliefs for 186 populations which indicated that for small-scale societies such as foragers and simple horticulturalists, socially sanctioned deities are much less concerned with human morality than those of societies organized into larger, more complex groups (Roes and Raymond 2003). Likewise, Whitehouse et al. (2019) recent analysis of 414 societies indicates that the appearance of moralizing gods temporally follow the rise of complex societies, providing further support for this position (although see Beheim et al. 2019 for a re-analysis of their data with differing conclusions).

Once humans adopted agricultural life, however, their communities grew quickly and they often found themselves living in tightly packed villages of several hundred individuals, exceeding the number of people one could meaningfully monitor and drastically increasing the number of non-kin with which they interacted on a daily basis. In other cases, populations were incorporated into hierarchical regional polities in which local communities continued to be small, but had to interact indirectly with neighboring villages by conforming to the policies of centralized political authorities. These scenarios meant that for the first time people had to solve the free riding and conflict problems associated with increased anonymity and more interaction, as well as find some way to maintain sufficient social cohesion and cooperative relations to keep their growing societies operating properly and from splitting. It is in these contexts that researchers are quick to point out the visible role that religion plays in both encouraging altruistic and cooperative behavior and deterring antisocial tendencies (Monsma 2007), particularly through the pressure exerted by moralizing deities (Norenzayan and Shariff 2008; Shariff and Norenzayan 2007; Bargh and Chartrand 1999).

Still, researchers also note out that the effects of religious encouragement of prosocial behavior in large-scale complex societies is not constant, particularly when dealing with distant co-religionists or those outside of the religious group. Earlier behavioral experiments showed that for contemporary populations, religious intensity and affiliation were not by themselves good predictors of altruism and cooperation amongst groups of unrelated individuals (Darley and Batson 1973). More recently, research by Purzycki et al. (2016) and Lang et al. (2019) show that resource sharing with distant co-religionists depended on how punitive and monitoring a group's moralizing gods were. More so, depending on the presence or absence of intergroup conflict, moralizing gods even extended cooperative behavior to out-groups.

The fact that moralizing deities affect the behavior of religious participants differently depending on how one perceives the religious membership of anonymous individuals points to another important feature of religion, its ability to malleably redefine in-group identity to groups of various sizes. This is an important feature that has several critical implications for human social evolution. First, as noted above, it can extend the benefits of group membership to non-kin and even to distant co-religionists (Whitehouse and Lanman 2014; Whitehouse 2004). Secondly, and perhaps less often considered, the ability to re-organize a population by redefining how its members view their identity may be of great value if a community needs to subdivide in order to increase its size. Notably, ethnologists have highlighted that managing intra-community interaction and conflict within a large population depends heavily on the composition and number of its basal units of organization. For example, using Yellen's (1977) data about the seasonal organization of 20th century !Kung foragers, Johnson (1982, 402) shows that at 40 individuals, a group of nuclear families are already under high scalar-stress from too many nuclear family basal units, and need to be reorganized into fewer units of extended families when regrouping into larger seasonal camps. At 125 individuals, a group is again under high stress from too many extended family basal units, and in the absence of more complex forms of social organization, it will likely fission. A similar point on the importance of some mechanism of internal segmentation for the growth of villages is also made by Carneiro (1987, 118-120) in comparing the Yanomamö of Venezuela to the central Ge of Brazil. By contrast to Yanomamö villages, which only have simple patrilineages and almost never exceed 250 individuals, Ge villages frequently reach 500-600 individuals, a feature he attributes to the presence of more sophisticated internal structural divisions, including moieties, sibs, and age grades. If religion can malleably redefine a member's identity, it can potentially be a very useful tool for the type of complex community segmentation that may allow communities to exceed traditional populations ceilings.

Religious thought and social institutions

Before moving forward, it is important to unpack two related but separate elements of the general term religion we have been using so far. These are *a)* the cognitive propensity for *religious thought* that evolved during the Pleistocene, likely to symbolically represent the pressure that the natural world exerted unto us, as well as to symbolize our place in that cosmological order; and *b)* the *religious institutions* that arose to codify and structure the resulting religious behavior within public arenas. While in all likelihood our religious cognitive complex went mostly unchanged throughout the short span of the Neolithic, religious institutions were highly variable during that period, becoming increasingly complex in some regions but no others (and most notably in the hierarchically complex societies that humans developed only during the last couple of millennia). The fact that religious institutions vary so much and change so rapidly indicates they primarily evolve through processes of cultural selection answering to quickly changing social conditions. Studying religious phenomena, then, is a complex endeavor, simultaneously involving a variety of differently organized social institutions, the biological limits and predispositions of the human beings that compose them, and the interaction between phenomena at these two analytical scales.

Because evolutionary psychology has made great strides in our understanding of religious behavior in the last couple of decades, recent research has tended to explain religious behavior primarily from the cognitive part of the equation. This often results in viewing the human predisposition for religious thought as having the same general effect on any population regardless of social context, whether it influenced people in foraging bands, bureaucratic agricultural states, or modern industrial nations. Instead, here we approach the topic by asking how sometimes drastically different types of religious institutions—created to resolve the problems of very different types of societies—had to contend with a relatively similar human biology and cognitive structure.

In this endeavor, anthropological archaeology stands as a powerful aid because of its unique ability to reconstruct the actual organization of the different religious institutions that arose late in the Neolithic, allowing us to understand why each organized its population in specific ways to resolve its particular needs, and how they must have interacted with any propensities for religious thought to accomplish those goals.

The religious institutions of pre-Columbian America s

To explore religious institutional variation, pre-Columbian America offers a great set of comparative cases since its populations developed in isolation from other parts of the world and independently evolved a myriad of religious forms of organization ranging from small-scale shamanic complexes to state-sponsored religious organizations with full-time canonic specialists. This makes them perfect

candidates to shed light on how the structure of religious institutions varied depending on the level of sociopolitical complexity of the society that produced them, and how that variation interacted in different ways with our innate cognitive predispositions.

Below, we analyze three cases that exemplify key elements of the scenarios discussed above (shown in Figure 1). The Chiriquí Period (A.D. 1000-1550) occupation of the Upper Térraba region of Costa Rica provides an example of a population in which small groups of sedentary families dispersed across the landscape and used community fission as a key strategy to resolve conflict and growth. By contrast, for the populations of the North American Pueblo Southwest (A.D. 1075-1300), a lifestyle based on intensive agriculture meant they often settled in large, tightly packed but politically autonomous communities, frequently reaching several hundreds of individuals each. Finally, the Late/Terminal Classic Period Maya (A.D. 700-950) of the Upper Grijalva Basin are the quintessential example of a politically centralized bureaucratic state that incorporated an array of towns of various sizes—some reaching thousands of individuals—into a single polity.

Assembly location and congregation size

For these populations, we explore a key characteristic of religious institutional structure, the size of the basal religious congregation. This is the number of families that are pooled into homologous religious groupings, which constitute the basic unit of religious organization above the household level. In this respect, the physical assembly place represents the most direct archaeological marker of those religious units, not only allowing us to pinpoint their location, but providing clues as to the number of people pooled by each.

In modern contexts, congregation size has been shown to vary predictably based on participant needs and institutional structure. For example, Zaleski and Zech (1995, 450) note that more hierarchical Christian organizations in the United States such as the Roman Catholic Church will generally have larger congregations than less hierarchical Protestant denominations because their full-time religious officers absorb much of the responsibility for member monitoring, allowing for larger congregations inasmuch as those specialists can be financed. By contrast, participants of less hierarchical denominations are encouraged more active roles in member monitoring, placing them alongside other types of small self-monitoring groups whose sizes are capped at the point where anonymity begins to appear and conflict becomes unmanageable.

This also partly relates to the second reason why hierarchical religious systems generally have larger congregations, their higher operational costs. Hierarchical religious systems are often in a better position to coordinate and provide additional services to congregation members, but this means that more participants are needed to adequately finance those services—in addition to

financing the religious bureaucracy itself. However, the utility derived from those services for each participant eventually decreases from congestion and overcrowding if too many people join, at which point it is better to reorganize into two separate congregations whose size better optimizes the ratio of financing to utility (Zaleski and Zech 1995, 441,449).

Modern examples such as these highlight several important points about the nature of religious congregations. First is that basal congregation size is reactive to social context and responds directly to issues associated with population management. Second, because specific congregation sizes result from a particular set of social needs, they can shed light into the specific management issues they were formed to resolve. Third, while the size of each congregation might be directly related to issues of population management, the resulting basal religious groups have the effect of demarcating new culturally constructed in-groups whose identity is based on frequent and shared communal ritual.

Prehistoric religious organization can be similarly understood in all of these respects. Likewise, they arose from the specific realities of the societies that produced them, and are important mechanisms for the creation of new group identities. This makes congregation size a powerful tool for understanding the relationship between religious organization and increased social complexity. With this in mind, below we explore basal congregation size at each of the three outlined regions.

The societies of the Upper Térraba region, Costa Rica

The populations of the Upper Térraba are an example of extensive agriculture, a form of productive organization common throughout the American tropics in which domestic units place their residences on the plot of land they work so as to retain a higher degree of autonomy in subsistence strategies and other productive endeavors (Drennan 1988). Figure 2 shows the density distribution of ceramic material from the Chiriquí Period (A.D. 1000-1550) in the Upper Térraba, which illustrates how this productive strategy resulted in a dispersed settlement pattern where households were free to fission and scatter evenly throughout the landscape, making villages of more than a few dozen individuals rare. This meant that people mostly lived near a few close relatives whom they could easily monitor. It also meant that people were likely to interact more regularly with their nearest neighbors and less so with those further away, so that the precise community a household belonged to depended on which specific neighbors were close to it (another way of saying this is that everyone lived in a slightly different local community). Even though some evidence of political centralization appears during this period in the form of one larger community on the northernmost part of the study area, the degree of settlement centralization is nonetheless very modest, so that regional populations probably retained a high degree of autonomy in deciding where to settle and who to interact with.

We began our analyses by looking at the correlation between population and the number of possible assembly places at different locations on the assumption that if religious institutions in this area were systematically organizing households within communities, the material remains of assembly places should be some factor of each community's population. All data used in our analyses for this region are freely accessible in electronic form in Sol (2014b). Because settlements in the Upper Térraba did not organize neatly into discrete tightly packed communities, we took the approach of arbitrarily gridding the entire Upper Térraba landscape into 154 1 Km^2 squares (Figure 2a) to determine if locations with higher Chiriquí Period occupation showed accordingly high counts of the material remains of likely religious assembly locations.

One of us carried out a systematic full-coverage survey of the Upper Térraba with the explicit intention of recording such possible assembly locations or structures (Sol 2014a). Even though no architecturally formalized assembly places were found, the survey did reveal two cultural modifications of the landscape that may have resulted from religious rituals that grouped nearby households systematically.

The first is a set of roughly 203 petroglyphs sporadically distributed throughout the valley, of which 138 were associated with the Chirquí Period occupation. Because of their ecstatic shamanic designs and location relative to settlements they have been interpreted as byproducts of ideo-religious rituals and not status or territory markers (Sol 2014a, in press). Following a practice that is now standard in settlement archaeology, we used sherd density variation as a proxy for relative changes in population across the landscape (Drennan, Berrey, and Peterson 2015). Figure 3a shows a scatterplot of sherd and petroglyph density for each 1 Km^2 grid square from Figure 2a. Since many of these grid squares were only partially covered by the survey extents, sherd densities were standardized by dividing each square's density by the percentage of its area covered by the survey. The raw Chiriquí Period petroglyph count for each square was similarly standardized. Of the 154 grid squares, all those that fell completely outside of the surveyed limits and those with no discernable Chiriquí Period occupation (squares with sherd densities of 0) were discarded from analysis so as to not artificially inflate the correlation value with data points that had no petroglyphs because they were not surveyed or at inaccessible locations for human habitation in the first place. This brought the total number of grid squares analyzed to 73. An r^2 value of 0.089 reveals a negligible correlation between the two variables, indicating that occupation is not a good predictor of how many petroglyphs one will find. Locations may have small or large petroglyph counts regardless of how many people settled nearby. This suggests that whatever role petroglyphs played in Upper Térraba religion, they were not consistently produced as a factor of a given number of people, and are unlikely to be

byproducts of religious ritual systematically arranging a specific number of households.

The second possible set of assembly locations recorded during survey were Upper Térraba's funerary mounds, which are formal cemeteries located in hilltops separated from domestic spaces and the result of at least some degree of coordination between households. In fact, funerary practices have been the most important public rituals reported for pre-Columbian communities in the region (Herrera 2015; Quilter 2004) and are commonly cited as a key component of kin-group delineation in the broader academic literature (cf. Kuijt 2001). In Upper Térraba, they also represent the largest labor investment in construction, involving the preparation of terraces, mounds, and the use of cobblestones and pillars. Figure 3b shows a scatterplot of the sherd and funerary mound densities of each grid square. Funerary mound density was calculated by dividing each square's total funerary mound area by that square's percentage of area within the survey boundaries. As with petroglyphs, grid squares that fell completely outside of the survey boundaries and those with sherd density values of 0 were discarded from analyses. An r^2 value of 0.00006 again indicates no correlation between occupation and funerary mounds. Like petroglyphs, funerary mounds do not appear to have been produced as a factor of a set number of people in a given location, and are unlikely to represent rituals whose function was to group households systematically.

This suggests that the religious practices associated with these two ritual modifications of the landscape did not methodically organize people into groups within each local community, at least not in a predictably demographic way. It is possible that religious assembly locations that did, existed somewhere within the study area but are simply too archeologically opaque to be detected, which would only highlighting the low priority placed on allocating resources for the architectural formalization of those spaces on behalf of the households that used them.

We propose that in contrast to the two regions we explore below, the lack of institutionalized coordination of households through religious practices results from the specific form of social and productive organization of Upper Térraba communities, which encourages households to fission to retain autonomy in land tenureship and other productive endeavors. This produces a dispersed but contiguous settlement pattern that lacks large towns or villages, and where people reside in relative proximity to a small number of people who are usually their close kin and whom they interact with on a regular basis.

This settlement pattern has been noted for a wide range of traditional societies around the world and is argued to be a key factor promoting or inhibiting the development of specific types of community management institutions (Stone 1992, 1993; Martín and Murillo Herrera 2014). Martín and Murillo Herrera (2014,

69) specifically argue that since this type of settlement encourages dispersion, it is likely to pressure the development of rituals that gather populations scattered throughout a large area on a short, intermittent basis so as to resolve problems arising from a lack of social integration above the immediate kin group, including the need for labor pooling, enlargement of mating networks, regional coordination for defensive purposes, etc. (examples of these types of rituals include the Kofyar *mar muos* "beer farming" rituals of Nigeria or the Talamancan *Sorbón* dance of Costa Rica).

The distribution of both petroglyphs and funerary mounds fit well with what one would expect of this type of ritual since the number and location of their material markers have little to no relationship to the amount of people living immediately near them. Populations in this region were unlikely to require the institutionalization of rituals that methodically organized households within communities since they rarely packed into compact settlements that reached or exceed the point where anonymity became prevalent and intra-community conflict had to be mitigated.

The societies of the Pueblo Southwest, United States

An entirely different scenario can be seen in the North American Southwest, in which not only are communities more clearly defined, but the relationship between religious architecture and community size is strikingly more predictable. This region underwent a series of rapid demographic expansions, particularly beginning at around A.D. 1020. This period is known for the rapid construction of many Pueblo sites (characterized by tightly packed rectangular adobe mud rooms) before finally collapsing and depopulating rapidly at around A.D. 1150 (Lekson 2006). This makes their terminal architectural layout a practical snapshot of maximal community size and composition shortly before decline.

For the Pueblos of the early second millennium, nucleated town-life appears to have been a structurally significant settlement type and the inherent arena for daily face-to-face interaction. This type of settlement often results from a productive strategy based on intensive agriculture in which people live in compact villages that are flanked by their fields, either because of communal land tenureship, defensive strategies, or other reasons (Drennan 1988). Analytically, this creates an important difference from the intrinsically dispersed Upper Térraba region in that it makes it possible to treat each town as a discrete "local community" in the manner described by Peterson and Drennan (2005, 6). Also, even though some of these communities had a few dozen individuals and others several hundreds, they were relatively autonomous and generally avoided incorporation into large centralized regional polities. Pueblo communities are often described as a network of chiefdoms with staple economies based on corporate land-ownership and some degree of surplus extraction, at least for the larger sites (Earle 2001).

Another important distinction with the Upper Térraba is that throughout this period architectural investment in large sunken round structures called kivas increased as they became progressively formalized. Interpreted as ritual spaces for closed corporate groups within each community, kivas stand as clear architectural markers of supra-household assembly locations (Adler 1993).

In the following sections, we explore the relationship between the number of kivas and people for different types of settlements. We focused our analyses on three distinct Pueblo areas that capture a range of settlement variation during the period in question, from larger more central towns to smaller more peripheral regions. These are the Lower Chaco River Valley (Reher 1977), Wetherill Mesa (Hayes, Brugge, and Judge 1988; Hayes, Brugge, and Judge 1981; Hayes and Osborne 1964), and the Chaco Canyon (Lekson, Gillespie, and Windes 1984), all depicted in Figure 1.

Lower Chaco River Valley

The Lower Chaco River Valley immediately stands out as the most peripheral of the three Southwest areas analyzed, characterized by mostly small communities with relatively few adobe rooms. The size of each community and the number of kivas was taken from Reher (1977, 494-513, Appendix IB). For our analyses, only habitation sites (labeled "a" by Reher) were used since field houses were likely temporary non-habitation sites. When no precise number of rooms was given for a given community, we used the midpoint between the lower and upper range provided. Finally, all analyses are for sites with identified ceramic groups 7, 8, and 9 (dating to A.D. 1075-1325). Ceramic groups and period designations come from Windes (1977, 282).

Figure 4 shows a scatterplot of the relation between the number of rooms within a given community and the number of kivas present (r^2=0.321). Even though only 32% of the variation in number of kivas is explained by room count, this primarily results from the frequent lack of a kiva in communities with less than 12 rooms. Small sites such as these fundamentally represent marginal or newly formed communities in which investment in formal supra-domestic religious architecture is harder to finance than for larger or more established ones. It makes sense that at that size, communities would often choose to put off investing in an architecturally formalized kiva. As we will see below, the addition of larger sites to the samples of the other two Pueblo regions results in much higher and consistent correlations between room and kiva counts.

Another important point to highlight is that the linear regression y=-0.03+(.13)x predicts that we should expect about 1.27 kivas at a count of about 10 rooms (or about 1 kiva per 7.87 rooms). Hayes, Brugge, and Judge (1981, 49-50) provide good information to convert these figures into absolute population numbers. From ethnographic material for modern pueblos they estimate about 4.5 individuals per nuclear family, with each household occupying on average three

rooms. This means that for the Lower Chaco River Valley sample, each kiva accounts for only two to three nuclear families (7.87/3=2.62), or about 12 individuals (2.62*4.5=11.81). This basal congregation size makes good intuitive sense when measuring small peripheral communities of this type, as frequently it is synonymous with the extended family group that completely makes up the entire hamlet.

Wetherill Mesa

By contrast, Wetherill Mesa is characterized by a much larger number of communities, many of them exceeding 20 rooms each. All analyses are from data from Hayes and Osborne (1964, 136-157) and for sites with identified McElmo (A.D. ~1075-1150) and Mesa Verde (A.D. 1150-1300) occupations. Again, when a lower and upper range was provided for the number of rooms, the midpoint between the two was used. The few cases (n=5) for which the number of kivas was unknown (labeled "?" by Hayes and Osborne) were removed from calculations.

Figure 5a shows a scatterplot of sites that were only occupied during the McElmo Period, which provides an r^2 value of 0.503 between rooms and kivas. The linear regression y=.106+(.064)x predicts that we should expect 1.386 kivas when a community has about 20 rooms (or about 1 kiva per 14.43 rooms). So, as noted above, when a sample with larger communities is analyzed, average congregation size increases and is probably more reflective of the maximal number of people that a kiva can meaningfully manage. That is to say, it takes larger communities than those of the Lower Chaco River Valley sample to reach and surpass the maximal threshold upon which a second (or third) basal religious unit is necessary.

This becomes even clearer when an analysis of both McElmo and Mesa Verde Periods is carried out (all communities with a either McElmo or Mesa Verde occupations, as well as those that have both) (Figure 5b). This causes the predictive power of rooms over kivas to be even stronger (r^2=0.771; y=-.22+(.1)x), with 1.78 kivas likely when a community has 20 rooms (or about 1 kiva per 11.23 rooms). The linear regression also indicates that this relationship remains somewhat constant regardless of the size of the community, with an estimated 11.78 kivas when communities have about 120 rooms (or about 1 kiva per 10.19 rooms).

Again, if we were to assume nuclear families of about 4.5 people using about three rooms each, every kiva would account for 16.85 individuals at communities of 20 rooms, and 15.29 individuals in those of 120. These numbers—which likely represent some form of extended family group—show a very modest decrease in basal congregation size as population rises.

Wetherill Mesa, however, only contains one truly large community of over 140 rooms (site 1200), and analyses of larger communities are critical because they often signal the presence of some political economy at play, in which elites extract surplus from commoners and create the centripetal forces that pressure large groups of people to live in closer proximity to one another (Earle 1993, 1997, 2001, 2002; Sahlins 1963, 1972). To this end, in the next section we also explore some of the largest and most prominent sites of the Pueblo core area, the Chaco Canyon.

Chaco Canyon

The Chaco Canyon region includes many of the most populated Pueblo sites for which we have comprehensive architectural layouts, and was chosen precisely because it contrasts with the smaller and more peripheral sites of the Lower Chaco River Valley and Wetherill Mesa. The number of rooms and kivas were counted directly from the architectural maps provided by Lekson, Gillespie, and Windes (1984), with all analyses carried out on the largest expression of the community, always the last major construction stage (A.D. 1075-1140).

Figure 6 shows a scatter plot for the 12 most prominent sites in the Chaco Canyon region, most of which range somewhere between 100 and 300 rooms. An r^2 value of .743 and a best-fit straight line of y=-3.366+(.071)x predict the presence of 3.734 kivas at 100 rooms (or about 1 kiva per 27 rooms) and about 39 kivas at 600 rooms (or 1 kiva per 15 rooms). Not only is room count highly predictive of the number of kivas in a given community, but the larger the settlement, the more kivas per person. Using the same parameters as for the other two Pueblo regions, this would mean that for communities of 100 rooms, each kiva would account for about 41 individuals. By contrast, at communities of 600 rooms, each kiva accounts for only 23 people.

Congregations in the Pueblo Southwest

When all three regions are looked at simultaneously, two trends come into focus. First, congregations are generally larger in the more populated communities of Chaco Canyon than at the peripheral hamlets and villages of Wetherill Mesa and the Lower Chaco River Valley. Second for the crowded Chaco Canyon towns, congregation size in fact decreases as towns grow.

The decrease in congregation size at the large Chaco Canyon sites can be interpreted as either a rise in per capita religious investment or a reduction in basal congregation size associated with population growth. In either scenario, the outcome is that religious institutional footprint increases more steeply than population. If as noted earlier, a primary function of religious institutions is to mitigate the geometric rise in interaction and conflict, it follows that investment in those institutions would grow more steeply than the linear growth in population.

The fact that this per capita increase in religious investment only appears for samples where communities exceed the 100-room mark (and less so for samples such as Wetherill Mesa or the Lower Chaco River Valley) might be additionally significant. When converted to absolute population numbers, 100 rooms represents a community of approximately 150 individuals, the central tendency for the threshold over which anonymity is argued to become more prevalent and the ability to properly monitor community members stagnates, and over which one would expect the appearance of institutional solutions to those problems. It is also noteworthy that in the Wetherill Mesa sample (Figure 5b), the only community to exceed this threshold (site 1200, with 150 rooms and a population of 225 people) also conforms nicely to this trend with large residuals that cause it to have more kivas than the number of rooms would predict.

Also important is that while there is some variation in general congregation size for the three different Pueblo regions, it only ranges from 12 to 41 individuals at either extreme. It might be that researcher differences in defining kivas could account for some of this disparity. Lekson, for example, is explicit on not counting "clan kivas" or smaller round rooms as kivas, as he argues there are too many of these and are likely domestic rooms (Lekson, Gillespie, and Windes 1984, 50-53). These types of categorical issues might account for at least some of the variation seen here. Nevertheless, the differences are small, with peripheral areas having on average a kiva to room ratio of about 1:10, and the Chaco Canyon sites being closer to about 1:20. Both of these ratios only serve to highlight that the most conspicuous religious partitioning of communities was one and the same with the extended family group from which it probably arose.

Yet, at the same time, the differences in congregation size at the three Pueblo regions show how reactive congregations (even those based on close kinship) can be to social context, and particularly to community size. Ethnologists have long noted that kin-group definition is surprisingly reactive and may quickly become more or less discrete as a response to local community needs, even for the same region at different locations (cf. Frechione and Scaglion 1981, 29-30). Even though family composition is often seen as strict and immutably tied to the biological realities of consanguineal ties, Pueblo congregations vary predictably depending on the size of the community that holds them, with smaller peripheral villages consistently having smaller ones than large pueblo towns.

As to why, these differences might result from a process similar to the one made by Johnson (1982) which notes that the main stress points in the growth of a community are the number of its basal units of organization, not its raw population. If a community is to grow and lacks the ability to increase the complexity of its internal organization, there is more pressure on its already present basal units to hold more people rather than to increase how many of them there are. Since Pueblo communities were generally autonomous and largely organized around the same set of cultural institutions, it follows that

congregations would be larger in more populated but structurally analogous communities.

The societies of the Upper Grijalva Basin, México

Lastly, the Classic Period Maya are often cited as the archetypal example of pre-Columbian sociopolitical sophistication in which competing regional polities with bureaucratic administration looked to increase their surplus extraction by expanding their territory and incorporating peripheral communities under centralized control (Marcus 1993). Research carried out by de Montmollin (1985, 1989a, 1995, 1989b, 2018) in the Upper Grijalva Basin, Chiapas, provides detailed information on the location of domestic and religious structures for one such population for an area of roughly 150 Km^2. Similarly to the Pueblo Southwest, de Montmollin (1989a, 43) indicates that the Upper Grijalva Maya occupation expanded rapidly towards the Late/Terminal Classic Period ending abruptly at around A.D. 950, so that the terminal settlement distribution is again a useful snapshot of maximal occupation at a moment in time.

Figure 7a shows a density map of domestic platforms (which served as foundations for household dwellings) for the entire Upper Grijalva Basin using data from de Montmollin (2018). One can see there is wide variation in how people settled, from areas where they spread out more evenly in low-density hamlets to places where they grouped in large, tightly packed towns of thousands of individuals (for example at the Ojo de Agua community [RV329-330] in the northwest corner of the map). This makes defining local communities for the purposes of analysis less discrete than for the Pueblo Southwest. However, Peterson and Drennan (2005, 7-11) have noted that the contour intervals of population density maps such as these can be used effectively to delimit local communities as they likely indicate population groupings engaged in daily face-to-face interaction (see also Drennan, Berrey, and Peterson 2015; Drennan and Peterson 2006; Drennan 2006). The contour lines chosen to delimit local communities for the analyses carried out below are depicted in Figure 7b.

Using these local communities as our units of analysis, we searched for the types of non-domestic architecture that most closely correlated with the domestic occupation. Communities with less than 10 domestic platforms (n=13) were removed from analyses, leaving a total sample of 61 communities. The number of ball courts (r^2=.101), civic platforms (r^2=.165), and civic altars (r^2=.142) each correlated little with domestic platform count, and are thus unlikely to signal assembly locations that systematically grouped households. Civic ranges, which are structures associated with the Maya elite, scored higher with an r^2 value of .360, but temple pyramids had the strongest raw correlation where fully 40% of the variation in the number of temple pyramids is explained by domestic platform count (r^2=.404; Figure 8a shows a scatterplot of this relationship).

Upon closer inspection of the scatterplot, however, we notice two important details. On the one hand there are six relatively small communities that have a higher than average number of pyramids for their domestic structure count (see the dashed oval in Figure 8a). For these six cases, the number of domestic structures has little predictive power over the number of temple pyramids in a community. On the other hand, the remaining cases conform to a much clearer linear positive correlation in which domestic platform count is highly predictive of the number of pyramids in a community. Removing the six outliers increases the r^2 value of the remaining cases to 0.839, or 84% of the variation in pyramid count explained by the number of domestic platforms in a community. Closer inspection of the six outliers quickly reveals that, while having generally small populations, they have disproportionately high investment in civic architecture including ball courts, altars, civic platforms, ranges, and include the two settlements recognized by de Montmollin (1995) as political capitals (RV164 and RV242). Maya political elites frequently placed their residences in settlements separate from commoner areas, and these six communities likely represent the domiciles of Maya elite engaged in tributary surplus extraction from commoners who lived outside of those settlements (Sahlins 1972; Earle 2002), justifying their separation from a statistical batch meant to represent the general population being managed.

Once removed, the number of domestic platforms predicts pyramid count through the following linear regression: y=0.305+(.008)x (Figure 8b). The slope and y intercept of the regression means that when a community has 100 domestic platforms, we can expect it to have about 1.11 pyramids (or about 1 pyramid per 90.09 domestic platforms), but at 1,000 platforms, the community will only have about 8.31 pyramids (or about 1 pyramid per 120.33 domestic platforms).

There are two main takeaways from this. First, even if we remove all those structures that are too small to be habitation dwellings, each pyramid accounts for a very large number of domestic platforms. de Montmollin (1989b, 2018) provides the measurements for approximately 9,500 domestic structures (classified as platforms, small and extra-small platforms, or sub-dwellings) and he suggests that those that are 6 m^2 or less are probably too small to be residential and are likely adjuncts used for storage, detached kitchens, workshops, etc. Domestic platforms and sub-dwellings of this size only constitute a very small part of those surveyed (n=313), or about 3.2%. For comparison, in the Maya capital of Tikal, Haviland (1970, 193) proposes that 16% of structures were residential adjuncts (Wilk and Ashmore 1988, 10,154). For our sample, discarding a similar percentage to that of Tikal means treating structures with less than 12 m^2 as adjuncts, which is still reasonable as a rough area threshold for this type of structure. To err on the size of caution, we will use the larger of the two figures and remove 16% from each of our estimates, which means that

each pyramid accounted for about 76 habitation dwellings in communities of about 100 domestic platforms, and for 101 dwellings in communities of 1000 domestic platforms. de Montmollin (1989a, 43) indicates that at the maximal expansion of the Late/Terminal Classic Period these structures would have been synchronously occupied, with each dwelling likely housing a single nuclear family. If we again assume 4.5 people per nuclear family, then each pyramid oversaw a congregation of between 342 and 455 individuals depending on the size of the settlement. These are then much larger congregations than those of the Pueblo Southwest, and easily exceed the number of individuals that researchers suggest can be monitored internally by congregation members.

The second takeaway is that in contrast to the Pueblo Southwest, in larger towns there are actually less pyramids per capita. Most notably, the very large site of Ojo de Agua (RV329-330) has quite a few pyramids less than its population would predict. This means that as communities grows, the religious institutional footprint represented by temple-pyramids decreases per person.

These large non-kin congregations, then, look and behave very differently than the ones based on close family ties and seen in places like the Pueblo Southwest. For this reason we should interpret them as arising from very different needs and processes, and likely serving entirely different social functions. In the Upper Grijalva Basin, extended family groupings analogous to the small Pueblo congregations are in fact architecturally visible in the form of household clusters, which bring together several nuclear-family dwellings around a shared patio floor (Ashmore 1988, 156; Flannery 1972; 1976, 75). It should be noted that aside from the spatial separation that defines each of these household clusters, no formal religious architecture delineates them. This suggests that religious institutions placed their symbolic and architectural emphasis on the large congregations centered around temple pyramids, which existed superimposed over smaller, lower-tier basal units of social organization centered on close-family patio floors.

Discussion and Conclusions

The three cases reconstructed above are not just informative because they show a range of categorical variation in religious structure, but because they provide clues about the particular needs each institution was attempting to resolve and how the organizational variants they evolved interacted in different ways with our preexisting cognitive biology.

Analyses of the role of religion for small-scale traditional societies suggests that more than providing normative rules of behavior (Roes and Raymond 2003), religious thought primarily evolved to help humans symbolically interpret causation in their environment and to place the self and the close-kin group at center of the natural cosmological order (Bellah 2011, 96). Additionally, religious institutions would probably have had little need to directly manage populations

as long as communities could fission to avoid rising conflict, a key characteristic of our Pleistocene foraging past.

To show this, we explored the distribution of religious communal architecture within the Upper Térraba during the Chiriquí Period. For that region, domestic units systematically dispersed to retain autonomy in productive endeavors and land tenureship, making it so that people rarely lived in communities that reached or exceed the point where anonymity and conflict became prevalent. Population fission as the main mechanism for conflict mitigation has been well-documented for contemporary traditional societies in the Central and South American tropics (Carneiro 1987; Chagnon 1968) and maintains community size perennially small and easily monitored there. In the Upper Térraba, the distribution of both petroglyphs and funerary mounds suggest communal religious rituals were emphasized at locations away from human settlements, and likely helped to group populations scattered throughout a large area on a short, intermittent basis to resolve problems resulting from a lack of social integration above the immediate kin group (Martín and Murillo Herrera 2014).

This contrasts with the role of religious assemblies at the Pueblo Southwest, where large groups of people resided in close proximity to one another and where community size strongly predicted the number of congregations at each town, suggesting a more direct role for religion in organizing populations. There, the increase in the number of basal congregations per settlement charts more closely with the geometric rise in interaction than with the linear growth in population, which implies congregations might have been an institutional response to conflict. Religious institutions in this region appear to have mitigated rising conflict by mapping themselves over the extended family and situating the close-kin group at the center of religious ritual, demarcating each one as a basal social unit within a community. The academic literature has long cited the need for some mechanism of community segmentation before villages can grow beyond a few hundred individuals (Johnson 1982; Carneiro 1987). In small Puebloan hamlets, where the presence of only one kiva indicates that the kin group, the community, and the congregation were one and the same, reputational concern and member monitoring could easily manage low levels of conflict. However, in larger towns where member monitoring would not suffice because of increased anonymity and geometrically rising conflict, the presence of religious congregations that maintained kin groups discrete through repeated ritual could have provided a mid-tier organizational level that supported the growth of larger communities.

Finally, an entirely different religious institutional response to population needs can be seen for the Maya of the Upper Grijalva Basin during the Late/Terminal Classic Period. There, we see the development of much larger "supra-kin" congregations centered around temple pyramids. These large congregations were also strongly predicted by community size, again suggesting they were

directly involved in population management. However, they did not map themselves over close family networks and there is no evidence that they became smaller as towns grew larger, which implies they had different social functions than the small, kin-based congregations of the Pueblo Southwest.

Polities such as those of the Upper Grijalva, which in the Americas only developed in the last few thousand years of human social evolution, brought together for the first time large numbers of unrelated individuals from multiple communities into centralized control. Large centralized polities intrinsically need to foster allegiance and cooperation both to themselves and between the unrelated citizens who populate them, as well as decrease natural tendencies towards kin-based factionalism that may put in jeopardy their stability. Joining large groups of unrelated individuals in frequent and shared ritual can effectively accomplish those goals. Political entities whose populations were engaged in religious practices that frequently assembled them together would have had a clear advantage over those which did not by more rapidly incentivizing social cohesion amongst their citizenry (Norenzayan et al. 2016). As large groups of individuals engaged in periodic ritual, they would rapidly adopt new community identities based on frequent interaction with other congregation members through shared communal experiences, beliefs, and practices (Whitehouse 2004; Whitehouse and Lanman 2014).

Key to the effectiveness of this type of communal religious ritual is that participants bestow fellow practitioners—and even anonymous co-religionists—the same categorical privileges that evolutionarily had been reserved for close family members. This would help resolve some of the problems of increased conflict, free riding, and antisocial behavior associated with interacting with larger groups of anonymous people. We have emphasized that a religious predisposition for prosocial behavior towards non-kin was unlikely to have been directly selected for during the Pleistocene since this particular social context—in which cooperative behavior towards unrelated individuals is required—only appears once populations became incorporated into larger towns or regional polities. Instead we suggest that as others have argued (Norenzayan et al. 2016, 6; Whitehouse and Lanman 2014, 676), some Late Neolithic religious and political institutions successfully exploited Pleistocene era propensities for reputational concern, altruism, and cooperation within close-kin (Yang et al. 2018; Gintis et al. 2003), but redirected them towards the non-kin religious community through ritual and visual reminders that activated those cognitive tendencies.

Controlled studies have shown that in contexts where direct reputational and reciprocity incentives are insufficient to maintain stable levels of cooperation, religious participants require active reminders in the form of religious ritual or paraphernalia to activate feelings of cooperation and reciprocity (Shariff and Norenzayan 2007). While the debate on the effectiveness on these types of

"priming" reminders is ongoing, Shariff et al. (2015) meta-analysis of 93 studies is particularly notable, which finds they have a robust effect on behavior (although see van Elk et al. (2015) and Gomes and McCullough (2015) for analyses with more mixed conclusions).

As would be easy to imagine, a particularly effective way for an institution to activate our reputational sensibilities and affect our behavior is by reminding us that monitoring and punitive deities watch over us (Norenzayan and Shariff 2008, 60; Atran and Norenzayan 2004), which powerfully equates parental and/or retaliatory supernatural deities with the scrutiny we would normally receive from our close circle of kin. Crespi and Summers (2014), for example, explicitly explore the idea that serving god and serving one's close circle become synonymous in participant's minds. This allows us to view reputational sensibility to moralizing deities as a natural extension and expected outcome of the cultural re-definition of the in-group.

Important here is that only religious institutions under a very specific set of social conditions would require this type of cognitive hijacking. Several recently proposed models of institutional development and their interaction with cognitive predispositions explain quite well how only certain types of societies would evolve the necessary ritual behaviors to accomplish this. Norenzayan et al. (2016, 6), for example, propose that through cultural selection, group competition would rapidly produce a whole set of religious behaviors that are effective at exploiting human psychology for the benefits of the group, which in addition to the belief in moralizing deities, include rituals that incentivize fictive kinship beliefs and pressure human solidarity and selflessness. Similarly, Whitehouse and Lanman (2014, 676) propose that the specific needs of different social contexts would culturally select for ritual "packages" that exploit different tendencies of our innate human cognition. Specifically, the onset of agriculture and centralized regional polities likely brought on the need for religious rituals that reinforce what they call "doctrinal practices," which heavily emphasize the credibility-enhancing displays of beliefs, ideologies, and values needed to create sufficient trust to cooperate with strangers in ways required by centralized governments.

The ubiquitous monumental religious architecture of the Maya example discussed above attests to the intense effort on behalf of their religious institutions to trigger their citizenry's already present propensity for reputational sensibility, including iconographically rich temple pyramids, platforms, stelae, ranges, altars, etc., in addition to a vast array of portable religious art and paraphernalia aimed at making religious figures and doctrine visible and always present.

An additional point has to do with the specific size of the Maya congregational units reconstructed above. As noted earlier, congregation size is the result of several key institutional variables. First, it depends on the congregation's ability

to adequately monitor its members, leading to larger ones in more hierarchical systems. Second, it depends on the ability of members to pay the tributary costs associated with supporting it, whether by force or choice. Finally, size is also curtailed at the point where the utility participants derive from membership begins to decrease from congestion and overcrowding. How much any given member uses the services provided by the congregation will also influence its size since low participation will extend the onset of congestion and overcrowding. Thus, the precise size of pyramid-based congregations of about 400 participants is meaningful because it represents a number that accommodates all those variables for Maya society.

It is interesting to compare how this figure stacks up to the optimal congregation size calculated by Zaleski and Zech (1995, 448) of between 290-913 participants for relatively hierarchical present-day denominations in the United States such as Lutherans, Episcopalians, and Methodists, to about 1,116 for very hierarchical ones like the Roman Catholic church. In this sense, the size of Maya congregations likely represented some form of hierarchical institution where at least some of the monitoring responsibilities were absorbed by full-time religious specialists, allowing membership to comfortably surpass the 100-200 anonymity threshold, but where the higher tributary costs and derived utility, as well as the higher participation rates and monitoring needs associated with prehistoric religious organizations, curtailed membership at much lower numbers than for the modern examples provided by Zaleski and Zech.

At the same time, it is worth noting how closely the congregational reconstructions of the Pueblo Southwest (at between 10-20 individuals) and Maya examples (at around 400 individuals) conform to the predicted layered structure of human groups proposed by Dunbar and Sosis (2018). They argue that human groupings of 15, 50, 150, and 500 are much more common than other sizes because human cognitive limits probably create natural group fission points that make those sizes more socially stable (with the 500 layer, here represented by the Maya example, being roughly three communities of 150). Congregation size, then, also reflects the perpetual negotiation between institutional needs and innate cognitive limits.

One final consideration from an institutional viewpoint is that the large Maya congregations show no evidence of per capita increase in religious investment as the communities that hold them grow (in fact, we see a mild decrease in pyramids per capita at the largest communities such as Ojo de Agua). This is an important distinction from the small kin-based Pueblo congregations centered around kivas where the largest settlements have nearly twice as many kivas per person as the smaller ones. It points to the small, close-kin group as the social institution most central in mitigating rising geometric conflict as communities grow. Since we have suggested that the Maya household cluster (centered around patio floors) is likely the best analogue for the small Kiva congregations

within Maya society, a reconstruction of how Maya household clusters vary as population increases would provide additional information regarding this role. By contrast, the larger non-kin congregations of the Maya seem to change little with population growth, suggesting they played a more indirect role in mitigating conflict. One possibility is that creating a shared sense of group identity or encouraging prosocial behavior through religious reminders that activate reputational concern may sufficiently suppress antisocial behavior irrespective of the frequency of conflict.

The above reconstructions aim to highlight how social institutions are important active players in the processes of differential social evolution, not only reacting to specific population management needs, but interacting with cognitive predispositions in very different ways depending on what they need from their citizenry. The study of the role of religion in social evolution can benefit greatly from looking more closely at how human social institutions interact with our innate cognitive predispositions as they develop and grow. Comparative anthropological archaeology can be a powerful aid in this endeavor.

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Figures

Figure 1. Location of study areas analyzed.

Figure 2. (a) Upper Térraba survey boundaries depicting (in black) areas were Chiriquí Period ceramics were recovered. The arbitrary grid used for the correlation analyses is also shown. **(b)** Perspective rendering of the density of Chiriquí Period ceramic material.

Figure 3. Scatterplots of **(a)** sherd density versus petroglyph density and **(b)** sherd density versus funerary mound area density for each occupied grid square of the Upper Térraba region.

Figure 4. Scatterplot of the number of rooms and kivas for each of the communities of the Lower Chaco River Valley dating to the period between A.D. 1075-1325.

Figure 5. Scatterplot of the number of rooms and kivas for each of the communities of Wetherill Mesa, Mesa Verde National Park, separated by period.

Figure 6. Scatterplot of the number of rooms and kivas for the twelve largest communities of the Chaco Canyon National Monument dating to the period between A.D. 1075-1140.

Figure 7. (a) Perspective rendering of the density of domestic platforms dating to the Late Terminal Classic Period throughout the Upper Grijalva Basin. **(b)** Contour lines used to delimit the 61 local communities used for analyses.

Figure 8. Scatterplots of the number of domestic platforms and temple pyramids dating to the Late/Terminal Classic Period in the Upper Grijalva Basin for **(a)** 61 identified local communities and **(b)** with 6 elite sites excluded.

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