RITUAL DIVERSITY AND DIVERGENCE OF CLASSIC MAYA DYNASTIC TRADITIONS: A LEXICAL PERSPECTIVE ON WITHIN-GROUP CULTURAL VARIATION

Jessica Munson, Jonathan Scholnick, Matthew Looper, Yuriy Polyukhovych, and Martha J. Macri

To study the Classic Maya is to at once recognize the shared material representations and practices that give coherence to this cultural category as a unit of analysis, as well as to critically examine the diversity and idiosyncrasy of specific cultural traits within prehispanic Maya society. Maya hieroglyphic writing, in particular the tradition of inscribing texts and images on carved stone monuments, offers evidence for widespread and mutually intelligible cultural practices that were, at the same time, neither unchanging nor uniform in their semantic content. As conduits of linguistic and cultural information, Maya hieroglyphic monuments offer detailed records of Classic Maya dynastic history that include the names, dates, and specific rituals performed by elite individuals. In this article, we analyze the distribution and diversity of these inscriptions to examine ritual variation and the divergence of dynastic traditions in Classic Maya society. Diversity indices and methods adapted from population genetics and ecology are applied to quantify the degree of ritual differentiation and evaluate how these measures vary over time and are partitioned within and between elite populations. Results of this research refine our understanding about the variation of Classic Maya ritual traditions and make substantive contributions to examining the population structure of cultural diversity within past complex societies.

Estudiar el Clásico Maya implica, por un lado, reconocer las representaciones materiales compartidas así como las prácticas que dan coherencia a esta categoría cultural como unidad de análisis, y, por otro lado, examinar críticamente la diversidad e idiosincrasia de los rasgos culturales específicos de la sociedad Maya prehispánica. Los jeroglíficos mayas, en particular la tradición de la escritura e inscripción de textos e imágenes en monumentos de piedra tallada, ofrecen evidencia de prácticas culturales generalizadas y mutuamente inteligibles que no fueron ni inmutables ni uniformes en su contenido semántico. Como medios de información lingüística y cultural, los monumentos jeroglíficos ofrecen un registro detallado de las dinastías del período Clásico e incluyen los nombres, fechas y rituales específicos escritos por individuos pertenecientes a las élites. En este trabajo se analizan la distribución y diversidad de estas inscripciones para determinar la variación ritual y divergencias entre las tradiciones dinásticas de la sociedad maya clásica. Se aplicaron métodos e índices de diversidad que fueron adaptados de la genética de las poblaciones y la ecología para cuantificar el grado de diferenciación ritual y para evaluar cómo estas medidas varían con el tiempo y se dividen en y entre las poblaciones de élite. Los resultados de esta investigación agudizan nuestra comprensión acerca de la variación de tradiciones rituales del Clásico Maya y ofrecen contribuciones significativas al examen de la estructura poblacional dentro de la diversidad cultural de sociedades antiguas y complejas.

Archaeology is well suited to investigate both broad patterns and long-term processes of culture change as well as to identify individual variation between social actors and within assemblages of material objects. With the goal of uncovering meaningful cultural diversity across time and space, an important question emerges when we try to reconcile these disparate scales of analysis: to what degree are human cultural traditions coherent? According to Peter Jordan, cultural coherence can be exemplified by what linguists call a *speech community*—

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a communication system, propagated by a specific population, consisting of arbitrary sets of traits, attributes, and collective rules relating to the words, grammar, and syntax of a particular linguistic tradition (Jordan 2015:35–36). Analogously, archaeologists are adept at uncovering past communities engaged in shared material culture practices based on similar criteria (Bowser and Patton 2008; Canuto and Yaeger 2000; Joyce and Hendon 2000; Knappett 2011; Mills et al. 2015; Wenger 1998; Wilk and Ashmore 1988). The key challenge, however, is to identify the degree to which traits within a single cultural or linguistic tradition fit an overall pattern, or whether different sets of traits follow different evolutionary histories (Gray et al. 2010; Jordan 2015:42; O'Brien et al. 2010). In short, how tightly bundled are specific cultural traits within a community? In this article, we investigate the diversity and population structure of terms referring to Classic Maya elite rituals to assess the coalescence and divergence of these dynastic traditions across multiple temporal, spatial, and social scales of analysis.

This study analyzes the diversity and population structure of Classic Maya ritual inscriptions to better understand the shared practices and differences among elite ceremonial traditions. In particular, we quantify the frequency and distribution of ritual terms recorded on hieroglyphic monuments to systematically analyze lexeme diversity and determine how these inscribed practices were structured and changed throughout the Classic period (ca. A.D. 250–950). As statements of authority and dynastic duty, rituals inscribed on stone monuments document conspicuous patterns of past performances that were important opportunities for community integration, social cohesion, and identity formation as well as the negotiation of asymmetric power relations (Bell 1992; Inomata 2006a; Turner 1957, 1969). Variation and divergence of these documented rituals provide clues to evaluate how different communities chose to celebrate the political, military, and religious power of their divine rulers as well as measure the degree to which elite cultural traditions were shared across Classic Maya polities. We present novel methods for quantifying ritual diversity using a set of statistical techniques originally designed to measure population differentiation in genetic data. Contributing to a growing interest in understanding the population structure of human cultural variation, this study offers critical historical data and interdisciplinary perspectives for investigating past cultural variation at multiple social scales.

Royal Rituals Writ Large

The ability to create and transform social structure through ritual is well established in the anthropological literature (Bell 1992; Rappaport 1999; Turner 1969). Recent archaeological studies similarly emphasize the integrative and communal aspects of Maya public rites, highlighting how these social practices are embedded in power relations (Inomata 2006a; Lucero 2003). Rituals are not timeless nor do they simply restore social equilibrium, but are active and ongoing social processes that unite and divide across multiple social categories. The balance between such centrifugal and centripetal forces reflects comparable processes in Classic Maya society in which ritual and ceremony played a central role (Houston and Inomata 2009; Inomata 2006a). Kyriakidis (2007:294–296) makes the important point that rituals not only create connections between social groups, but simultaneously draw boundaries within them, thereby creating "social groups within social groups." Thus, ritual is not only culturally specific, but can be distinguished at different levels of society by examining how strategic actions promote diverse meanings within the group. Such multivocality is inherent in the theatrics of Classic Maya performance; however, archaeological studies of performance tend to concentrate on the processes and contexts in which meanings were created and contested in the past (Inomata 2006a:807, 832). For example, variation in mortuary rituals at Teotihuacan demonstrates how gender roles and ideology were constructed differently across diverse sectors of this ancient Mesoamerican metropolis (Clayton 2011). Similar attention is drawn to the diversity of social life in Classic Maya society based on representational and household evidence that isolates the everyday experiences of commoners, nobles, and royals (Robin 2004). Distinctions along this social axis, however, do not lend themselves to making meaningful observations about

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variation *within* these categories, while inconsistent units of analysis may hamper comparisons *between* groups. The result of such a priori categorization may lead to the unintended consequence of lumping together potentially significant differences between Maya royal courts, for example. To overcome this potential bias, this study analyzes a sample of royal rituals along different axes of variation to evaluate the degree of cultural diversity within the elite stratum of Classic Maya society.

Recent research on Classic Maya ritual emphasizes the political and social significance of royal ceremonies, independent of materialist or idealist agendas of individual researchers (Lucero 2003; Stuart 2005). The shared idea is that royal rituals derived from a "vocabulary of more common activities" that represented the moral obligation of the ruler to his community (Houston and Inomata 2009:62). Lucero's (2003) model for the emergence of Maya rulership is based on the idea that dynastic rites were simply enlarged versions of domestic rituals, which allowed aspiring rulers to extract and appropriate surplus production for political means. Focusing on the scale of dedication, termination, and ancestor veneration rituals across a range of social contexts at different sized Maya centers, Lucero (2003:543) concludes that "commoners, elites, and royals conducted the 'same' rites, albeit at an increasingly grand and public scale, over time." The structural and functional similarity Lucero describes, however, belies potential differences in the content, form, and meaning of royal rituals themselves. LeCount (2003:548) aptly points out that these dynastic rites were not just "bigger, fancier, and more public versions of traditional rites but ... must have been qualitatively different in form and content from those that every Maya could perform." We therefore need to consider not only a wider range of ritual practices, but also the ways that leaders set themselves apart from rival competitors while maintaining distinct positions of power within Classic Maya society.

Evidence from the hieroglyphic record may offer the best source for identifying variation among large samples of elite rituals. It is widely acknowledged that the principal genre of Classic Maya monumental inscriptions is dedication, which often frames political discourse (Stuart 1995:99–102, 1998). Within these political narratives, a number of different themes can be discerned, which in turn involve a variety of events (Biro 2011:10–11; García Campillo 1995). Emphasizing the underlying ideology of Maya kingship, Stuart (2005) uses specific texts and images to discern the basic religious concepts that oriented the king and his dynastic duties. In particular, he proposes three general categories of Classic Maya royal ritual: bloodletting, dancing, and burning/censing, which may overlap considerably, but "seem to cover the majority of ceremonial categories we find recorded in the inscriptions" (Stuart 2005:273). Despite an effort to present a comprehensive overview of Classic Maya dynastic ritual, this classification scheme obscures potentially meaningful variation in the content, context, and diverse forms of royal practice. Dancing, for example, was performed in a variety of cosmological and political contexts as observed on hieroglyphic monuments at Dos Pilas and Yaxchilan (Looper 2009:18–43). In contrast, a recent study of epigraphic terms associated with Maya bloodletting finds equivocal evidence for the ubiquity of this particular royal ritual (Munson et al. 2014). Acts of burning, on the other hand, are so widely documented across ceremonial contexts (Morehart et al. 2005) that this general category may prove useless for differentiating distinctive ritual acts. Moreover, this tripartite schema overlooks how other well-documented royal rituals, such as impersonation, conjuring, and scattering rites, intersect with these attested categories.

According to a practice-based approach, "ritual should be analyzed and understood in its real context...not as some a priori category of action" (Bell 1997:81). Rather than impose external categories of ritual practice, we identify and classify elite rituals based upon their verbal roots expressed in Classic Mayan as recorded in the hieroglyphic inscriptions. We interpret these lexemes or phrases as records of ceremonial events that were performed in historical time by human actors embodying multi-agentive social roles. In short, these ritual terms are cultural traits that can be used to study the evolutionary history of Classic Maya dynastic traditions. We can derive inferences about these cultural traditions based on the distribution and diversity of these ritual terms,

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just as an archaeologist would draw conclusions about past human behavior from a sparse and often incomplete material record. Unpacking this definition, however, requires some basic assumptions and discussion of the semantic content and historical contexts of Classic Maya writing. Obviously, there may be a strong difference between the royal acts recorded in Maya art and writing and a broader set that likely existed (Houston and Inomata 2009:61), but this does not necessarily imply that recorded rituals were limited in number or formulaic in expression.

The Content and Contexts of Classic Maya Writing

Long recognized as a defining attribute of the Classic period (Willey and Phillips 1958:182–183), Maya hieroglyphic writing is considered one of the most visually striking and fully developed writing systems in prehispanic America. As most commonly described, writing is a method of communication that conveys meaning and sound through the structured use of conventional visual symbols (Coulmas 2003:15–18). The *choice to record different lexemes referring to* the same type of dynastic accession ritual thus encodes potentially meaningful information about the ways that Classic Maya rulers differentiated themselves from rivals. In addition, the inscription of multiple and diverse elite rites provides clues to evaluate how different communities chose to celebrate their rulers and define themselves in relation to others.

The Classic Maya script was a mixed logosyllabic system comprised of graphemes denoting full word (logograph), numeric, and syllabic values. Some scholars suggest the usage of a single prestige language in Classic Maya writing (Houston, et al. 2000), but recent linguistic studies identify variability in the language groups recorded indicating that multiple dialects or languages may be represented in the hieroglyphic texts (Gronemeyer 2014; Lacadena García-Gallo 2010; Law 2014; Wichmann 2004). Although it is linguistically complex, Maya hieroglyphic writing represents a set of mutually intelligible texts that developed over the course of 1800 years, beginning as early as the third century B.C. (Saturno et al. 2006) and continuing until the Spanish suppressed it during the sixteenth century. The bulk of extant monumental texts, however, are dated to the Classic period (ca. 250–950), and these inscriptions offer the most legible and abundant texts for conducting detailed studies of lexeme variation. In addition, advances in decipherment over the last 30 years have significantly expanded our understanding of the grammar, orthographic conventions, and semantic content of Maya writing. Access to this information in digitized formats, through cataloging and coding efforts by the Maya Hieroglyphic Database Project, create unique opportunities to conduct systematic empirical studies of the hieroglyphic record.

Like other works of art in Classic Maya society, the production of hieroglyphic texts was an elite craft that required specialized training and knowledge concerning mythology, astronomy, mathematics, sacred rituals, and history (Inomata 2001, 2007). Restricted to elite and royal contexts, hieroglyphic texts can be found on a variety of carved or painted architectural features including stelae, lintels, altars, wall panels, and murals, as well as on decorated polychrome vessels and other ornaments made of jade, wood, bone, or *shell. A limited number of fan-fold books written* in Maya hieroglyphs survive from the Late Postclassic and Early Colonial periods (ca. A.D. 1200–1600), although this scribal tradition was also likely widespread during the Classic period (Reents-Budet 1994; Rossi et al. 2015; Saturno et al. 2015). Demonstrating the esoteric knowledge held by Maya scribes, inscriptions from the codices primarily document astronomical cycles and religious content (Bricker and Bricker 2011; Vail 2000). Personal objects such as jade pendants and ear spools were often engraved with texts to be read by the owners of the objects but not seen by others (Houston and Taube 1987; Joyce 2003; Mathews 1979). Inscriptions found on some painted ceramics may document ancient speeches (Law et al. 2013) in addition to recording common expressions that identify the drinking vessel, its contents, and the personal name and titles of the owner. In contrast, monumental inscriptions were usually less intimate, portraying the public persona of Maya rulers by recounting their dynastic history and marking important political and historical events. Regardless of the medium they worked in, scribal artists achieved high social

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status as suggested by their official courtly titles (Jackson and Stuart 2001; Saturno et al. 2015) and through the power and prestige associated with the objects they produced (Inomata 2001). However, elites did not engage in these crafts only for political or personal gain; their participation in arduous, sometimes unpleasant or even costly tasks points to their commitment to underlying cultural values associated with their artistic practice (Bliege Bird and Smith 2005; Inomata 2007).

Beyond its technical components and significance as a status marker, writing is fundamentally a method of communication that should be examined within its specific social and political contexts. Here we are interested in how Maya hieroglyphic signs may have been interpreted, transmitted, and acted upon in past sender-receiver dynamics (Godfrey-Smith 2014; Skyrms 2010). Such "literacy practices" are essential to understanding the ways in which writing, reading, and their related acoustic and bodily acts are embedded within social and political power structures in society (Street 1984). Focusing on the inscriptions allows us to emphasize the social significance of royal rituals regardless of whether they actually happened.[1] Although archaeologists can rarely identify the intended recipients of ancient writing, the location, sculptural presentation, calendrical information, and semantic content of Classic Maya monuments allow us to reconstruct potential social interactions centered on past literacy practices.

Formalized reading and writing were independent skills, with writing likely restricted to the noble class in Classic Maya society (Houston 1994:28–29). Although levels of literacy probably varied between communities and even among individual scribes, the visual cues and performance-related aspects of monumental texts may have facilitated wider access to the information inscribed in stone. Hieroglyphic inscriptions found on carved stone monuments were commonly integrated with scenes depicting royal individuals engaged in the documented ritual action. The combination of image and text displayed in the public spaces where these ceremonies took place provides another vehicle for people to remember and re-experience those events (Grube 1992; O'Neil 2012). But the texts could also stand alone, fully capable of communicating information not otherwise represented (Martin 2006). Classic Maya writing also displays attributes of recitation literacy (Brown 1991). A Maya term for ruler, *ajaw*, which may literally translate as "he who shouts" (Houston and Stuart 1996:295), bolsters the idea that Maya kings were oratorical performers capable of communicating to wide audiences. Inomata (2006a, 2006b; Inomata and Coben 2006a, 2006b) develops this performance-based approach for understanding the ways that public ceremonies were theatrical and politically charged occasions—not only for Maya rulers to assert their authority and divine power, but also for community participants to engage in the creation of social identities and negotiation of political struggles that characterize Classic Maya society. Central to these studies of past performance is the investigation of plazas and open spaces where community members gathered and ceremonial events took place (Inomata 2006a, 2014). Nonetheless, it is sometimes difficult to identify and distinguish different types of public ritual through archaeology alone. Tokovinine (2006:831) rightly points out that the "most important question that remains unanswered is what *kinds* of [public] theatrical performances ... were essential to the maintenance of the imagined communities of Classic Maya polities." By examining lexical differences in the rituals inscribed on hieroglyphic monuments, we may inch closer toward understanding the intersubjective ways that Classic Maya communities chose to commemorate their political leaders and signal their shared social identity.

Materials and Methods

Ritual Inscription Dataset

Ritual inscriptions analyzed in the current study were collected and coded from monumental texts recorded in the Maya Hieroglyphic Database (MHD). The MHD is a unique catalog of hieroglyphic texts that encodes comprehensive spatial, temporal, and linguistic information about Classic Maya script and language (Looper and Macri 1991–2015). Each record in the database represents a spatially discrete unit of text, called a glyph block, which contains variable numbers of

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graphemes that in combination commonly denote a word or phrase. At the time of data collection, there were 73,359 records in the MHD representing thousands of carved, modeled, and painted hieroglyphic texts. Attributes of the glyph blocks are coded for detailed information about each textual source, including its location (site, region, monument name, coordinate, associated structure), dates of monument dedication, and most documented ritual events, as well as linguistic and semantic content including glosses in Classic Mayan and English.

In this study, we identified and coded every inscribed ritual in the MHD based upon its verbal root expressed in Classic Mayan. For the purpose of this study, we define elite rituals as intentional acts in which the main protagonist is a human actor rather than a deity or other supernatural. This includes not only kings (*k'uhul ajaw*), but also elite women and other titled individuals such as *sajals*, *ajk'uhuns*, and other human agents whose exact social standing is uncertain. By extension, we exclude purely calendrical observances such as temporal "completion" (*tzutz*) or "diminishing" (*lam*) events as well as *k'altun* "stone setting" and *chumtun* "stone seating" rituals, which in our view are not always clearly associated with physical acts performed by human agents. We note that some events, such as wars and the making of monuments, doubtlessly involved multiple actors; however, in many of these cases, the text either explicitly or implicitly attributes these events to the agency of a single person, usually a ruler. Since some rituals are recorded using constructions that delete or suppress the identity of the actor, we assume that all persons whose acts are recorded on monuments belong to the upper tiers of Maya society. Although this elides the ritual actions of rulers with non-royal elites, this grouping results in a large dataset that facilitates the analysis of overall elite ritual behavior.

In total, 81 different rituals are represented across 102 epigraphic expressions. According to a practice-based definition of ritual, we minimally assigned rituals to categories based on epigraphic readings that converge on shared meanings (Supplemental Table 1). Seventy-five percent of all ritual inscriptions are accounted for by the top 12 categories, indicating that the majority of rituals were rare occurrences (Figure 1). Elite rituals previously discussed as essential to Maya kingship are, not surprisingly, high frequency events in our dataset. Accession rituals are by far the most common rite ($n = 281$) and are represented in the inscriptions by one of six Classic Mayan verb roots: *ajaw, ch'am k'awil* (in some contexts), *chum, joy, k'al hun*, and *(y)okte'* (See Supplemental Table 1). We use this subset of accession rituals to investigate finer scale differences in Classic Maya dynastic traditions. In addition, to evaluate the consistency of our results and reduce any bias in comparing royal rituals associated with different sociopolitical contexts, we conducted the analysis using both the complete set of ritual inscriptions and this subset based on the dynastic accession rituals.

We restricted the sample of ritual inscriptions analyzed in this study to include only events that were historically dated and recorded on hieroglyphic monuments from known archaeological sites. Although additional ritual actions were recorded on portable objects as well as on unprovenienced monuments, these were excluded because they lack the necessary temporal and spatial controls required for the present analysis. The current dataset yields a total of 1,581 ritual inscriptions. These records come from 124 archaeological sites and include event dates ranging from 8.6.0.0.0 to 10.8.10.0.0 based on the Maya Long Count calendar system (159–998 A.D.). The frequency of elite rituals through time closely tracks the production of monumental texts (Figure 2), making clear that these ceremonies were the dominant theme of hieroglyphic monuments. In addition to the significant increase in monumental inscriptions during the seventh and eighth centuries, it is also important to point out that the quantity of writing varies considerably across the Maya lowlands (Figure 3). It is notable that ritual inscriptions do not occur at every site where hieroglyphic texts have been documented, indicating the need to consider alternative factors that may structure the distribution of Classic Maya royal rituals.

Analyses

As discussed above, practice-based theoretical approaches to ritual focus on the diversity and dynamics of structured human actions. In partic-

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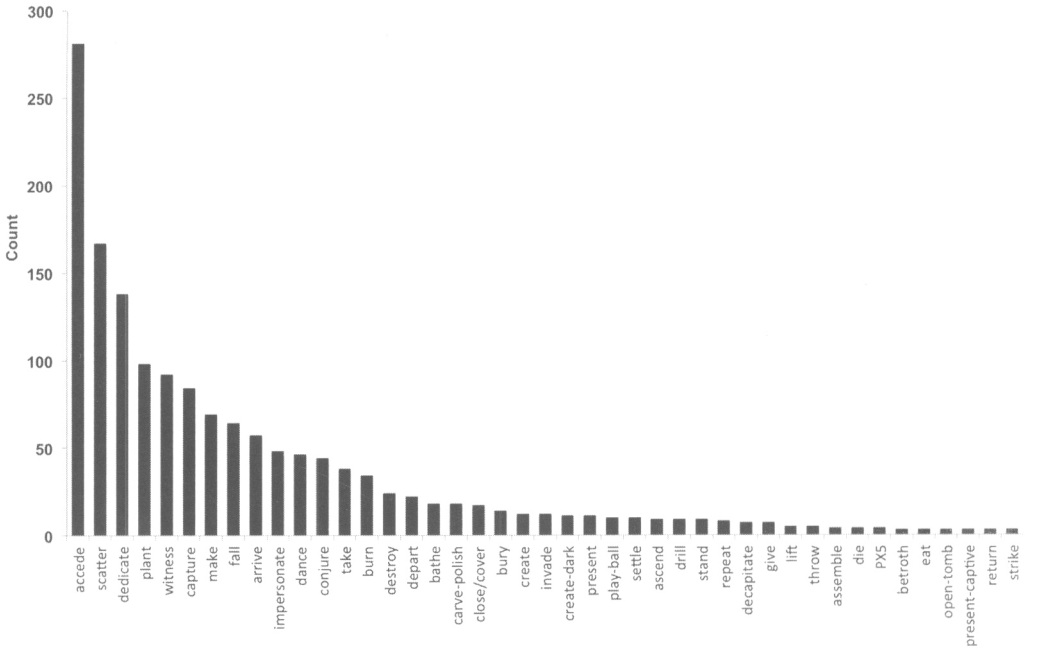

Figure 1. Frequency distribution for all classified rituals in the current dataset with more than two occurrences.

ular, "thorough, painstakingly detailed, and warranted arguments that *measure cultural diversity and change at multiple scales* and degrees of temporal resolution [and] that take the complexity of the human experience into account" are explicitly called for by archaeologists employing this approach (Pauketat 2004:202). However, the fundamental question of how to do this remains incompletely answered. In effect, there is a gaping limitation for operationalizing the types of archaeological analyses called for by practice-based approaches (Munson 2015), and this is especially true for large and complex datasets. Here, we describe a set of statistical methods that are explicitly designed to quantify variation and population structure at different scales. We first describe these techniques and then apply them to evaluate how Classic Maya ritual differentiation varies through time and space, and is partitioned among sites at different social scales.

Measuring ritual diversity. We use a simple estimate of diversity (D) to assess the probability, p, that two ritual inscriptions randomly sampled from the extant corpus of Maya hieroglyphic monuments belong to the same ritual ceremony based on its verbal root form expressed in Classic Mayan. Simpson's (1949) index is a standard measure of diversity commonly used in ecology to quantify habitat biodiversity (Legendre et al. 2005) and applied in population genetics to assess heterozygosity (Nei 1987). Formally, Simpson's index, is given as:

$$D = 1 - \sum_{i=1}^{j} p_i^2$$

where p_i is the proportion of ritual ceremony i of j total rituals. This gives an index that ranges from 0 to 1, indicating the probability that two rituals chosen at random from the sample are different. We use this index to measure ritual diversity because it takes into account the number of rituals present as well as the relative abundance of each ritual. Diversity is a function of ritual richness and evenness, or how the rituals are distributed among each category. This index is sensitive to sample size so we also need to consider possible effects due to small samples. We use this index to evaluate changes in ritual diversity through time and to detect population structure at different scales as described by the index below.

Detecting population structure. Following re-

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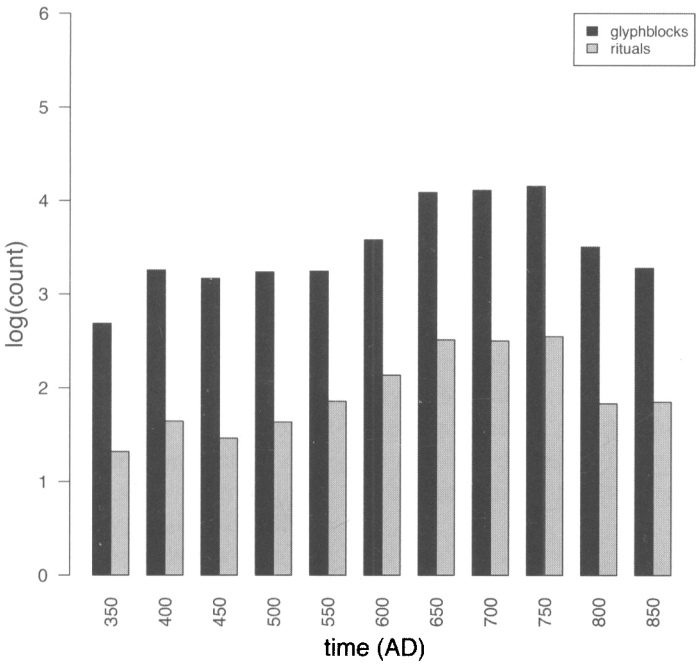

Log-scaled bar plot comparing the frequency of all ritual inscriptions (gray) and the total number of glyph blocks (black) recorded during each 50-year period. The glyph block count represents the amount of writing on dated monuments from known archaeological contexts. Note the association between increased ritual frequency and monument inscription during the seventh century.

cent adaptations for cultural data, the fixation index F_{ST} is used to measure the extent of ritual differentiation as observed from Classic Maya hieroglyphic monuments. This provides a quantitative measure of the degree to which the diversity of rituals recorded at a single site is represented in the total population. As a relative measure of differentiation, F_{ST} is calculated as the ratio of the difference between the total estimated population diversity D_T and the average estimated subpopulation diversity $\bar{D}_S$ over the total estimated population diversity D_T, formally expressed as:

$$F_{ST} = \frac{D_T - \bar{D}_S}{D_T}$$

Ranging from 0 to 1, a F_{ST} value of 0 indicates no differentiation between subpopulations or that all of the diversity in the population is represented within each subpopulation; a value of 1, in contrast, indicates complete differentiation between subpopulations. In other words, low F_{ST} values indicate a high degree of interaction or cultural transmission between sites and sharing of similar ritual traditions. High values, in comparison, suggest little interaction among sites and in this case, could reflect divergence of Classic Maya ritual traditions.

Originally developed by Wright (1951, 1965) to measure genetic differentiation between subpopulations, F-statistics, such as F_{ST}, have recently been used to investigate the population structure of cultural variation. Bell et al. (2009) pioneered the application of cultural F_{ST} in studying the evolution of prosocial human behavior by comparing genetic and cultural differentiation at a global scale. More recently, these measures have been used in large-scale cross-cultural studies of European folktales (Rosset et al. 2013), to examine musical variation in Austronesian aboriginal songs (Rzeszutek et al. 2012), and to detect archaeological cultures in Neolithic Europe (Shennan et al. 2015). We can make qualitative comparisons between F_{ST} values generated from our study with the results from other cross-cultural studies to inform our understanding of cultural variation within Classic Maya society. In the above cases, population structure was inferred from a wide range of cross-cultural datasets and consistently show values less than .10 (see Shen-

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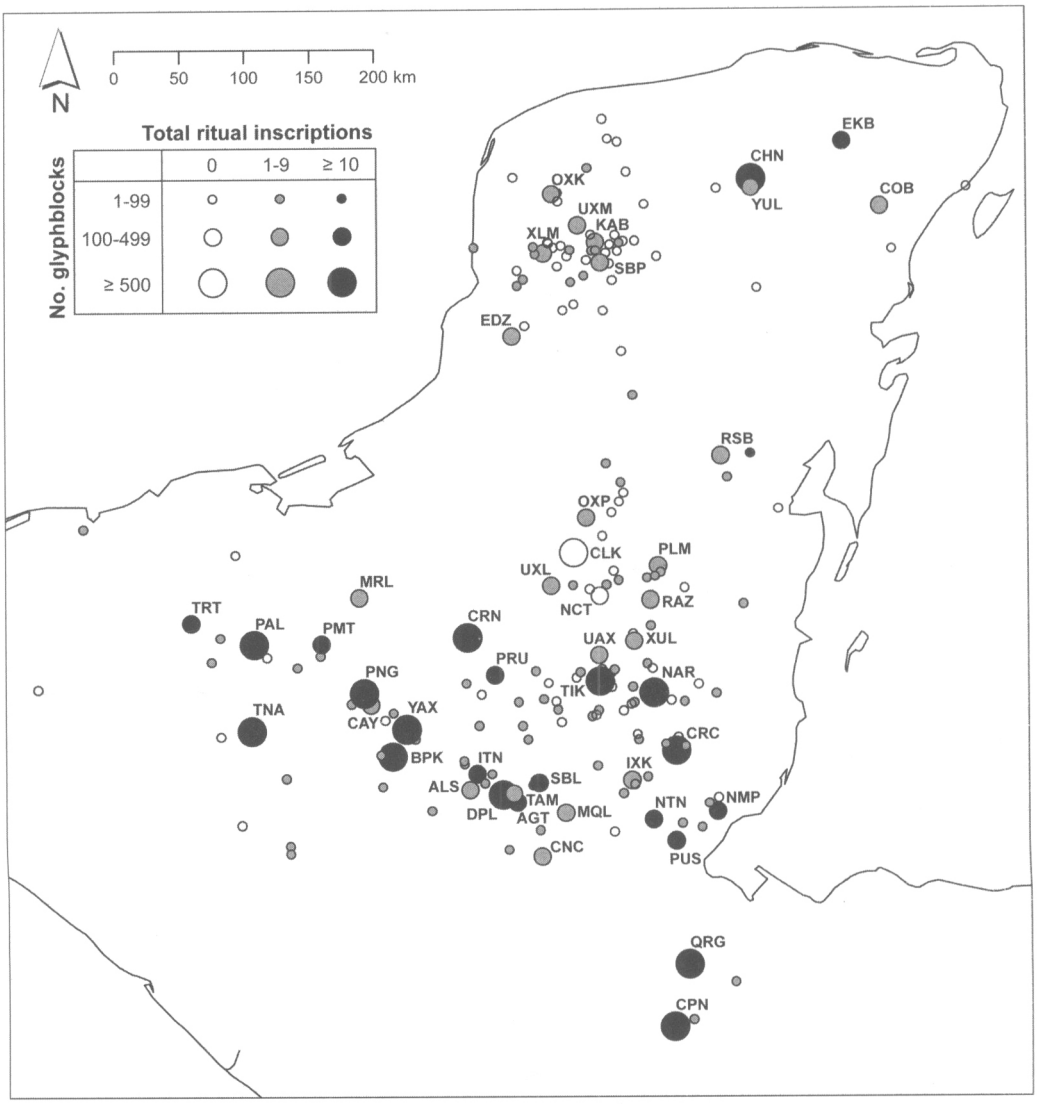

Figure 3. Map showing all sites (n = 198) with monumental inscriptions in the current dataset. Size of the circles indicates the different site-size classes based on the number of legible glyph blocks found on hieroglyphic monuments. Color represents the number of ritual inscriptions found at each site. Labels identify sites with 100 or more glyph blocks that were included in the current analyses. Three-letter codes correspond to site names listed in Supplemental Table 2.

nan et al. 2015:106). In addition, recent archaeological applications of population structure in ornament and pottery data show similar magnitudes for Neolithic European cultures ϕ_{ST} = .134 for pottery and ϕ_{ST} = .109 for ornament data (Shennan et al. 2015). Scherer (2007) has also recently used used F_{ST} to infer population structure among Classic Maya groups based on dental metric data, thus providing a unique opportunity to make structured comparisons between biological and cultural variation within the same archaeological population.

Hierarchical extensions of the fixation index can also be used to assess how diversity is partitioned among subpopulations within groups (F_{SC}), as well as how it is partitioned between groups within the total population (F_{ST}). Thus, an advantage of this family of F-statistics is the ability to measure population structure at multiple nested scales. In this case, we can partition ritual diver-

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sity into groups based on geography, site size, or other sociopolitical groupings to investigate how ritual diversity is partitioned at these different scales. One way to consider possible effects of space on population structure is to examine the variance among sites within specific geographic regions as well as the variance among these regions relative to the total. To do this, we classify sites into seven different archaeological zones that were first defined by Culbert (1973; Culbert and Rice 1990) and later used in Scherer's (2007) study of Classic Maya population differentiation based on biological traits. We also consider population structure as a function of site size based on the overall quantity of monumental inscriptions found at each site. This allows us to examine differences in ritual diversity within and between groups of sites that had different levels of scribal output as expressed in hieroglyphic monuments.

Assessing Ritual Dissimilarity

Correlations between geographic distance, social network distance, site size, and ritual dissimilarity are obtained using Mantel and partial Mantel tests (Legendre and Legendre 2012; Smouse et al. 1986), as implemented in the R package "vegan" (Oksanen et al. 2014). Mantel tests are commonly used to measure the correlation between two distance or similarity matrices, where standard regression analysis cannot be used to assess significance because the distances are not independent. *P*-values are obtained by comparing the observed correlation against a distribution of correlations obtained by randomly permuting the rows and columns of the matrix.

We first computed a ritual dissimilarity matrix using the Bray-Curtis (BC) differentiation measure (Bray and Curtis 1957) implemented in the R package "ecodist" (Goslee and Urban 2007), which quantifies the shared differences between two sites based on the relative frequency of ritual inscriptions at each site. Importantly for archaeological data, this measure ignores instances of negative matches (i.e., shared absences) that are common in sparse matrices. We then test the hypothesis that isolation by distance is a factor explaining ritual dissimilarity using a simple Mantel test to compare matrices of BC measures with spatial distances. Spatial distance is measured using Euclidean distance between projected UTM coordinates. Since the Classic Maya region is smaller than continental datasets (e.g., Shennan et al. 2015), and relatively close to the equator, Euclidean distances provide a good measure of distance between sites. A social network distance matrix was generated based on the presence or absence of a tie between two sites, with ties defined by the inscription of foreign emblem glyphs or personal names of individuals from other sites (see Munson and Macri 2009). Finally, we test the effect of sample size by computing a matrix that measures the difference in the total number of glyph blocks between pairs of sites. Combining these matrices in a partial Mantel test allows us to consider the effect of one variable at a time while accounting for the other variables.

Results

It is well known that the tradition of carving hieroglyphic monuments was widespread in Classic Maya society. Scholars recognize major scribal centers based on the quantity and quality of texts discovered at sites like Copan, Palenque, and Tikal (Martin and Grube 2008), while epigraphic studies of individual centers provide unparalleled details about Classic Maya political history (Houston 1993; Looper 2003; Polyukhovych 2012). This uneven distribution of hieroglyphic inscriptions, along with limited documentation of monuments and varied levels of epigraphic analysis, has created a situation in Maya studies that privileges the largest and best documented hieroglyphic records (c.f. Martin and Grube 2008). For a systematic investigation of ritual variation, we need to minimize this subjective bias and consider the most complete set of hieroglyphic inscriptions currently available from the MHD. In analyzing these data, however, we also need to consider the potential effects of sample-size variation in the statistical techniques we employ.

Archaeologists have long recognized the relationship between sample size and diversity (Grayson 1981; Neiman 1995). We therefore need to base our diversity estimates on samples of ritual inscriptions that are drawn from the same population. To do this we first evaluate the relationship between ritual frequency and sample size based on the total number of glyph blocks recorded at each site (Figure 4). Although the

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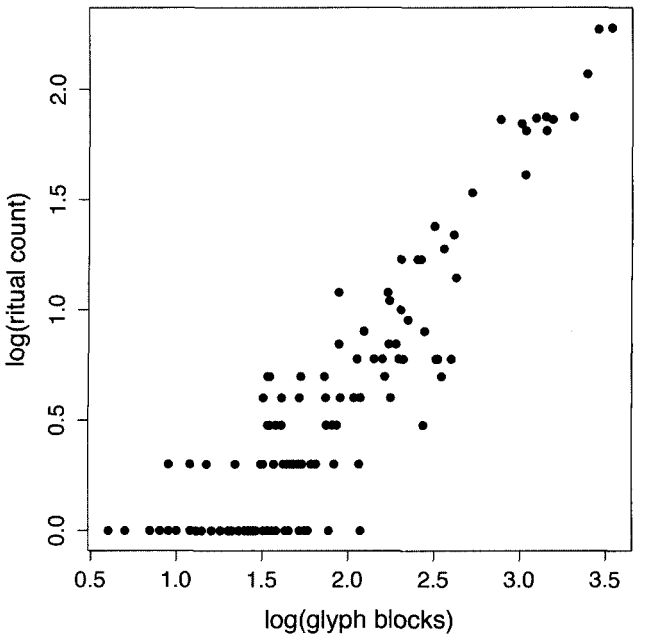

Log-log plot showing the relationship between the total number of glyph blocks and the frequency of ritual inscriptions recorded at each site (Adj. $R^2 = .91, F = 230.3, df = 22, p < .0001$). Large numbers of sites with less than 10 recorded rituals contribute to a heteroskedastic distribution.

log-linear relationship is positive, sites with fewer than 10 ritual inscriptions exhibit heteroskedasticity indicating that the variance across the number of glyph blocks in these small samples is unequal. In the following analyses, we therefore restrict our sample to sites that have at least 10 ritual inscriptions. Doing so produces a better fit in the log-log plot of ritual frequency and glyph block counts (Adj. $R^2 = .91, F = 230.3, df = 22, p < .0001$). In addition, we find three natural break points in the distribution of glyph blocks across all sites and group these accordingly into small (less than 100 glyph blocks), medium (100 to 499 glyph blocks), and large (500 or more glyph blocks) size classes to further estimate sample size effects in the analysis (Supplemental Table 2).

Ritual Diversity

Overall ritual diversity is consistently high during the Classic period (Figure 5). After accounting for sample-size variation by excluding sites with fewer than 10 rituals, we find significant differences in diversity between large- and medium-sized sites. Figure 6 compares medium and large sites, excluding small sites that have less than 100 glyph blocks since all but one of these (DZB) has more than 10 rituals. Large sites with 500 or more glyph blocks ($\bar{D} = .8786$) are significantly more diverse than sites with moderate abundance of monument inscriptions ($\bar{D} = .6567$) (Two Sample t-test: $t = 5.8972, df = 36, p < .0001$). While this suggests that ritual diversity may in part be explained by differences in the total quantity of monumental inscriptions found at each site, it also reveals that sites with moderate quantities of hieroglyphic monuments significantly contribute to our understanding of ritual variation in Classic Maya society.

Partitioning Ritual Diversity at Multiple Scales

To examine the partitioning of ritual diversity through time, space, and as a factor of sample size, we computed a set of hierarchical F-statistics (Table 1). The global fixation index F_{ST} shows that ritual differentiation between sites accounts for 12.37 percent of the total variance in ritual inscriptions. At this scale, this means that sites with more than 10 rituals record similar frequency distributions of the same royal rituals. In short, at the global scale and accounting for sampling bias, Classic Maya sites with monumental in-

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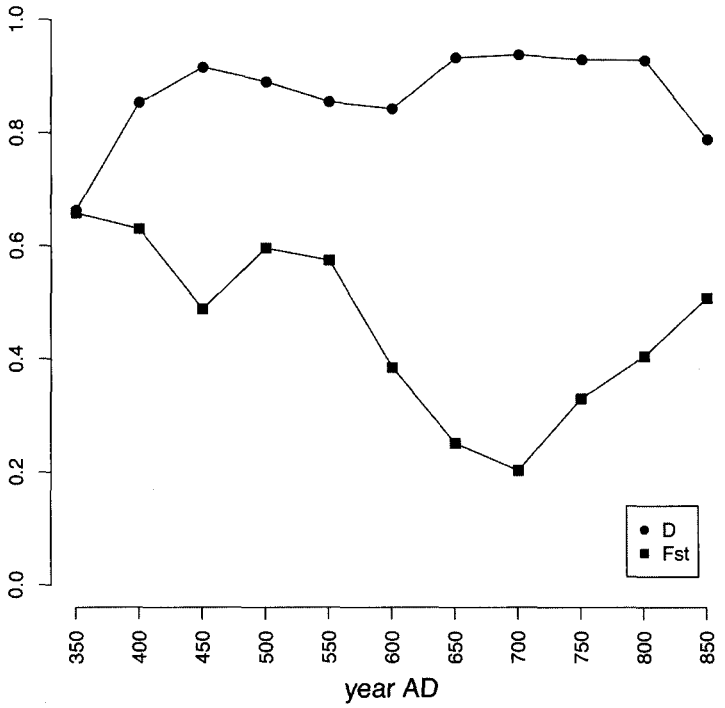

Figure 5. Ritual diversity (D) estimates and fixation index F_{ST}.

scriptions share a large percentage of ritual variation and exhibit a high degree of interaction. This F_{ST} value is slightly higher than analogous measures of population structure observed in cross-cultural and archaeological datasets discussed above (see Shennan et al. 2015:106), but is consistent with the idea of cultural coherence among communities engaged in the production of Classic Maya monumental texts. The results of Scherer's (2007) biological population structure study found an overall F_{ST} value of .018. Qualitative comparisons between these F_{ST} values follow similar trends observed by Bell et al. (2009) for cross-cultural and genetic data in which cultural F_{ST} was more than an order of magnitude larger than corresponding genetic F_{ST}.

When we consider overall fluctuations in F_{ST} through time, we see a decline in ritual differentiation during the seventh and eighth centuries (see Figure 5). Although diversity indices remain relatively stable throughout the Classic period, this decrease in F_{ST} suggests that more of the diversity is shared between sites with increasing convergence toward a similar set of ceremonial practices. It is likely that this results from increased interaction in the Late Classic period. It is notable that the dramatic increase in writing and production of hieroglyphic monuments coincides with the expansion of rulership and greater competition between Maya kings (Neiman 1997; Webster 2000).

One possible factor accounting for the high degree of shared ritual variation is the high frequency of accession ritual inscriptions in the dataset. Not only are they the most commonly recorded ritual, accession rituals are recorded at 46 out of 124 sites including those identified with small, medium, and large samples of writing in the current dataset. If we remove these dynastic statements from the analysis to consider ritual differentiation based on all other royal rites, we find a substantial increase in F_{ST} (.5832). This supports the idea that rituals other than dynastic accession rites may have been free to vary and contributed to the formation of unique community identities. Conversely, this indicates that accession rituals were common and widely shared by communities that produced hieroglyphic monuments, thus contributing to the lower levels of population structure we observe when all rituals are considered.

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Table 1. Results of the Hierarchical *F*-statistic Analyses.

Index	Scale of variation	value
F_{ST}	sites ≥ 10 rituals	.1237
F_{ST}	sites ≥ 10 rituals (Late Classic only)	.1011
Hierarchical *F*-statistics based on site size classes		
F_{SC}	within medium-sized sites (100 - 499 glyph blocks)	.1520
F_{SC}	within large-sized sites (≥ 500 glyph blocks)	.0554
F_{CT}	between site classes (med + large)	.0096
Hierarchical *F*-statistics based on geographic region		
F_{SC}	within central zone	.0636
F_{SC}	within eastern zone	.1776
F_{SC}	within northern zone	.2935
F_{SC}	within Pasión zone	.0615
F_{SC}	within southeastern zone	.0267
F_{SC}	within Usumacinta zone	.0524
F_{SC}	within western zone	.0305
F_{SC}	between geographic zones	.0323
Hierarchical *F*-statistics for accession rituals		
F_{ST}	all sites ≥ 100 glyph blocks	.6306
F_{SC}	within medium-sized sites (100 - 499 glyph blocks)	.8849
F_{SC}	within large-sized sites (≥ 500 glyph blocks)	.3345
F_{CT}	between site classes (med + large)	.7070

We can also examine how ritual variation is partitioned within and between sites of different size classes to determine whether investment in writing and production of hieroglyphic monuments is associated with greater or lesser degrees of ritual variation. There is significantly less partitioning in ritual diversity when we consider the collection of large sites (F_{SC} = .0554) in comparison to medium-sized sites (F_{SC} = .1520). The small value in F_{SC} means that about 95 percent of the ritual variation is shared among sites that recorded large quantities of monumental texts, in comparison to about 85 percent of shared ritual variation in medium-sized sites. The fixation index for large-sized sites suggests a high degree of interaction among these communities. In addition, close to 90 percent of the ritual variation between the groups of medium and large sites is shared, indicating that interaction between these groups likely contributed to a low degree of ritual differentiation.

We also computed a set of hierarchical F-statistics to evaluate geographic partitioning of ritual variation at multiple spatial scales. In this case we assigned sites to one of seven geographic regions and computed F_{SC} values within each region as well as F_{CT} to evaluate differences between the regions (Supplemental Table 2). In this case, there is very little ritual diversity that can be accounted for between regions (F_{CT} = .0323), indicating very low partitioning and a high degree of interaction among regions. Within regions, we find high levels of ritual differentiation within the Northern (F_{SC} = .2935) and Eastern (F_{SC} = .1776) regions, suggesting a greater amount of community structure within those regions. In contrast, the remaining regions show population structure of less than 6.5 percent, implying more intense interactions within the Central, Pasión, Southeastern, Usumacinta, and Western regions. Although Scherer's (2007) dataset is much smaller, the biological F_{ST} values obtained for the three geographic zones he surveyed follow similar trends in that our cultural F_{SC} values are more than an order of magnitude larger than comparable measures of biological population differentiation.

Correlations with Space, Network Distance, and Sample Size

We conducted a series of Mantel and partial Mantel tests to determine how geographic distance, network ties, and sample size effects contribute to explaining ritual differentiation between sites (Table 2). Our results show consistently positive correlations for each of these variables when assessing ritual dissimilarity for the entire dataset

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Table 2. Results of the Mantel and partial Mantel tests.

Model ID	Variables	Mantel R	95% Confid. Interval	Signif.
All sites with rituals ≥ 10				
A1	Ritual dissim. ~ geography	.3848	.2842–.4865	**
A2	Ritual dissim. ~ geography (holding sample size)	.3968	.3023–.4888	**
A3	Ritual dissim. ~ geography (holding network)	.3176	.2347–.4178	*
A4	Ritual dissim. ~ geography (holding network, sample size)	.3319	.2239–.4530	*
A5	Ritual dissim. ~ network	.3112	.2477–.3718	***
A6	Ritual dissim. ~ network (holding sample size)	.3042	.2398–.3636	***
A7	Ritual dissim. ~ network (holding geography)	.2163	.1393–.2974	**
A8	Ritual dissim. ~ network (holding geography, sample size)	.2040	.1279–.2809	**
A9	Ritual dissim. ~ sample size	.1799	.0311–.2768	*
A10	Ritual dissim. ~ sample size (holding geography)	.2075	.0708–.3035	*
A11	Ritual dissim. ~ sample size (holding network)	.1667	.00580–.2606	
A12	Ritual dissim. ~ sample size (holding network, geography)	.1945	.0445–.2959	*
Late Classic sites with rituals ≥ 10				
B1	LC Ritual dissim. ~ geography	.1592	.1281–.1914	***
B2	LC Ritual dissim. ~ geography (holding sample size)	-.1127	-.928–-.0172	
B3	LC Ritual dissim. ~ geography (holding network)	.4094	.2420–.5362	**
B4	LC Ritual dissim. ~ geography (holding network, sample size)	.4796	.3225–.6296	***
B5	LC Ritual dissim. ~ network	.2467	.1886–.2987	**
B6	LC Ritual dissim. ~ network (holding size)	.2439	.1956–.2881	*
B7	LC Ritual dissim. ~ network (holding geography)	.1077	.0368–.1837	
B8	LC Ritual dissim. ~ network (holding geography, size)	.0772	-.0176–.1411	
B9	LC Ritual dissim. ~ sample size	.4573	.2948–.5613	**
B10	LC Ritual dissim. ~ sample size (holding geography)	.4091	.2649–.4949	**
B11	LC Ritual dissim. ~ sample size (holding network)	.3341	.2286–.4466	***
B12	LC Ritual dissim. ~ sample size (holding network, geography)	.4222	.3229–.5286	***
Med. + large sites with accession rituals				
C1	Accession dissim. ~ geography	.0108	-.0324–.0554	
C2	Accession dissim. ~ geography (holding sample size)	.0127	-.0281–.0679	
C3	Accession dissim. ~ sample size	-.0510	-.1038–-.0117	
C4	Accession dissim. ~ sample size (holding geography)	-.0514	-.1065–-.0117	

Significance values: * = $p < .05$; ** = $p < .01$; *** = $p < .001$)

(A1, A5, and A9). For sites with 10 or more rituals, both geography on its own (A1) and geography accounting for sample size (A2) are strong predictors of ritual dissimilarity. Although the latter partial Mantel result is slightly higher than geography as a single effect, the 95 percent confidence intervals of these Mantel statistics overlap, so it is not possible to determine whether the models are significantly different. In order to control for the effect of time, we recalculated Mantel statistics but in this instance only included samples dated to the Late Classic period (A.D. 573–909; 9.7.0.0.0–10.4.0.0.0 in the Maya Long Count system). Here again, we find that ritual dissimilarity is significantly correlated with the three main variables of interest: distance, network ties, and sample size (B1, B5, and B9). Network ties become a significant variable in the partial Mantel result when we restrict the analysis to the Late Classic period. The strongest model effect takes into account geography holding network ties and sample size constant (B4), although again this model is not significantly different from sample size alone (B9), even though the Mantel *R* statistic is slightly higher. The equivocality of these results suggests that geography, network ties, and sample size have a complex, and perhaps collinear, relationship with each other.

Diversity and Structure of Dynastic Accession Rituals

We conducted the same analyses for a subset of the ritual dataset to examine finer grained differences in Classic Maya dynastic traditions. The subset consists of the accession rituals only but in this case we compute diversity and ritual dis-

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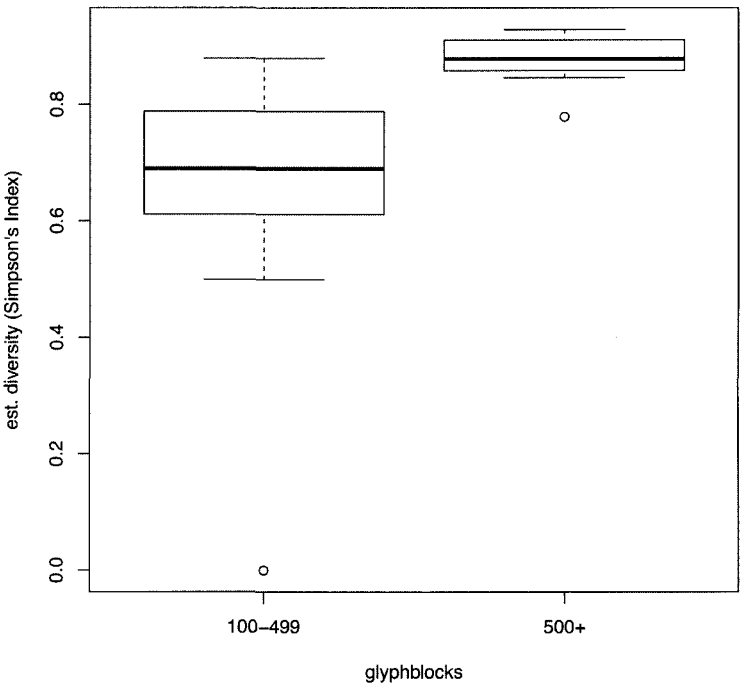

Figure 6. Pairwise comparison of diversity estimates for medium (100-499 glyph blocks) and large (≥ 500 glyph blocks) sites shows a significant difference in overall ritual diversity based on sample size.

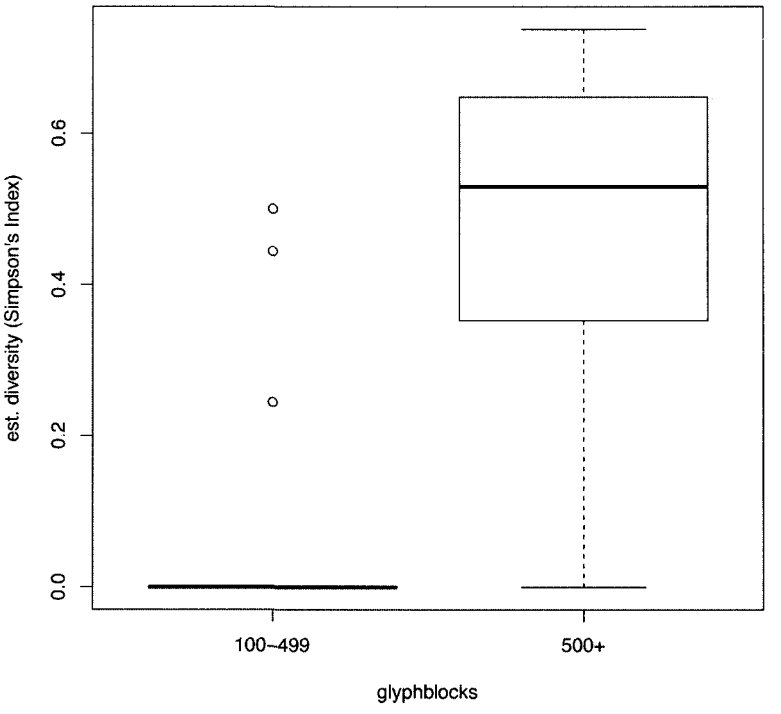

Figure 7. Pairwise comparison of diversity estimates for medium (100-499 glyph blocks) and large (≥ 500 glyph blocks) sites shows a significant difference in the variation of accession rituals based on sample size.

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similarity measures based upon their lexical expression in Classic Mayan (see Supplemental Table 1). There is a significant difference in ritual diversity between medium and large sites (Figure 7). Most sites with 100 to 499 glyph blocks only record a single type of accession ritual, whereas Piedras Negras is the only large site that does not record multiple different accession rituals, preferring instead the term *joy* documented 16 times. The high level of ritual diversity at large sites suggests that Maya rulers performed an array of dynastic rituals associated with taking office. Indeed, some kings such as Hawk Skull of Moral-Reforma, Tabasco were installed on multiple occasions (Martin 2003:45–47), while others repeatedly celebrated the anniversary of their accession, commemorating these events in writing.

There is considerable ritual differentiation between sites when we examine the subset of accession rituals (see Table 1). The large F_{ST} value may result from the fact that there are only six different accession rituals. This becomes clear when we examine the hierarchical F-statistics based on site size. The large F_{SC} value for medium-sized sites is a result of the fact that these communities only recorded a single type of accession ritual, and it becomes apparent from this analysis that those accession rituals were not widely shared. The F_{SC} value for large sites is lower (.3345) but is still about three orders of magnitude greater than the overall F_{ST} for all rituals. Such high levels of ritual differentiation suggest significant cultural divergence and little interaction across this domain. The types of accession rituals Maya rulers performed, and subsequently recorded, points to a preference for selecting novel terms that differentiate individual rulers while participating in this Classic Maya dynastic tradition.

Discussion

The case study presented here shows how the application of diversity measures that quantify ritual differentiation at multiple scales can reveal variation and divergence in past cultural traditions. We now discuss the results in terms of three overarching themes: (1) revised understandings about Classic Maya elite rituals, (2) substantive contributions to understanding the population structure of cultural diversity within groups, and (3) advantages of combining interdisciplinary theoretical and methodological perspectives to further scientific understanding of past cultural diversity.

Classic Maya Elite Rituals

The substantial amount of previous research on Classic Maya writing provided the opportunity to assemble an unprecedented database of hieroglyphic inscriptions that facilitates systematic analyses of these records. Ritual events inscribed on dated and provenienced monuments offer a unique dataset to extrapolate information about the cultural traditions of elite individuals. The strong relationship between ritual diversity and sample size empirically falsifies the notion that Classic Maya royal rituals represent a culturally coherent elite tradition. That is, if we base our inferences on samples drawn only from the sites with the largest hieroglyphic records, we are apt to see a fairly unified dynastic tradition in which Maya rulers are primarily ceremonial specialists performing a wide array of rites. Nonetheless, after examining the population structure of cultural diversity with *F*-statistics, a more fragmented ritual landscape emerges. The main point is that we need to take into account smaller sites with moderate amounts of inscriptions in order to make generalizable claims about Classic Maya dynastic traditions based on the epigraphic record.

A second and related outcome calls into question the structural and functional similarity of Classic Maya rituals proposed by Lucero (2003). Although this dataset cannot evaluate the degree to which elite rituals emerged from and simply amplified commoner rituals performed in the domestic sphere, our results reveal discrete differences in the intensity and diversity of royal rites recorded at medium and large Maya centers. Instead of focusing on the form or meaning of rituals, the approach taken here coded and grouped references to ritual actions recorded in their indigenous verbal forms into a maximal number of categories to examine a much wider array of elite rites than has been previously studied. This dataset identifies many of the same important ceremonies described by Stuart (2005), but by scaling the terms in this way allows us to distinguish different levels of variation across Maya society. For example, when we consider the full dataset, acces-

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sion rituals are not only the most common inscribed dynastic rite, but appear to be the social practice that both solidifies our notion of "Classic Maya" as a cultural category and serves to signal differences in power and class within the royal sphere itself. Analyzed at a finer scale, we observe divergence in these dynastic traditions based on the structure of accession ritual variation. It is possible that dynastic rites signaled differences in social identity between rulers vying for power in political contests. Alternative hypotheses should consider whether different accession rituals were regionally specific or gained popularity at varying rates. Future work will also need to consider how accession rituals spread and examine the relationships between sites to determine the degree of shared dynastic traditions.

Within-Group Cultural Variation

There are several substantive results from our multiscalar analyses of ritual variation, which inform current research on the population structure of cultural diversity. Anthropologists and archaeologists studying cultural evolution have found that cultural complexity scales with population size (Collard et al. 2012; Henrich 2004; Kline and Boyd 2010; Powell et al. 2009; Richerson 2013; Shennan 2001). That is, the accumulation of technologically complex tools and tasks can, at least in part, be explained by large group size based on computer simulation and cross-cultural studies. Nonetheless, there have been few archaeological studies that directly test this hypothesis with empirical data (Eerkens and Lipo 2007:264), and in general, even fewer applications of cultural evolutionary approaches to Maya archaeology. The results of our study find some support for the idea that effective population size, based on proxy measures of scribal output, are positively correlated with ritual diversity. An important yet often over-looked dimension to the emergence of social complexity rests on the degree to which groups are integrated (Feinman 2013), which has implications for how archaeologists estimate demographic factors. Future research is needed to determine whether increased network interactions during the Late Classic period contribute to the transmission of ritual practices and conformity to specific sets of royal rites as suggested by changes in F_{ST} through time. As a starting point, this study demonstrates that methods and theories adapted from the cultural evolution literature can be applied to epigraphic data to inform our understanding of cultural diversity within past complex societies.

Secondly, and perhaps more importantly, cultural evolutionary perspectives would benefit from more of these kinds of investigations to aid in refining their theories and developing models that explicitly address complex issues of power, identity, and inequality. To date, most studies emphasize diversity *between* cultures, and downplay or ignore the inherent richness of cultural forms that exist within single societies (Foley and Mirazón Lahr 2011; Rzeszutek et al. 2012). Owing to strong constraints on mutual intelligibility, language is recognized as a cultural trait that is mostly variable between, rather than within, speech communities (Newson et al. 2007). Nonetheless, focusing on lexical variation within a restricted domain of written texts affords an opportunity to investigate patterns of variation within specified subsets of Classic Maya society. In particular, this study shows that one of the strongest factors influencing the structure of ritual variation during the Late Classic period has to do with the underlying sociopolitical organization. Additional research in this vein should consider other sources of variation (e.g., artifact, biological, and linguistic) and how these intersect along multiple dimensions.

As discussed above, this study's explicit focus on identifying, measuring, and explaining ritual variation moves us closer to understanding the degree of cultural coherence within Classic Maya society. Restricting our studies to the central tendencies of artifact variation or past social practice limit the explanatory power of archaeological narratives (Eerkens and Lipo 2007:262–263). A direct consequence of this approach is the intuitive uneasiness associated with such essentialized categories of "culture" and "identity." Rather than emphasizing the central tendencies of ritual practice, the goal of this project concentrates on the dispersion of specific linguistic traits to develop more detailed understanding of ritual diversity during the Classic period. Moreover, our multilevel analysis of variation within a single class of rituals reveals how diversity can be partitioned at multiple social scales.

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Integrating Diverse Perspectives

The challenge to analyze the relational dynamics of shared culture underscores a major theme in debates about the use of explanatory frameworks within the discipline (O'Brien and Lyman 2004; Pauketat 2004). While it is generally agreed that material culture change, variation, and continuity form the core subject matter of archaeology, there are a number of different approaches to investigate the manifestation and relationship between these apparent paradoxical phenomena. One viewpoint claims that contemporary cultural evolutionary theory (vis-à-vis Boyd and Richerson 1985) offers convincing and rigorous accounts for explaining empirical patterns of stability and change in the material record (cf. Shennan 2011). Others support theoretical plurality through interpretative frameworks that range from narrative accounts of reading the past to self-reflexive perspectives that actively write the past (Hodder and Hutson 2003; Tilley 1989). Still others place greater emphasis on what people *do* (Joyce and Lopiparo 2005; Pauketat 2001), and examine particular social practices at variable temporal scales (Robb and Pauketat 2013). To the extent that history plays an important role in explaining artifact patterning as well as the actions, ideals, and materiality of past social agents, a more unified approach should be feasible. Although recent attempts have aimed to bridge this dialectical divide by synthesizing important cross-cutting themes in archaeological research (Cochrane and Gardner 2011), calls for such an integrated approach deserve empirical calibration. Contributing toward this goal, we bring together diverse perspectives and interdisciplinary methods to investigate the formation and divergence of Classic Maya ritual traditions.

The interdisciplinary perspectives that contribute to this study produce useful insights for the future integration of theoretical and methodological approaches in archaeology. This empirical research draws upon and benefits from the collaborative efforts of multiple scholars based in diverse disciplines working towards common goals. In order to expand our understanding of cultural variation in the past, archaeologists need to draw upon the insights and expertise of researchers in related domains as well as make use of the full range of relevant theories and tools that contribute to this area of research. Kristiansen (2004, 2014) is optimistic about overcoming theoretical divides in archaeology, and in his recent paper describes progress towards this goal through new developments linked to two areas relevant to the current study: big data and quantification. Results of this research demonstrate the power to derive empirically tested inferences by systematically analyzing a large body of hieroglyphic texts. Importantly, we operationalize a practice-based concern for measuring the diversity of cultural schemes and styles of ritualization using methods that are explicitly designed to do this and that take into consideration the multiscalar complexity of past human experience. Our hope is that this study opens up the possibility for the type of productive, theoretically integrated, and methodologically rigorous archaeological research Kristiansen (2014) espouses.

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Data Availability Statement. The list of sites, rituals, and frequencies used in the current study is published online in Supplemental Tables 1 and 2. For additional information and inquiries about the Maya Hieroglyphic Database, please contact ML.

Supplemental Materials. Supplemental materials are linked to the online version of this article, which is accessible via the SAA member login at www.saa.org/members-login.

Supplemental Table 1. Listing of all rituals included in the extant dataset including the verbal root form expressed in Classic Mayan with supporting translation and bibliographic information.

Supplemental Table 2. Listing of all sites included in the extant dataset along with the frequency of ritual inscriptions and legible glyph blocks recorded on monumental texts at each site.

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Note

1. Though we only consider historically dated ritual inscriptions in our sample to maximally ensure significance in both the social and historical realms.

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