Design Divergence: A Comparative Study of Pottery Designs from Chaco Canyon and the Northern Rio Grande

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Chapter 1 – Introduction

Introduction

The Ancient Puebloan society of Chaco Canyon was located in the San Juan Basin of New Mexico and is the center of much archaeological inquiry (Lekson 2015). Outside of the canyon's border, aspects of Chacoan life are identifiable (Lekson 2015). . Features of Chacoan society spread to other communities by way of the Chaco Phenomenon (Mills 2002). Chacoan outliers, a product of the Chaco Phenomenon, extend approximately 250 kilometers from the center of Chaco (Lekson 2015, 26). As seen in Figure 1, Chaco Canyon was not the only large settlement in New Mexico from 850 C.E. to 1125 C.E. (Lekson 2015, 58). Archaeologists still debate the impact of the Chaco Phenomenon on the Northern Rio Grande. There is some evidence of interaction and similarities in material culture between the two areas. However, archaeologists are still working to understand the impact of the Chaco Phenomenon on the people of the Northern Rio Grande.

Archaeologists study the different painted designs exhibited on ceramics in order to learn about and increase scholarly knowledge about the social or cultural values of their makers (Conkey and Hastorf 1990). For example, similar stylistic choices present on pottery sherds can be used to link groups together or suggest an interaction between them (Plog 1980, Washburn et al. 2010). Archaeologists have extensively and continuously investigated how social behaviors manifest themselves on pottery (Hill 1970, Washburn and Webster 2006).

My thesis research project grapples with the potential of ceramics to provide information on the interaction between societies. This project analyzes excavated pottery from the Pojoaque Grant Site (LA 835) and compares the occurrence of design elements on these pottery sherds

Figure 1. A map of settlements in the Southwest with the approximate location of LA 835 represented by a blue circle (Editors of Encyclopaedia Britannica 2019).

with design elements recorded for sherds found at contemporaneous sites in Chaco Canyon. Both of the areas featured in my analysis are located in the American Southwest and had overlapping occupation periods. The object of the inquiry is to better understand relations between Chaco and the Northern Rio Grande through a careful study of the designs present on sherds. Identifying and comparing the frequencies of design elements on ceramic potsherds from these two regions will allow me to determine the strength of social connections between the people of Chaco Canyon and the Northern Rio Grande. In other words, I am using data from the Pojoaque Grant Site and Chaco Canyon to understand the dimension of their social relationship across time. More broadly, my thesis also examines how design elements on pottery are used in archaeology to evaluate potential social interactions.

My thesis is grounded in archaeological scholarship and theory about how style can provide useful information about the social interactions between groups in the past. My project, therefore, focuses on understanding the stylistic choices potters made, in relation to their social affiliations. Using ceramic analysis as a means of understanding social interactions, I worked to understand how the relationships between Chaco and the Northern Rio Grande changed over time.

Chaco Canyon and the Chaco Regional System

In the following section, I review aspects of the Chacoan Regional System that are relevant for understanding its relationship with the Northern Rio Grande. Chaco was home to Ancestral Puebloans from 850 C.E. to 1125 C.E. (Lekson 2015, 58). By the 11th century, Chaco had become the first regional center in the northern Southwest (Lekson 2015, 55). Chaco Canyon comprises several monumental structures that connect socially to outlying settlements.

Consistent with 11th century Puebloans elsewhere, approximately half of the 2,500 to 3,000 residents of Chaco lived in single-family homes, often referred to as *unit pueblos*, that consist of "five or six stone masonry rooms and a kiva" (Lekson 2015, 7). Chaco Canyon was home to a society that was marked by its distinctive "architecture, roads, and the presence of Cibola ceramics" (Toll et al. 2001, 148). Overall, Chaco was a complex society that is still not fully understood by archaeologists.

Great houses, "large sandstone masonry buildings, remarkable for their scale, formality, and craftmanship" (Lekson 2015, 7), were a distinctive feature of Chacoan society. For the most part, the rooms in these structures were not residential (Lekson 2015, 11). However, when great houses were inhabited, they appear to have been occupied by elite members of Chacoan society (Lekson 2015, 11). At the end of the 9th century and the beginning of the 10th century, the buildings at Chaco began to expand in size (Plog et al. 2017, 2). Great houses at Chaco were larger than contemporaneous settlements in the Puebloan world (Mills 2002, 65).

Characterized by their multiple stories, large size, substantial planning effort, and specific masonry styles, Chacoan structures are identifiable to scholars (Mills 2002, 68). The Bonito Phase is identifiable in Chacoan outlier settlements due to the distinctive features of great houses (Mills 2002, 81). The 11th century in Chaco marked the expansions of great houses constructed before the 11th century and the erection of new great houses (Plog et al. 2017, 2). The construction of great houses coincided with a "downturn in environmental conditions" in the area (Mills 2002, 75). By the early 12th century, over a dozen great houses were constructed, and 1130 C.E. marked the end of the building and expansion of the great houses (Plog et al. 2017, 3). The presence of great houses on the Chacoan landscape reflects the larger patterns of social organization in the Chacoan world.

Outliers signify that Chaco was at the center of a regional system (Lekson 2015, 26). Chacoan outliers varied, displaying different characteristics depending on their level of integration into the Chacoan world (Lekson 2015, 28). The distribution of Chacoan aspects of life across the Southwest may also indicate the spread of Chaco forms of religion or cosmology (Plog et al. 2017, 13). Besides Chacoan-style great houses, communities in the San Juan Basin (and possibly beyond) displayed other forms of connection to Chaco, although the degree of contact is not precise (Mills 2002, 66). Within the Chaco Halo, the outlier communities located in an oval shape around Pueblo Bonito inside Chaco Canyon, there were "significantly fewer kivas," and connections between Chaco and these outliers were also suggested by "their density and the fact that many of them have equally high proportions of nonlocal materials as sites in the central canyon itself," (Mills 2002, 94). Individual outliers displayed more connection to Chaco than others (Mills 2002, 81). Overall, Chaco's extension beyond the boundaries of the canyon signifies a larger social arrangement of influence and interaction.

My thesis intends to contribute to the discussion in Southwestern Archaeology about the relationship between the Chacoan world and the Northern Rio Grande. One assumption this research project relies on is that designs on pottery play an essential role in understanding patterns of social interaction. There is a debate in Southwestern Archaeology concerning the extent to which people from the Northern Rio Grande were associated with the Chacoan world. This debate is ongoing, and my research project offers a new line of evidence that can help advance our understanding of why people of the Rio Grande did not conform to the social structure of the Chacoan world. While early pottery of the Northern Rio Grande has traditionally been classified as part of the same style as contemporary Chacoan pottery, to date, there has been no attempt to measure whether the styles of these two areas diverged in subsequent centuries,

and, if so, by how much. My thesis aims to answer these previously unexplored questions, and more broadly, to contribute to the archaeological understanding of changes in social interaction between the Northern Rio Grande and the Chacoan world over time, as indicated by details of pottery decoration.

Overview of Thesis Chapters

This thesis is divided into five chapters, including this introduction, which is the first chapter. My second chapter is dedicated to the discussion of the relevant literature for the Northern Rio Grande and Chaco Canyon. We will see that existing scholarship is not clear on the nature of the interaction between these two regions. My project directly addresses this gap in the literature by carefully examining the potential relations that people from these areas may have had with one another. The role of designs and other aspects of style for understanding social interaction between groups is another relevant section of my literature review. Overall, the second chapter contextualizes my research within the discipline.

Chapter Three delves into the methods I used for this research and discusses other studies that contain relevant references to methods related to those I employed. I detail the process I followed to record the design elements present on sherds from LA 835. This chapter also describes the process by which I constructed various ways of grouping designs, and what the four attempts at grouping represent. Finally, Chapter Three explains my use of the Brainerd-Robinson Coefficient to analyze the data. Associated constraints and limitations of my methods are also included in this chapter.

I discuss my results in Chapter Four, where I present results from the raw data and various groupings of the data. My findings suggest that the design systems of the Northern Rio

Grande and Chaco Canyon were initially very similar. Still, they diverged over time with the adaption of differing pottery types. I argue that these findings support the idea that a social boundary developed between the two regions during the Chacoan era.

In Chapter Five, which is the conclusion of my thesis, I discuss what my results revealed and what they mean for my research questions. This project attempted to interpret social relations between people of the Northern Rio Grande, specifically the site of the Pojoaque Grant Site, to those in Chaco Canyon. My conclusion also outlines directions for future research that could further develop our understanding of the complexities of social relations into the past.

Chapter 2 – Literature Review

Introduction

This chapter covers the literature relevant to my study. Throughout the chapter, I present information on previous studies that provide the foundation from which I am drawing my theories of understanding. I discuss how the relationship between Chaco and the Pojoaque Grant Site is understood and how that understanding could be enriched by taking a deeper look at the complex relationship between the people who inhabited these places. This review concludes with the discussion on how archaeologists understand how ceramics can indicate the presence of social boundaries and relations. This will ultimately relate to how I am applying these theories throughout my analysis.

Chaco Canyon

Chaco Canyon is one of the central pieces of this study. There is debate among Southwestern archaeologists as to the purpose or function of Chaco Canyon. One perspective is that the canyon was a pilgrimage site or ceremonial center. Another view supports that Chaco was a "centralized political system" and functioned in a similar capacity to a state (Mills 2002, 78). Recently the discussion turned to the idea that the Chaco system was not "ruled by a centralized polity" or just a pilgrimage site (Mills 2002, 78). Still, a hierarchal system was nevertheless present a Chaco and potentially tied to a ritual or ceremonial dimension of life (Mills 2002, 92). The dominant anthropological narrative often categorizes Chaco as "a center for sociopolitical, economic, and ideological influence throughout the Ancient Puebloan world during the 9th through 12th centuries" (Weiner 2018, 38). Although many aspects of Chacoan life

are debated among specialists, the understanding of Chaco as a major social center is agreed upon.

Chaco is thought to have formed as a society "as early as the late 9th century" (Toll et al. 2001, 148). The Pueblo II period potentially had more movement and interaction between groups. It increased population densities, which some argue created localization of pottery types, but they see more similarities on a bigger scale. The society is thought to have "a bilocal residence pattern more similar to Rio Grande Pueblos" (Mills 2002, 91). Certain Pueblo groups established themselves "in reaction to and rejection of Chaco" (Lekson 2015, 36). Chaco potentially had a higher population density than other areas of the Northern Southwest (Plog et al. 2017, 8). The details of Chaco, as it pertains to my study, will be discussed throughout the chapter.

Chaco was a hierarchical society where to societal hierarchy involved religion and the exchange of exotic goods. It is important to detail the hierarchical structure of Chaco to understanding their social behavior and engagement in trade. Chaco can be distinguished from other areas based on several attributes that reflect the hierarchical nature of the site and its extensive trade network. The presence of the luxury good turquoise at Chaco, at a higher rate "than any other region of the Southwest," is a possible indicator of trade or the distribution prestige goods (Plog et al. 2017, 3). The trade network of Chaco imported several exotic goods. This exchange network becomes important to this study in particular when the trade network extended into the Northern Rio Grande.

The Unclear Components of Northern Rio Grande Archaeology

This section covers some general information on the American Southwest; however, it will focus on the contextualization of Chaco and the Pojoaque Grant Site as well as their relation

to other areas. The sourcing of turquoise will also be discussed in this section in terms of the potential for interaction between the two regions. Ceramic sourcing is another topic that will be discussed in this subsection. The information presented in this section is necessary to understand the analyses that follow.

Mills and Crown's (1995) edition covers several lines of ceramic production in the Southwest as a whole. Cross-cultural research by Clark and Parry (1990) established that measurements of social complexity covary with the "intensification of craft production" in the Southwest (Mills and Crown 1995, 4). Specialized pottery the Southwest developed around 575 C.E. – 725 C.E. in the Basketmaker III period (Mills and Crown 1995, 12). Across the Southwest, white ware vessel's primary functions were to serve or store goods (Mills and Crown 1995, 66). Due to white wares being produced as a household industry, there was variation in vessels due to specialization across the broad area (Mills and Crown 1995, 77-78). Understanding white ware production in the Southwest is relevant to my study of ceramics, as these pottery types are central to my research project.

Ceramics are a way of examining Chacoan interaction with external sources. Ceramics were brought into Chaco from outside sources during the Bonito Phase, during which they accounted for more ceramics in Chaco than those locally produced (Mills 2002, 85). Mills references a study conducted by Toll (2001) that estimates at least half of the white wares were made beyond the confines of Chaco Canyon (Mills 2002, 85). Within their work, they also acknowledge the regional differences or distinction of ceramics within Chaco. The distinctions on designs across the region are important to acknowledge because the variation they display allows archaeologists to trace the social uses of designs.

Harry (2005) delves into the relationship between craft specialization and living conditions. The study is evaluating how craft specialization is related to "poverty and inadequate agricultural yields" (Harry 2005, 313). This project suggested that ceramic specialization potentially led to the marginalization of certain people in societies from the capitalist economy (Harry 2005, 313). Beyond economics, the project connects specialization to agriculture. The piece suggests that specialization in small-scale societies is often observed alongside agricultural marginality (Harry 2005, 295). In the Southwest, the specialization of pottery production is tied to the individuals who did not have access to land suitable for agriculture (Harry 2005, 296). The project also addresses the two relevant geographic areas to my study, Chaco Canyon and the Rio Grande. In regards to Chaco Canyon, the study shows that much of the pottery consumed in Chaco Canyon was imported from the Chuska mountains, outside the boundaries of Chaco (Harry 2005, 305). Harry relates ceramics to larger social experiences that are relevant to consider when studying the interactions of populations.

The connection between Chaco Canyon and the Rio Grande can potentially be gleaned from studying the circulation of material goods. Hull et al. (2014) used chemical isotope ratios to understand where materials were sourced from to understand the trade routes used to move goods into Chaco Canyon. Turquoise was found in high quantities in Chaco Canyon, even though "the nearest known source of turquoise is over 200 km" away (Hull et al. 2014, 187). The nearest site was the Cerrillos Hills near Santa Fe, New Mexico (Hull et al. 2014, 187). Turquoise came from several other states in addition to New Mexico; however, the site near Santa Fe is of interest because of its proximity to LA 835. Evidence shows that occupants of Pueblo Bonito had connections to those "along the Rio Grande Rift" through networks created by the turquoise trade (Hull et al. 2014, 193). Ceramics from the San Juan Basin displayed "Chacoan attributes"

that serve as another avenue of connection from Chaco to beyond its outliers (Hull et al. 2014, 190). Several lines of material culture can be analyzed to illuminate historical trade routes.

The Chacoan and Rio Grande interaction due to turquoise is important to discuss in terms of my project. Occupation of the Rio Grande Valley began around 900 C.E. (Bernstein and Ortman 2020). If Chacoan people regularly visited the Rio Grande Valley, it is interesting to consider why the major settlements of the Rio Grande did not come to resemble Chacoan outliers. The Bronze Trail Site Group is an important area, and here I examine its importance related to turquoise use in New Mexico. This group is located southeast of the Cerrillos Hills and is comprised of five pueblos and several artifact assemblages that yielded several materials used to work with turquoise, including lapidary stones and mining tools (Darling and Wiseman 1986, 116; 117; 122). These sites have little archaeological evidence of agricultural activity, which potentially suggests their use as quarters for mining activities (Darling and Wiseman 1986, 134). Darling and Wiseman (1986) also mention that LA 835 and Arroyo Negro (LA 114) are "anomalously large sites" in proximity to the Bronze Trail Site Group (Darling and Wiseman 1986, 129). The vast turquoise assemblages associated with Chaco Canyon have important implications for the interaction with the Northern Rio Grande indicating an established trade network set up between the two regions

Carroll (1995) discusses aspects of the Rio Grande and Chaco intersection and distinctions. Imported goods were another discussion in Carroll's work, including the trade of turquoise, macaws, and shells as part of the Chacoan world (Carroll 1995, 85). Carroll calls LA 835 a Chaco outlier (Carroll 1995, 83). This is something other scholars have not commented on and is not part of the general discourse of Chaco's extent in the Rio Grande. Carroll makes this connection due to the presence of a great kiva. However, the part of Carroll's work concerning

LA 835 that is most likely true is that the people of the Pojoaque Grant Site had involvement with Chaco through trade. Although I do not agree that LA 835 is a Chacoan outlier, the site was likely connected to Chaco through trade, as the evidence discussed below suggests.

The importance of turquoise is also relevant to discuss. It can hold "a prominent place in Pueblo myth, ritual aesthetics, and cosmology" (Hedquist 2016, 210). Turquoise also can be representative of the "color of winter," masculinity, and serve as a "metaphor for moisture" in some of the Pueblo traditions (Hedquist 2016, 210). The article also discusses where several sources of turquoise used by those in the Southwest originated. Two of the inhabitants of the place of the Southwest got their turquoise from includes the Cerrillos Hills in New Mexico and Canyon Creek in Arizona. Understanding the role turquoise played in Chacoan life is essential for understanding why people seek it out even though it was sourced from areas far beyond the Chacoan outlier community.

The Chaco Canyon Project

Introduction to the Project

The Chaco Canyon Project collected the Chacoan data used in my research project. John M. Corbett spearheaded the early effort to create and execute the Chaco Project to understand the area (Frazier 1986, 85). One of the major projects was to identify roads and other archaeological indicators of settlements (Frazier 1986, 128). The survey of the outliers was conducted in 1976 (Frazier 1986, 136). Across the 26,000 square miles of the San Juan Basin, Chacoan settlements were identified by the group (Frazier 1986, 171). By 1983, the Chaco Project had finished its data collection and marked one of the largest ventures conducted at Chaco at the time.

Mathien 1997

Mathien's efforts detailed in *Ceramics, Lithics, and Ornaments of Chaco Canyon Volume I. Ceramics* are the foundation for my entire study. The excavated pottery was collected using a sort or bulk sample (Mathien 1997, 22). This sample covers an assemblage dating approximately to A.D. 950 to 1150 (Mathien 1997, 32). The sites included in this sample are specified in Mathien's (1997) Table 1.2 (Mathien 1997, 7-8). The sites are 29SJ 299, 29SJ 389 (Pueblo Alto), 29SJ 423, 29SJ 627, 29SJ 628, 29SJ 629 (Spadefoot Toad Site), 29SJ 633 (Eleventh Hour Site), 29SJ 721, 29SJ 724, 29SJ 1360, and 29SJ 1659 (Shabik'eshchee Village) (Mathien 1997, 7-8). This particular part of the Chaco Canyon Project began in 1971 "with a sample transect survey, followed by a complete survey of the monument, plus tests and excavations at numerous sites between 1973 and 1979" (Mathien 1997, 1). In Mathien's (1997, 5-6) Table 1.1, all of the site's tests in Chaco canyon are recorded. The data displayed in tables throughout the volume primarily shows information derived from primarily rim sherds as part of the "detailed analysis sample," though the sample also included body sherds (Mathien 1997, 22). When possible, people in the field tried to find full vessels or piece together sherds, and then they counted the pieces as a single item. The study covered several forms of vessels that are bowls, ladles, jars, ollas, pitcher, seed jars, tecomates, canteens, duck pots, miniatures, effigies, mugs, cylinder jars, and vessels that could not be identified. The temper of a sherd can be used to identify production place (Mathien 199, 123). Surface characteristics also can enlighten archaeologists as to where the ceramics were imported from (Mathien 1997, 123). The presence of carbon paint also indicates the place of production. These attributes help archaeologists place the source materials used for the production of ceramics to understand where ceramics originated and the extent of trade networks. I selected the majority of my methods and the framework for my project based on the information presented in Chacoan ceramic literature.

The Pojoaque Grant Site

The Pojoaque Grant Site is a "Late Developmental period site in the Tewa Basin" (Boyer and Lakatos 2000, 94). LA 835 was an Ancestral Pojoaque site that is estimated to have been occupied from approximately 900 C.E. to 1150 C.E. (Boyer and Lakatos 2000, 39). The site was dated by evaluating the ceramics present along with tree-ring data, which have been reported by Wiseman (1995). Red Mesa Black-on-white and Kwahe'e Black-on-white were indicators of occupation across the areas of LA 835 (Boyer and Lakatos 2000, 98). LA 835 is located north of Santa Fe, New Mexico along U.S. Highway 285 (Stubbs 1954, 43). Today, the closest Pueblo to the Pojoaque Grant Site is Pojoaque Pueblo. The ancestral language of Tewa is still spoken in Pojoaque. This site was likely inhabited by ancestors of present-day Pojoaque Pueblo, although whether the inhabitants considered themselves to be Tewa people at the time is debatable (Ortman 2012). Tewa people are a cultural group that exists within the broader Pueblo category and have their unique cultural system.

It is important to note the cultural and social history of the Pojoaque Grant Site. LA 835 was home to ancestors of Pojoaque people who inhabited the region since A.D. 900 (Bernstein and Ortman 2020, 3). The people of Pojoaque, past and present, are Tewa people. Even though LA 835 does not have an associated Tewa name, the residents of the settlement are almost certainly Pojoaque ancestors (Bernstein and Ortman 2020, 25). The ancestral Pojoaque sites were comprised of "clustered family residences" (Bernstein and Ortman 2020, 25). The Pojoaque Grant Site was no longer inhabited by "the late 13th century" when a large number of people from the northern Southwest moved into the Tewa Basin (Bernstein and Ortman 2020, 25). The social background of those inhabiting LA 835 is reflected in the archaeological remains and current social understandings of the site.

Ortman (2012) provides background on archeological sites in the Northern Rio Grande. Information on the Stubbs (1954) excavation was also referenced in this piece and is relevant to discuss how the Stubbs excavation is understood in the context of the work conducted at LA 835. During Stubbs' 1954 excavation, two small pueblos were excavated. These pueblos were occupied in different periods. The first one was inhabited during A.D. 900 to 1050 and the second during the following period from 1050 to A.D. 1200 (Ortman 2012, 63). Ortman's book also considers a linguistic dimension when providing information on how Tewa people understand the Pojoaque Grant Site. Specifically, he found that sites that were abandoned during the Late Developmental period, such as LA 835, do not have Tewa names (Ortman 2012, 184). In contrast, several sites that were occupied continuously from the Late Developmental period into the Coalition period, including K'uuyemugeh and P'osuwaegeh, are associated with Tewa names (Ortman 2012, 184). This presentation of LA 835 in this study contextualizes the site within the Rio Grande and includes a cultural context in the analysis.

An important aspect of the Pojoaque Grant Site is that, despite being occupied during the prime of Chaco, there is no great house at the Pojoaque Grant Site, or anywhere else in the Northern Rio Grande for that matter. This distinction raises the question of whether Northern Rio Grande people participated in the Chacoan Regional System. Due to its occupation period and prominence as the largest site in the region at the time, the Pojoaque Grant Site is crucial for answering this question.

Previous Research at the Pojoaque Grant Site

This section is dedicated to presenting relevant information on the Northern Rio Grande with a focus on LA 835. With the material presented in this section, the Pojoaque Grant Site will

be understood in a regional and archeological context. Presenting the archaeological understanding of LA 835 shows where my research will fit into the present discussion.

Understandings of LA 835 have evolved along with archaeological investigations. At the time of Stubbs's excavation of the site in the 1950s, the site was thought to contain "12 to 15 small house groups scattered along low ridges" (Stubbs 1954, 43). The Stubbs excavations can be seen in Figure 2. Several kivas, including a great kiva, were also recorded at that time. Later analysis of the site revealed that some of the details that Stubbs recorded were incorrect. The Bureau of Indian Affairs resurveyed the site in 1999 and concluded that there were 21 house groups instead (Boyer and Lakatos 2000, 41). Stubbs also assumed that the pottery found in his excavations dated from was from the Pueblo I-II or Chaco I-II periods and was primarily locally made (Stubbs 1954, 45). However, later analysis revealed that the Tewa White Ware series, "characterized by fine dark paste with tuff or ash temper long employed in the Northern Rio Grande," was present at the site with Kwahe'e Black-on-white being the prime pottery type in the series (Boyer and Lakatos 2000, 92). The understanding of LA 835 continues to evolve as more work is conducted on the site.

Wiseman (1995) re-evaluated LA 835 by comparing tree ring data to ceramics to address previous conceptions of occupation based on ceramics alone. Wiseman looked at 222 tree-rings that were dated from LA 835 and showed the site was occupied earlier than was previously thought to have been, and it altered the narrative of the Rio Grande's relationship to the Four Corners area (Wiseman 1995, 237). This examination revealed that all the datable trees examined in this study were cut after 1000 C.E. (Wiseman 1995, 237). Alongside dendrochronology, the study examined ceramics. Ceramics found at LA 835 were primarily of the utility ware variety made in the Rio Grande (Wiseman 1995, 240 and 243). Pueblo A and

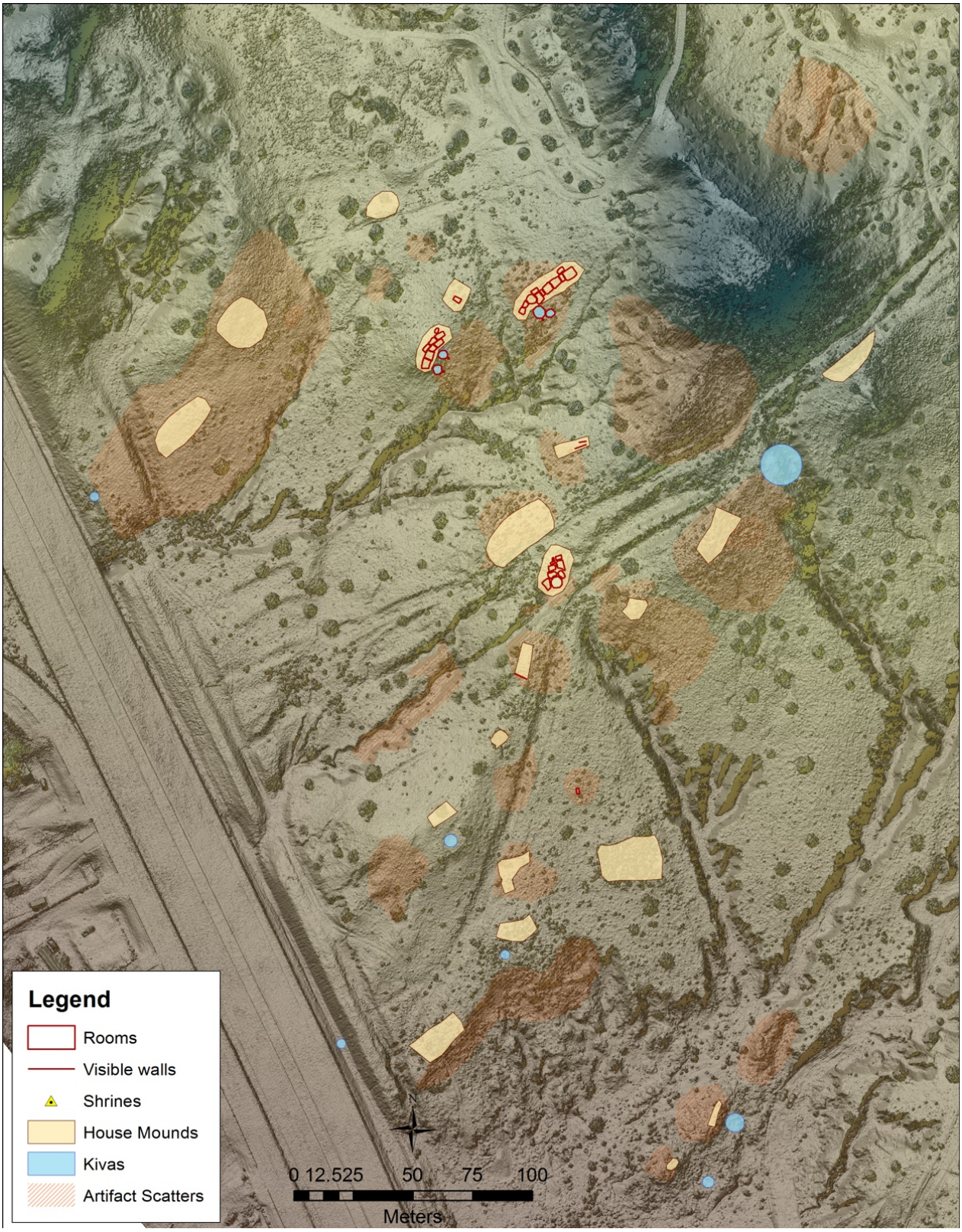


Figure 2. Map of the architectural features at LA 835. Stubbs' excavations are outlined in red (Figure courtesy of Scott Ortman).

Pueblo B both were found to have "Red Mesa Black – on – white with middle and late design styles" (Wiseman 1995, 244). The article posits that LA 835 is an example of the transmission of cultural traits from the Four Corners to the Rio Grande (Wiseman 1995, 237-238). Wiseman's work at LA 835 thus reframed the conception of its occupation.

The Wiseman study also discusses the definitions of the periods that are relevant to the sites discussed in the study. According to Dickson (1979), there are several sub-periods within the Developmental period (Wiseman 1995, 238). The Middle Developmental Period (900 C.E.-1000 C.E.) has Red Mesa Black-on-white as a diagnostic pottery type (Wiseman 1995, 238); and the Late Developmental Period (1000 C.E. – 1200 C.E.) can be diagnosed by the presence of Kwahe'e Black-on-white (Wiseman 1995, 238). This study addresses new conceptions of the site and situates it in the larger context of the Northern Rio Grande. It also contributes to one of the themes in this section, addressing what Stubbs excavation means today. It is important to explain the occupation of the sites as it relates to the area from which my source materials were derived for my study.

The population changes and migrations in the Northern Rio Grande are debated in Southwestern Archaeology. Cooper (In Press) supports the idea that the farming population that came into the Northern Rio Grande around 900 C.E. originated near the Navajo Reservoir/Fruitland District in northwestern New Mexico. This study compares population calculations, structures, material culture, and language to assess whether the population comes from a Northern or Southern origin. Cooper's Northern Origin hypothesis supports that Proto-Tiwa was spoken by the "the initial farming population of the Northern Rio Grande," which was settled in the 9th century (Cooper In Press, 4). Migration of people from the Northern San Juan brought the Tewa language into the area while those who spoke Proto-Tiwa originally lived in

the Upper San Juan drainage (Cooper In Press, 4). Prior to the 10th century, there was a sedentary population in the Middle Rio Grande (Cooper In Press, 6). Cooper calculated that during the period from 900 C.E. and 1000 C.E., an increase in the Northern Rio Grande population went from approximately 800 to 5,500 people (Cooper In Press, 6). This is a high level of population growth for that period, so migration is an option for understanding how the population grew so rapidly. At the same time, the population decreased in the Navajo Reservoir/Fruitland District (Cooper In Press, 12). The use and presence of Red Mesa Black-on-white and Kwahe'e Black-on-white do not add support to the Southern Origin hypothesis. Despite this evidence of migration, Cooper notes that "the Rio Grande is far from a homogenous cultural entity" (Cooper In Press, 14).

Cooper also discusses LA 835 in his discussion of migration in the Northern Rio Grande. He notes the significance of LA 835 as a key Late Developmental site in the Northern Rio Grande (Cooper In Press, 15). The site has around 200 surface rooms with kivas and "a great kiva measuring 52 feet in diameter" (Cooper In Press, 15). As indicated by the "ceramic diversity and use of civic-ceremonial architecture" at the site, LA 835 was "an important economic and religious center" (Cooper In Press, 15). Beyond ceramic diversity, the indicators of extended trade networks are linked to the "presence of turquoise, jet, and shell ornaments" at LA 835 (Cooper In Press, 16). Concerning the work done by Cooper at LA 835, my project will work to address the possible connection of LA 835 to Chaco Canyon.

The raw materials used to make pottery can be useful for understanding population trends and interactions. Schillaci and colleagues looked at sources of pottery in the Northern Rio Grande to determine if they were locally made or produced outside of the region (Schillaci et al. 2020). Looking at the composition of the pottery allowed them to see how pottery potentially fit

into the Chaco Regional system (Schillaci et al. 2020, 8). Studying clays allowed them to determine whether pottery was local or not (Schillaci et al. 2020, 6). They focused on "on identifying compositional groups and determining the potential geographic origins of non-local Cibola white ware sherds commonly found at Late developmental period sites" (Schillaci et al. 2020, 3). The study used source material from LA 835 to characterize pottery production and exchange at Late Developmental sites. Schillaci et al. found that a portion of the sampled Kwahe'e Black-on-white sherds from LA 835 was "produced at various Chaco great house communities in the San Juan Basin, including one from Chaco Canyon" (Schillaci et al. 2020, 22). The group composition included one local with two non-local groups, of the twenty-two Kwahe'e Black-on-white sherds sampled from LA 835, five were from Non-local Group 1 that was largely composed of Chacoan areas, while seventeen Kwahe'e Black-on-White was found to be locally made (Schillaci et al. 2020, 21; 31-33). Kwahe'e Black-on-white has a "distinctive decoration style" that relies on a local temper and local clay to create a vessel that is tied to the community (Schillaci et al. 2020, 23). A small portion of the Cibola white wares was produced "in the southern Tewa basin" (Schillaci et al. 2020, 22). Out of the 11, Red Mesa Black-on-white sherds sampled, none were locally made Schillaci et al. 2020, 31-33). Five Red Mesa Black-on-white sherds sampled from LA 835 were assigned to Non-local Group 1 (Schillaci et al. 2020, 31-33), and five Red Mesa Black-on-white sherds were assigned to Non-local Group 2 (Schillaci et al. 2020, 31-33). Overall, the study suggested that the people of the Northern Rio Grande obtained a higher fraction of their pottery through exchange with the Chaco region than previously thought (Schillaci et al. 2020, 25).

Ceramic Style in Archaeology

Through the analyses of designs on pottery, I am able to provide new evidence concerning the relationships between the Northern Rio Grande and Chaco Canyon. My search builds on previous research that supports the idea that pottery designs can aide in the process of understanding the social relationships of groups. In this section, I will delve into several studies that cover a wide range of ceramic studies in the field of archaeology. Within this section, I discuss a mix of foundational studies in the field and modern research. Ceramic analysis has been a key part of the field of archaeology for years. The addition of design analysis to the interpretation of pottery allows more information to be gathered and built on. The similarity of designs in archaeological studies and their relation to the interaction frequency between social groups is of interest to this project.

General Theories

There are two primary theories in archaeology used to interpret style (Hill 1970). These theories are the social interaction theory and the information exchange theory. The former is based on the idea that humans who spend time together often share more aspects of style than those who do not (Hill 1970, 364). The theory also operates under the assumption that style does not work to preserve social relations "or anything else" (Hill 1970, 364). This theory is not as widely supported anymore because differences in design can be present stylistically even if interaction levels between groups are high (Hill 1970 365). The alternative is the information exchange theory based on the idea that style is "both functional and adaptive" (Hill 1970, 366). This theory also sees the transmission of stylistic messages as a decision to signify the identity of the group (Hill 1970, 368). However, it is important to note that not all stylistic choices are meant to convey a message (Hill 1970, 370). Variability occurs, and this cannot always be

attributed to the flow of information exchange (Hill 1970, 371). Both of these themes are valid discussions of style.

Hill (1970) posits another way to evaluate style, the conceptual evolutionary framework. This framework combines the positives of each of the theories discussed while addressing the gaps they create. Hill based his framework on "modern synthetic biological evolutionary theory" (Hill 1970, 382). He also believes in "style as being hierarchically organized" that could account for its trends across social groups (Hill 1970, 374). Hill also acknowledges that individuals are part of several levels of social groups that can play into style selection based on the group they choose to invoke. The conceptual evolutionary framework also stresses that some elements of style do not carry messages, but that does not mean they are not relevant "within an ecological/adaptive framework" (Hill 1970, 382). Hill's framework attempts to create a theory that can account for more variability in the selection of stylistic elements. Understanding the key theories used to analyze ceramics in archaeology sets a precedent for how ceramics can be studied.

Middle range theory, design analysis, and the comparison of designs over time about changes in cultures are all important parts of Washburn and Webster's (2006) investigation into the history of ancestral Pueblo design. They worked to explore the relationship between Basketmaker basket designs and designs on Basketmaker ceramics. Working with the archeologically supported concept that people with shared cultural ideals can be reflected in the "homogenous design symmetries" found in artifact assemblages, Washburn and Webster analyze Basketmaker ceramics (Washburn and Webster 2006, 236). Using middle-range theory, the study draws on the experience of the past by understanding how patterns on material culture relate to "ideological concepts" (Washburn and Webster 2006, 236). The results of their study noted that

over time the basket design system had limited consistency across specific assemblages, and there were differences in the appearances of designs and symmetry between regions (Washburn and Webster 2006, 250). Even though basket and early ceramic designs were related, they found a difference in the way weavers and potters displayed layouts and used colors (Washburn and Webster 2006, 259). Within the publication, it shows that specific decisions were made to incorporate past design elements into new styles. Washburn and Webster researched the changes in designs over time and encountered several reasons why designs may vary, which could be useful in the assessment of my results.

Conkey and Hastorf (1990) delved into how style plays a role in the archaeological interpretation of sites and the people who occupied those sites. Considering how archaeologists approach style and what that means for their interpretation of sites is a relevant topic for my study as I am engaging with the interpretation of the stylistic selection of designs. When examining the stylistic decision of a potter, the object should still be understood in the context of the social situation in which the materials were created (Conkey and Hastorf 1990, 1). Another interesting section of the paper notes the importance of having a "self-aware perspective" when making judgments about past people's stylistic decisions (Conkey and Hastorf 1990, 3). In the study of style choices, it is important to not put more meaning into the style than may have originally been intended. Archaeologists studying patterns on artifacts operate on the assumption that patterns can be "read" and that those patterns "reflect various sociocultural phenomena" (Conkey and Hastorf 1990, 9). Style functions as "a medium of social practice" (Conkey and Hastorf 1990, 11). Style is not just a proxy of the culture, but a way to understand social phenomena (Conkey and Hastorf 1990, 15). Mediating what style can tell archaeologists and what is reasonable to interpret is important to consider when conducting analyses that rely on

stylistic choices. The protocols presented in Conkey and Hastorf's (1990) study are foundational for understanding the processes involved in the decoration of ceramic vessels.

Related to the earlier work of Crown and Bishop (1994), the assumption that migration and pottery designs can be connected through the archeological study was shown by Washburn (2013). The continuities in design structure seen throughout the Coalition period have supported the systematic migration from the Four Corners region, as design structure changed during the Classic period supports a shift toward households becoming the primary social unit in the new plaza oriented pueblos together are supported by this project (Washburn 2013, 47). This project tracks lifestyle transitions in ceramic designs, which is something I am working to detect within my data and that from Chaco Canyon.

Several general archaeological concepts are brought up in Peckham's (1990) research. The notion that pottery can be local or imported is relevant to my study because not all pottery types present at LA 835 were local (Peckham 1990, 15). The assumption that classifications made by archeologists are straightforward is also dismantled by Peckham (1990, 16). Another relevant point Peckham makes is that "designs tend to change more rapidly than any of the technological features" on pottery (Peckham 1990, 20). Understanding the classifications of pottery by archaeologists through a critical lens is important when dealing with the subjective nature of the classification process.

Methodology

Plog (1980) began to work on standardizing how to measure the factors that led to stylistic variation in pottery, which is a variable that is important to measure because it helps to create a more uniform way to evaluate pottery across the discipline. His work suggests that a large portion of research focuses on assessing stylistic change over time to aid in the dating of

sites (Plog 1980, 1). This paper also addresses assumptions that are often made in archaeological studies. According to Plog, the usage or diffusion of designs between social connections is proportional to the interactions between the social units (Plog 1980, 2). When evaluating social interaction, Plog believes that increased rates of interaction between social units will lead to a higher stylistic similarity, and the stylistic similarities within sites will also be lower (Plog 1980, 2). This assumption allows me to use data derived from designs to answer my research question about the relationships between the Northern Rio Grande and Chaco Canyon.

Plog addresses the issues associated with studying stylistic variation. If sites are purely dated on "stylistic attribute frequencies," and the "rates of change and the causes of differential rates of change are not known and/or not constant," then errors can occur (Plog 1980, 5). If you cannot measure the change across space, then it will be less accurate. In an earlier study, Plog (1976, 6) demonstrated that the similarity between sites often "does not decrease with increasing distance between them." Plog suggests that design variation occurs for several reasons (Plog 1980, 13). When comparing pottery, it is important to determine whether or not the people who inhabited the communities were the same people and that the sites were inhabited at the same time (Plog 1980, 15). Vessel form affects the designs potters can select to paint onto the containers (Plog 1980, 18). Trading ceramics, according to Plog, is a result of the natural resource available to different groups creating a demand for other pottery types (Plog 1980, 21). This paper also recognizes that it is important to not operate on the assumption that pottery is locally or non-locally made (Plog 1980, 76). Plog also attributes variation in ceramics to the individual who created it (Plog 1980, 116). Although it is not possible for me to control for all of these factors in my research, I have controlled for time by comparing designs on sherds that were made during the same archaeological period in the two areas.

Plog also discusses how the information exchange theory can predict how styles may vary in relation to the closeness of social groups and their access to shared material culture (Plog 1980, 118). If an individual is participating in a larger social network, Plog posits that more options for stylistic behaviors will be present (Plog 1980, 119). Plog believes that the social interaction theory can be an explanation for the "decrease in the spatial extent of style zones through time in the American southwest" (Plog 1980, 134). The dimensions of variability in regards to social interaction discussed in Plog's work sets a precedent that my research relies upon.

The most relevant section of Plog's work for my project is the portion on designs. He acknowledges the ability to define design elements is highly subjective, and there is even deviation in how people conceive design elements (Plog 1980, 40). Plog notes that it is important to remember that the ways archaeologists categorize designs that may not fit the conceptions the potters had when creating the vessels (Plog 1980, 43). Decisions about how to decorate a vessel are made at several steps in the process of creating vessels (Plog 1980, 51). One of the goals of this source is to standardize how designs are analyzed so the results can be compared. His point that the "attributes in this study are equated with decisions, whether conscious or unconscious, made by the artisan during the manufacturing or decorating process" is important to consider when evaluating a collection for patterns (Plog 1980, 41). This paper presents a general background on what design analysis means in archaeology and what to consider when evaluating designs on ceramics.

Style Analysis in the Southwest

Shepard (1985, 203) examines the steps a Puebloan potter takes to complete a vessel. Paint can be applied at several points in the firing process. In the creation of ceramic vessels, several

aspects of the ceramics can be adapted, such as the way the vessel is formed, the elements used in the composition, or the design motifs (Shepard 1985. 260). Shepard notes that the positioning of designs is often a reflection of the vessel form and the decision of the potter to leave areas free of paint (Shepard 1985 pg. 261). In regards to the pot size and shape, there are restrictions on what designs are able to go on certain spaces. Shepard identified fundamental portions of the design that may be attached to or framed by straight lines (Shepard 1985 pg. 273). The information presented here is useful for understanding the decisions behind where designs were placed on the pottery I am analyzing in my study.

The discussion of the brushstrokes in the paper by Van Keuren (1999) is of great interest because of the role it plays in shape and line production. Details of ceramic production are one avenue archeologists pursue to gain a better understanding of the past. The monograph produced by Van Kuren situates ceramic design within artifact style analysis and suggests how this way of looking at the past provides information about behavior. The study looks at brushstroke application on Cibola White Ware vessels and is concerned with the Pueblo III to IV transition period (Van Kuren 1999, v). This presentation of the general ceramic research in the American Southwest is an important aspect of this paper. Van Kuren sees ceramic designs as "complex and fluid signals that record a range of intended and unintended behavioral information" (Van Kuren 1999, 1). Artifacts display the material items and displays of communal ideas (Van Kuren 1999, 6). This paper points out that focusing only on the assumption that design elements are the main behavioral choice in the pottery production process is flawed (Van Kuren 1999, 9). Van Kuren argues, "that variation in design execution sequences occur in whole vessel assemblages painted with similar designs when style barriers exist" (Van Kuren 1999, 51). In relation to my project,

Van Kuren's study provides a great framework for how ceramics can be evaluated and later understood in the southwest.

According to Wobst's functional model, style is interpreted as a dynamic variable, serving specifically in the processes of information exchange and boundary maintenance (Hantman and Plog 1982, 239). Pottery exchange could lead to the appearance of design characteristics on vessels not from the assumed "area of manufacture" (Hantman and Plog 1982, 238). The execution of style on pottery is a learned behavior (Hantman and Plog 1982, 238). It is also important to note that "without knowing other parameters of social and spatial organization, it is not possible to assume information exchange and boundary maintenance as the only mechanisms affecting style" (Hantman and Plog 1982, 239). Hierarchical structures influence the information exchange that can influence pottery creation. The "division of social groups into varying status levels" affects the ability for designs to be translated across groups (Hantman and Plog 1982, 242). The adoption of certain styles relates to the presence of a hierarchical system and the implementation of status symbols "between regional centers" (Hantman and Plog 1982, 257). Hantman and Plog's book covered several lines of information and assumptions made in archaeology that are relevant to understand the assumptions I rely on to complete my research.

Hantman and Plog's study suggests that homogeneity in style often occurs in "low-density, mobile populations" (Hantman and Plog 1982, 250). Social stratification and social differentiation in the Southwest existed before the Chaco Phenomenon and can be found across the Southwest (Hantman and Plog 1982, 254). The information collected by Hantman and Plog (1982) is relevant to my study as it provides a foundation for understanding the social dynamics that are at play behind pottery production.

Crown and Bishop (1994) tie historic environmental changes and population shifts to ceramic trends. The study looked at Salado Pottery, specifically polychromes, and how they fit into the area and those who inhabited the area. The results of the study found that there were "multiple production loci for the pottery" (Crown and Bishop 1994, 2). Even with production across the area, product exchange still occurred (Crown and Bishop 1994, 30). The study defined design fields as the "general portion of the vessel that was painted" (Crown and Bishop 1994, 55). They observed "twenty-three distinct layouts" in how designs could be arranged (Crown and Bishop 1994). The way Crown and Bishop perceived the characteristics of the vessels that led them to believe that the conceptions of creating vessels operated on "a common template" across several areas (Crown and Bishop 1994, 90). The iconography itself signaled that "a unified system" was present and created "related symbols" (Crown and Bishop 1994, 192). Crown and Bishop's presentation of ceramic analysis is very detailed and provides a framework for understanding how analyzing design elements can be done. It is useful to consider this piece within the scope of the level of ceramic analysis I conducted.

Washburn and colleges worked to examine the relationship between designs on ceramic vessels and the social relationships of the people who created or used the vessels (Washburn et al. 2010). They looked at Pueblo ceramics to understand how social relationships and the ability to function in the environment is reflected in trends in ceramic design structure (Washburn et al. 2010, 766). The study concluded that the symmetry on pottery reflected the way the Puebloan people were socially organizing themselves due to environmental pressures (Washburn et al. 2010, 767). This study is key to understanding how my project can work to answer the degree to which people of the Pojoaque Grant Site were expressing themselves on pottery to those in Chaco Canyon.

Work by Washburn et. al. (2010) continues to validate the assumption in archaeology that social relationships are reflected in ceramic designs. Looking at Puebloan pottery from the Northern portion of the Southwest, the transition of how motifs were arranged symmetrically on the pots were observed in relation to social relationships (Washburn et al. 2010). They found that environmental changes impacted how people organized themselves, which was then reflected in their ceramics. This project demonstrates that social behaviors and pottery can be linked or at least understood in the context of each other.

The connection of archeological data to social identity, while not conflating it, is the subject of Matthew Peeples' 2018 book. Peeples' stipulates that humans can choose whether or not to invoke their social identity in the creation and display of their material culture (Peeples 2018, 199). He defines this decision, a form of categorical identification, as a way of people identifying themselves as members of certain social groups or roles (Peeples 2018, 207). Focusing on the selection of pottery designs, Peeples suggests that if communities were part of the same sphere of ceramic circulation than they were also possibly interacting in regards to "public ceremonialism" which leads to "contexts where categorical identities could have been expressed and contested" (Peeples 2018 pg. 64). Using the apparent similarities in the technical execution of ceramics, Peeples' assumes that connections between people and larger social groups across his research can be analyzed (Peeples 2018, 205). The operational assumptions made in Peeples' study are also used in this study.

Peeples' research looks at the pottery in the Cibola region and how the ceramics relate to social spheres of influence and interaction. One of the ways he analyzed his pottery was to identify primary elements and then code for all variables possible (Peeples 2018, 161). The results of his study found that designs may convey a larger social adherence to agreements on

what designs to use and possibly what identity they may convey (Peeples 2018 pg. 169). Peeples also noted that there is a distinction between the selection of brown and grey in their pottery as well as in their choice of raw materials due to social boundaries in the Cibola region. His matrix analysis revealed that the spatial distance of potters potentially accounts for a large percentage variation due to "the circulation of decorated ceramics as well as strong similarities in public architectural features" (Peeples 2018 pg. 107). Unpacking the social relationships that occur behind the creation of pottery is at the core of Peeples' work. The understanding of the selection of social identity in ceramic contexts is important to my research as well. Peeples' work explains how human choices and the stylistic choices displayed on pottery are linked.

Summary

This chapter discussed Chaco Canyon, the Pojoaque Grant Site, and how archaeologists can use ceramics to learn about social relationships in the past. The previous work done at these sites and using designs on ceramics as a way of understanding social interaction places my research within the discipline. The most important outcome of these studies is a detailed understanding of how ceramics can be used as a proxy for understanding social interaction or influence. The wide variety of literature presented here is merely a portion of the scholarship that supports the assumption involved in my analysis. Nevertheless, these studies support my approach to answering my question about the relationship between Chaco Canyon and the Northern Rio Grande.

Chapter 3 – Methods

Introduction

In this chapter, I will present the methods used in my study and explain why those techniques were selected. I will discuss the relevant scholarship regarding the methods I have chosen and how they have been used in previous archaeological studies. The data collection methods I selected allowed me to gather the information that is the foundation of my argument in regards to the social relationships between people of Chaco Canyon and the Pojoaque Grant Site, as observed through design element frequencies.

My project is centered on replicating Mathien's (1997) identification of design elements on sherds in Chaco Canyon at the Pojoaque Grant Site. I examined designs found on sherds from Stubbs' excavations at the Pojoaque Grant Site, and on sherds excavated by the National Park Service as part of the Chaco Canyon Project (Mathien 1997). Specifically, I applied the coding scheme developed by the Chaco Project to the Pojoaque Grant Site collection so that I could compare design frequencies on Red Mesa Black-on-white in the two areas, and Kwahe'e Black-on-white in the Northern Rio Grande versus Puerco, Escavada and Gallup Black-on-white in Chaco. Data produced through this project worked to help answer if a reduced interaction between Chaco and the Northern Rio Grande over time can be seen in design element frequencies. The information collected in this project will be one line of information that contributes to a better understanding of Chaco's potential influence or interaction with people of the Northern Rio Grande. The methods required for this project generated quantitative data that allowed me to process the information and find patterns within the data (Bernard 2006, 453). Determining if there are patterns and what they are will allow me to understand the artistic

selection of people from Chaco and the Pojoaque Grant Site and evaluate the possibility that these choices reflect hardening social boundaries over time.

Relevant Studies to My Methods

Studies Conducted at Chaco Canyon

The work completed as part of the Chaco Canyon Project provides immense amounts of on Chaco Canyon. I used the data presented in Mathien's (1997) book to characterize the designs on Chaco Canyon pottery. The Chaco Canyon Project generated several publications that contain a wide variety of information. Designs on Chacoan ceramics are one of the topics that were recorded during the Chaco Canyon Project (Powers 1983). Lekson provides an essential section on design styles that are used by the people in Chaco Canyon (Powers 1983). It also contains some relevant details about site procedures. Information by Mathien (2005) is key to understanding how the Chaco Canyon project conducted its archaeological study and survey. The National Park System's Chaco Canyon Project investigated several aspects of the Canyon from 1969 to 1985 (Mathien 2005, 1). The project worked to document the ecological conditions of the area, map the sites, create visual records of the sites, and record archaeological data. There also was a considerable amount of detail about the archaeological record of the area that was uncovered during the project. Literature produced by the Chaco Canyon Project is relevant to my project and provides a wealth of knowledge about the area.

The academic sources that have greatly influenced my methods come out of practices used in the study of Chaco Canyon. The 1981 Publication in Archaeology 18A Chaco Canyon (Hayes et al.) also notes some of the procedures used by the Chaco Canyon Project. The expression of the assumptions and limitations of the Chaco Canyon study includes selecting sherds based on the knowledge that certain types of sherds yield more information than others is

important to consider when interpreting the study's results (Hayes et al. 1981, 15). One hundred and forty-two sites out of 844 had sherds from the post-contact period (previously known as the historic period, Hayes et al. 1981, 83). Understanding how and where archaeological studies from the Chaco Canyon Project were conducted was essential for understanding the methods of the project and how they influence the information used in my study.

Dr. Lekson remarked on the Outlier Survey conducted as part of the Chaco project and described some of the procedures and details of the work done there. Information derived from sherds was collected on-site. To expedite the data collection process, members of the Chaco Canyon project only collected evidence on the "presence and abundance of styles and types" (Powers et al. 1983, 347). Lekson noted that the design style concepts were based on works by Colton and Hargrave (Powers et al. 1983, 370). The inconsistent nature of this study generates assumptions about the procedures they used. They drew on prior literature to understand styles and then applied their interpretation of previously designed styles and created a new series when conducting the survey (Powers et al. 1983, 350). It is important to note that several assumptions were made during the outlier survey, including interpretations of styles that were not detailed in the published volume.

Studies Conducted at LA 835

Boyer and Lakatos (2000) contextualize LA 835 within its regional role in New Mexico. The updated information in their report provides an explanation of the ceramics present at the site and the occupation periods that correspond with the presence of the specific pottery types. The western portion of the site dates "to the Kwahe'e phase" (Boyer and Lakatos 2000, 94). Their study places the use of the great kiva and house groups "at the base of the mesita" to 900 C.E. (Boyer and Lakatos 2000, 41). Boyer and Lakatos conducted surface testing methods to

understand what portions of the site were used for or contained. They found that LA 835 had material from the "Late Developmental period and historic period " (Boyer and Lakatos 2000, 46).

Understanding why and how variations in designs are executed is important to understand, especially within a relevant regional context. Guthe's (1925) ethnographic research at San Ildefonso is a pertinent piece of work to situate myself into the discourse of Rio Grande archaeology. In regards to painting a vessel, a vessel that is open in the center, like a bowl, then the lines at the top of the vessel must be completed first (Guthe 1925 pg. 67). One of the observations made in the study is that the brush was held by the right hand which could potentially account for how the designs lean or angle across multiple vessels. Lines on San Ildefonso pots can vary in width from one-thirteenth to one-tenth of an inch; the great majority are between one-fifteenth and one-twentieth" (Guthe 1925 pg. 68). There is also variation in how many times lines are adjusted to "ensure a constant width" across potters (Guthe 1925 pg. 68). Groups of painted lines can either serve as enclosing lines or fill in sections of panels (Guthe 1925 pg. 69). The study also noticed that in the village, the men were only involved in the ceramic productions at the design stage, if at all. This study provides another Tewa study in the Northern Rio Grande about the explanation for variation in designs on pottery.

The Stubbs excavation at LA 835 was notable for generating early information about the site. His excavated collection is my source material. Some of the information he offers for the site provides the foundational knowledge of the area. Stubbs believed that some of the pottery was made locally because of stylistic decisions and pottery materials (Stubbs 1954, 45). The material collected from this excavation is what my source material will be. Breaking down the early

understanding of the site allows the later examination of LA 835 to build on the existing scholarship.

Studies Relevant to Methodology

Beyond contextualizing Chaco, Toll (2001) looks at the designs on pottery and those who produced the ceramics present at Chaco. The study focused on "studying the degree of similarity" on Anasazi pottery to that at Chaco (Toll et al. 2001, 149). In regards to the role of those creating the pottery, the article suggests that the potters could identify where a vessel was made because of the stylistic features (Toll et al. 2001, 148). In this study, the challenges and assumptions made when studying ceramics are addressed. The study also addresses that there is no widely accepted method across the field to analyze designs. This study is relevant to my project because I am also conducting a study that analyses designs.

Studying white wares can be challenging because of the variability of designs, wide production location possibility, and division of typology by archeologists (Toll et al. 2001, 149). Quantities of Gallup pottery at Pueblo Alto and building episodes of Chaco led some archaeologists "to speculate that there was some association between hachure and the Chaco Phenomenon" (Toll et al. 2001, 151). This is interesting to consider in my research because of the variation in hachure varieties that I looked for within the pottery from the Pojoaque Grant Site. The association with Dogoszhi style hachure and the uncommon cylinder jars, which can be seen as prestige items, although the authors of this study do not agree with this interpretation (Toll 1990). One Cibola region hachure style, squiggle hachure, is attributed to the Red Mesa design style (Toll et al. 2001, 151). This project contextualizes the broad nature of Chacoan pottery design and its qualities. Toll and colleagues acknowledge the difficulties and lack of

standardization that comes along with studying design elements. This is relevant to my attempts to adhere to a standardized process in which I can analyze designs.

In his analysis of the ceramics of Broken K Pueblo, Hill found it necessary to use a multivariate analysis technique to address the vast quantities of data and numerous variables he collected (Hill 1970, 18). Hill approached the ceramic design elements with his classification that was created by identifying elements, then placing them into element-classes (Hill 1970, 23). Using this approach, Hill found that "it now seems reasonably certain that it is possible to identify social units in prehistoric sites (at least at some of them) and that these units can be compared in time and space" (Hill 1970, 74). Hill developed a system design elements; however, this is not a standardized practice within the field of archaeology.

Data Collection

To collect my data, I analyzed the decorated ware ceramics of the excavated LA 835 site collection housed at the University of Colorado Boulder. Table 1 displays the total number of sherds analyzed in this study from the Pojoaque Grant Site and Chaco Canyon The decorated wares I analyzed belong to either the Red Mesa Black-on-white pottery type or the Kwahe'e Black-on-white pottery type. These types represent a chronological sequence spanning the period from 900 C.E. to 1150 C.E. and thus allow me to gauge changes in the Northern Rio Grande design style over this period. There are other decorated pottery types present at the site, but they are too rare for useful comparison. The pottery types from Chaco Canyon I compared to pottery types at LA 835 were Red Mesa Black-on-white, Puerco Black-on-white, Escavada Black-on-white, and Gallup Black-on-white. I recorded four elements in my spreadsheet that are connected, through relational database software, to other data collected about the sherds from LA

835. With this information, I was able to compare the presence of design elements in the Pojoaque Grant Site collection to that recorded in Chaco Canyon.

Table 1 shows the total number of sherds from each assemblage referenced in this study.

Sample Size per assemblage	**Red Mesa**	**P.E.G.**	**Kwahe'e**
Chaco Canyon	5512	3100	
LA 835	522		317

I recorded four variables while conducting the study. The first variable is the sherd number that I assigned to a sherd within a specific bag. If a sherd has more than one design element, it will have the same sherd number; however, it is recorded on a new line of the query. The sherd number is a form of a counter that allowed me to track the number of design elements present on each sherd within the bag. The next element I recorded is the weight of the sherd so that I was able to distinguish the sherd within the bag. I set my weight parameters with two grams being the lowest I recorded data from, and any weight above that point is acceptable to use as a data point. The decision to set the weight of the sherd at two grams was based on my ability to determine what design is present on the sherd. When setting this parameter, I was operating on the assumption that weight (i.e., size) can relate to how much of a design is visible. The third variable I recorded is the design element present. The design categories I used, and their associated numbers, were established by Mathien in her record of the Chaco Canyon Project (Mathien 1997). In Table 2, I have listed the design categories and their titles, as defined by Mathien. The final variable is any additional comments I chose to make concerning the sherd or the designs present on it. Tracking the presence of design elements is central to my research project, and these variables help me track the designs and sherds the designs are present on.

Table 2 This is a reproduction of information detailed in Mathien (1997)

Design Code	**Design Code Title**
1	Isolated single elements
2	Hooks, Flags
3	Nested Isolates
4	Unnested isolates
5	Stars, Suns
6	Overlapping steps
7	Non-overlapping steps
10	Parallel Lines
11	Cribbed Parallel Lines
12	Banded Framers
13	Pendant Parallel Lines
14	Framers with unticked solids
15	Framers with ticked solids
16	Irregular wide lines
17	Ticking
18	Corner triangles
20	Scrolls
21	Framed solids
22	Dots
23	Other Framed Isolates
24	Framing Dots
25	Linear Dots
26	Dotted Lines
27	Thick Wavy Lines
29	Parallelograms
30	Dots in Parallelograms
31	Dotted Checkerboard
32	Checkerboard
33	Eyed Solids
34	Sawteeth
35	Barbs
36	Elongated Scalloped Triangles
37	Wide Sosi Style
38	Heavy Dotted Lines
39	Heavy Curvilinear Lines
40	Solid Band Design
41	Hatched Band Design
42	Isolated Triangles
43	General Solids
44	Bold Bisecting Lines
50	Hachure A-1
51	Hachure B-C
52	Hachure A-2
53	Hachure B-1
54	Hachure B-2
55	Hachure B-3
56	Hachure B-4

Design Code	**Design Code Title**
57	Hachure C
58	Hachure B-5
59	Hachure B-6
60	Hachure A-3
61	Hachure B-7
62	Countercharge
63	Hatched Checkerboard
64	Heavy Gallup Squiggle
65	Hatched Pendants
70	Squiggle Lines
71	Interlocked Frets
72	Anthro/Zoomorphs
73	Solid Ticked Triangles
80	Painted Motif on Rim Interior
81	Exterior Bowl Motif
82	Jar Neck Motif
83	White Exterior Design
84	Unslipped Motif Area Polychrome
85	Narrow Sosi Style
86	Narrow curvilinear
87	Interlocking Ticking
995	Others, Solid
996	Others, Hatched

Pottery Types

My project is specifically focusing on certain decorated pottery types to ensure that the comparison is chronologically and stylistically equivalent. Pottery type refers to a specific type of ceramic that is characterized by several attributes, such as clay type, decoration, or surface treatment. Red Mesa Black-on-white is one pottery type present in each region that was part of my analysis. Kwahe'e Black-on-white is a prominent pottery type in the Rio Grande. This pottery type will be compared to Puerco Black-on-white, Escavada Black-on-white, and Gallup Black-on-white. These three pottery types can be compared to Kwahe'e because of their overlapping periods of creation and similarities in style. Ceramics is one avenue to examine the choices, preferences, and potential social connections of past societies.

Red Mesa Black-on-white

Figure 3 The pottery sherds in this figure display (Wilson 2012)

The Red Mesa Black on White pottery type was in use from approximately 875 C.E. to 1050 C.E. (Wilson 2012). The Red Mesa Black-on-white pottery type is a common feature at both Chaco and Northern Rio Grande sites, such as Pojoaque Grant. Red Mesa Black-on-white was in use across a wide geographic area and was "the successor to Kiathuthlanna Black-on-white" (Peckham 1990, 67). It can be identified by its "stark white slip" and unique decorative style (Peckham 1990, 67). The use of "solid triangles, interlocking scrolls, and relatively fine, parallel lines or ticked parallel lines following zigzag fashion around the inner circumference of bowls and the exterior body of jars" can identify a Red Mesa vessel (Peckham 1990, 67-68). Dr. Lekson saw the defining characteristics of Red Mesa in the Chaco study as having "three distinct sub-styles: "longitudinal hatching" (Gladwin 1931), grids (checkerboards), and a residual category including motifs and elements associated with Red Mesa Black-on-white, such as scrolls, ticked lines, scalloped triangles, etc. (Powers et al. 1983, 351-352). Figure 3 displays several designs on Red Mesa Black-on-white sherds. Several key design elements can be used to identify Red Mesa Black-on-white, such as squiggle hachure, the repetition of design elements to form motifs, and sequences of parallel lines (Wilson 2012).

The understanding of Red Mesa Black-on-white in the context of Chaco is of great importance to my paper (Peckham 1990). People involved in the Chaco Phenomenon were

engaged in distributing both Red Mesa Black-on-white and Gallup Black-on-white (Peckham 1990, 72). The association of this pottery type with Chaco leads scholars to believe that it is an indication of interaction between Chaco and the Northern Rio Grande (Schillaci et al. 2020, 3). Even beyond Chaco's boundaries, the San Juan Basin saw high production rates of Red Mesa Black-on-white (Schillaci et al. 2020, 3). The Chaco Canyon Project found that they recovered more Red Mesa Black-on-white than any other pottery type (Wilson 2012). Red Mesa Black-on-white is critical to include in this project because of its widespread use across the American Southwest.

Kwahe'e Black-on-white

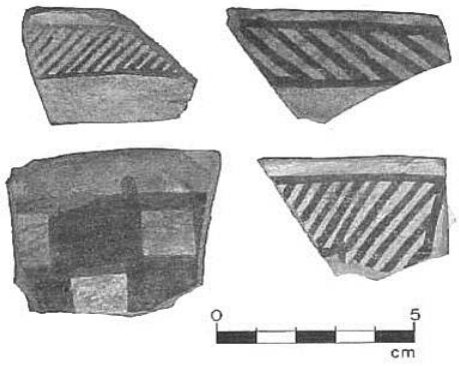


Figure 4 Displays Kwahe'e Black-on-white pottery (Wilson 2012)

Kwahe'e Black-on-white is argued to have developed as a variation on the previous Red Mesa Black-on-white pottery tradition (Schillaci and Lakatos 2017, 152). Recent investigations by Schillaci and Lakatos (2017) have placed the emergence of Kwahe'e Black-on-white to between 975 C.E. and 1023, which is earlier than previously thought (Schillaci and Lakatos 2017, 158). The new emergence dates were set due to Schillaci and Lakatos' (2017) study using ^{14}Carbon dates from sites in the Tewa Basin to help date Kwahe'e Black-on-white. Kwahe'e represents the earliest white ware pottery that was manufactured in the Northern Rio Grande

region (Wilson 2012). The pottery type was the first in the Rio Grande/Tewa ceramic series (Schillaci and Lakatos 2017, 152). Schillaci and Lakatos also link the emergence of Kwahe'e Black-on-white to a population increase in the Northern Rio Grande which contributed to the creation of this pottery type (Schillaci and Lakatos 2017)

This type can be identified by the use of mineral paint and pastes and tempers specific to the Northern Rio Grande (Wilson 2012). Designs presented on Kwahe'e Black-on-white vessels are not always executed with consistent quality (Wilson 2012). Figure 4 displays several of the designs that appear on Kwahe'e Black-on-white sherds. The frequency of Kwahe'e Black-on-white dwindles after 1150 C.E. and is no longer seen by the 13th century (Wilson 2012). Kwahe'e Black-on-white is "frequently referred to as the Rio Grande cognate of Gallup Black-on-white" (Darling and Wiseman 1986, 131). Kwahe'e Black-on-white does not occur at Chacoan sites; however, it can be compared to three contemporaneous pottery types that are common in Chaco Canyon.

Gallup Black-on-white

Figure 5 Shows pottery sherds that belongs to the Gallup Black-on-white pottery type (Wilson 2012)

Gallup Black-on-white was in use from roughly 980 C.E. to 1150 C.E. (Wilson 2012). "After Red Mesa Black-on-white, Gallup Black-on-white is the second most abundant specific

type in the Chaco Project collection, and the most common in the Pueblo Alto collection" (Mathien 1997, 313). This pottery type may resemble other pottery types due to the selection of hachured designs used (Wilson 2012). Some of the design styles were altered over time including the space between hachure marks that became increasingly separated as potters were located farther from Chaco Canyon (Wilson 2012). Some of the stylized portions of Gallup Black-on-white pottery include designs that "may consist of broad hatched triangles or pendants that cover most of the vessel" (Wilson 2012). Gallup Black-on-white sherds can be seen in Figure 5.

Puerco Black-on-white

Figure 6 Displays sherds from the Puerco Black-on-white pottery type variety (Wilson 2012)

The next pottery variety, Puerco Black-on-white, was primarily used from 1000 C.E. to 1150 C.E. (Wilson 2012). Puerco Black-on-white also has several design distinctions that make it identifiable, as can be seen in Figure 6. "In the Puerco style," according to Dr. Lekson, "grids are excluded, and parallel hatches, sectioned bands are emphasized" (Powers et al. 1983, 352-353). As a successive pottery type to Red Mesa Black-on-white, the Puerco style also uses lines to divide their sections of bold solids on ceramics (Wilson 2012). In comparison to Escavada Black-on-white, Puerco Black-on-white does not have hachured designs (Mathien 1997, 298).

Escavada Black-on-white

Figure 7. This is a picture of Escavada Black-on-white sherds (Wilson 2012)

Escavada Black-on-white (950 C.E. – 1150 C.E.) is another pottery type that is relevant to this study. The identification of Escavada Black-on-white pottery is based primarily on "it's rough, unpolished surface finish and coarse-grained temper" (Mathien 1997, 36). A late Pueblo II characteristic of this pottery type is the incorporation of styles that also appear on Sosi Black-on-white pottery (Wilson 2012). Elements such as "broad lines, large solid elements, and the absence of line elaborations with combinations of lines and solid elements appear on this pottery type and can be seen in Figure 7 (Wilson 2012). Motifs within lines can "include solid triangles, right triangles, and interlocking barbs" (Wilson 2012). The similarities and differences between the pottery types are key to note later to make sense of possible distinctions in the design element appearance. The typology of this pottery type and all mentioned in this study are useful to consider when understanding the relationships between the pottery and their place in societies.

Creating Grouping Fields

Creating grouping fields allowed me to analyze trends in the data at multiple levels using fewer design categories, which inevitably lead to larger sample sizes and larger percentages of

each category. To accomplish this, I created a lookup table within Microsoft Access for the design grouping definitions and gave each a number. This allowed me to calculate percentages and Brainerd-Robinson coefficients of similarity between my two sites, and two time periods, based on a variety of classification schemes. Consulting the tables in Mathien (1997), I transcribed the Chacoan information detailed in the tables so that I could compare both assemblages directly. In the creation of my grouping fields, there were a few factors I had to adjust for. First, not all design categories in Mathien's record appeared on the sherds I examined from LA 835. Every design was grouped into a category, as per the constraints of Microsoft Access. Second, it was also important to carefully construct my categories so elements would fit within one group only. The reorganization of the data by grouping fields allows the design element totals described above to be viewed in different ways to compare element frequencies across the two assemblages. Organizing data according to grouping fields is not a systematized practice in archaeology. In regards to applying this to the Chaco Canyon data, it has not been done using the categories I have constructed before. Grouping fields allows the design categories to no longer be the primary indicator of stylistic choice.

Similar to the variety of pottery from LA 835, ceramics at Chaco Canyon did not always display consistent and equal portions of the designs. The pottery types relevant to my project at Chaco Canyon did not contain all of the design elements listed by Mathien (1997). The designs not present on the five pottery types I looked at from Chaco Canyon were 6, 21, 31, 44, and 84. This is important to note because it affects how the design groupings present trends in design selection.

I grouped the 70 different designs, as defined by Mathien (1997), into categories. In the process, I grouped the designs in four ways. The same number in each grouping represented

design number 43 because it was the category I used to cover designs that were indeterminate. For the designs I did not observe on the pottery from LA 835, I gave the same number across all groupings. Even though some of these designs appeared on pottery from Chaco Canyon, I felt it best to distinguish these designs because they were not used in one region. These categories were created by me and were based on my experience looking at the material and my understanding of what the designs represent. In Appendix A, a table displays each of Mathien's design codes and the corresponding codes I assigned to them based on the grouping fields I created. This is not a reflection of what the potter or painter of the ceramics may have intended but is an estimate of the relation between the design elements.

Grouping 1 was based on my initial interpretation of the designs labeled by Mathien (1997). This grouping is based on what seemed logical to me as to how the designs seemed to fit together. In the process of grouping the designs, I created 15 categories to encompass all of the designs. Appendix B displays the labels for the categories I created for Grouping 1. This classification was used to regroup the established design categories to highlight different trends in the data potentially.

In the process of placing the designs into new categories, I worked to lump the designs into categories. This means I worked to place as many designs possible into as few categories as conceivable. In Grouping 2, I placed the designs into seven categories. Appendix C displays the labels for the categories I created for Grouping 2. Lumping the designs together allowed me to try and compare the data across the two areas in a potentially interesting way.

Grouping 3 was focused on differentiating designs based on their incorporation of lines. I created two categories. The first category I defined had to have some straight lines. The second category was the designs that did not have continuous, long, or straight designs. I created this

category because of the prevalence of designs that incorporated lines into their designs. Lines can also be used to create boundaries. Appendix D displays the labels for the categories I created for Grouping 3. Separating the data based on the use of lines was a decision I made to potentially highlight the variation in the uses of lines across pottery types.

The last grouping was created by separating the designs that used hachure compared to those that did not. Similar to Grouping 3, the subject of this comparison was two distinct stylistic choices. This was another distinction I wanted to make because it was another important type of design. Hachure could appear in several forms on vessels. This category was meant to highlight the selection of hachure as a potentially dominant trend on vessels from one region. Appendix E displays the labels for the categories I created for Grouping 4. Grouping 4 allowed me to examine the use of the hachure technique across pottery types.

The Brainerd-Robinson Coefficient

The Brainerd-Robinson coefficient allows the similarity of entire assemblages to be assessed. This is calculated by subtracting the sum of the absolute values of the differences in design percentages across all categories from 200. For this project, a specific script developed by Matthew Peeples was used to analyze the data titled "R Script for Calculating the Brainerd – Robinson Coefficient of Similarity and Assessing Sampling Error." (Peeples 2011). The coefficient ranges from a low value of zero (when no design categories occur in both assemblages) to a high of 200 (when the percentages of all design categories are identical between the two assemblages). This script is useful for archaeological analysis because it can compare assemblages "in terms of the proportions of types or other categorical data" (Peeples 2011). Within this form of analysis, this script can look at the similarity of the groups of pottery types across their corresponding periods. The Brainard-Robinson coefficient portion of the

analysis was applied after the design categories had been placed into design groups. This test was also used to determine if the pattern of design usage varied across the ways I grouped them, and if so, what categorizations altered the results. Peeples (2011) developed this program to measure the similarity in the process of assemblage comparison in regards to the "proportions of types or other categorical data" (Peeples 2011). The script he developed allows the probability "of obtaining a BR similarity value less than or equal the actual value by chance for every pair-wise comparison. These probability values can be useful in determining when differences between sites might be a function of sampling error and when they are likely not" (Peeples 2011). The results of the application of the Brainard-Robinson coefficient will be discussed in Chapter 4.

Limitations of My Study

It is important to recognize several limitations of my study. My project is centered on the replication of the information detailed in Mathien's (1997) record of information from the Chaco Canyon Project. Even though there was a guiding framework for my study, there are certain constraints on the accuracy of my execution of these methods. Some of the details of the Chaco Canyon Project are not revealed in the texts or were not described in detail. This led me to infer what was done and make the best decisions possible when unpacking the methods the Chaco Canyon project used. The classification of design elements I used is based on the representation in Mathien's book and does not necessarily reflect my ideas of what additional useful distinctions might be. Placing a weight parameter on the sherds was my decision, not part of Mathien's methodology (that was stated within the text). I did this to try and enable my ability to identify best what designs were present on a sherd. Also, when creating grouping fields, I placed them into categories based on my perceptions of what the designs are and how they can be

executed. My assumptions made about the similarity between designs or why they should be grouped does not necessarily reflect the conceptions potters would have of these design elements.

Chapter 4 – Results

Introduction

After my data was collected, I compared the relative frequencies of design elements to understand trends in pottery design element frequency within the Pojoaque Grant Site collection. Then I was able to compare data from the Pojoaque Grant Site to the appearance of design elements in Chacoan pottery recorded by Mathien. I looked to see if certain design elements are more prominent on the pottery of one area than the other. The abbreviation PEG will be used to represent the combined data for Puerco Black-on-white, Escavada Black-on-white, and Gallup Black-on-white. Puerco Black-on-white, Escavada Black-on-white, and Gallup Black-on-white can be compared to Kwahe'e Black-on-white because of their overlapping dates associated with each type. The data analysis methods section also covers the analyses I conducted on the data in raw form, after converting to percentages, and after calculating Brainerd-Robinson coefficients. These analyses allowed me to determine whether there are any statistically significant differences in design element selection between the two.

Data Discussion

Table 3 displays the raw data referenced in this study. Data in this table comes from Mathien's (1997) account of the Chaco Canyon Project's work and my research. The table shows how many times design elements are observed across the pottery types and assemblages. Puerco Black-on-white, Escavada Black-on-white, and Gallup Black-on-white are represented in one column to allows the comparison to the totals of designs used on Kwahe'e Black-on-white pottery to be more apparent. The difference in the sample sizes between Chaco Canyon and that

of the Pojoaque Grant Site is visible in this table. This table represents all of the information that will later be analyzed and reorganized in this thesis.

Table 3 This table displays the raw counts of times designs that were observed on pottery from each pottery type and place.

Design Code	Design Code Title	Chaco Red Mesa	Chaco PEG	LA835 Red Mesa	LA835 Kwahe'e
1	Isolated single elements		1		
2	Hooks, Flags	25	4	6	2
3	Nested Isolates	19	3	23	14
4	Unnested isolates		4	4	2
5	Stars, Suns		3		
6	Overlapping steps				
7	Non-overlapping steps	1	1	1	4
10	Parallel Lines	464	36	13	11
11	Cribbed Parallel Lines	48	6	7	7
12	Banded Framers		2	2	5
13	Pendant Parallel Lines	199	42	42	19
14	Framers with unticked solids	100	2	8	5
15	Framers with ticked solids	148	2	3	
16	Irregular wide lines	2	8	1	6
17	Ticking	8	9	2	5
18	Corner triangles	26	66	7	2
20	Scrolls	525	46	26	2
21	Framed solids				
22	Dots	18	2		1
23	Other Framed Isolates	2			
24	Framing Dots	17	1		
25	Linear Dots		1		
26	Dotted Lines	243	22	27	2
27	Thick Wavy Lines	37	3	7	1
29	Parallelograms	3	9		
30	Dots in Parallelograms		1		
31	Dotted Checkerboard				
32	Checkerboard	268	68	5	25
33	Eyed Solids	24	21	2	1
34	Sawteeth	228	68	26	19
35	Barbs	80	136	9	9
36	Elongated Scalloped Triangles	12	34	10	
37	Wide Sosi Style	12	205	2	4
38	Heavy Dotted Lines	16	5	3	

Design Code	Design Code Title	Chaco Red Mesa	Chaco PEG	LA835 Red Mesa	LA835 Kwahe'e
39	Heavy Curvilinear Lines	3	52		
40	Solid Band Design	1212	108	62	22
41	Hatched Band Design	7	46	18	12
42	Isolated Triangles	5	16	1	1
43	General Solids	304	145	79	77
44	Bold Bisecting Lines				
50	Hachure A-1	309	9	34	1
51	Hachure B-C	14	165		
52	Hachure A-2	23	26	5	6
53	Hachure B-1	12	357	1	6
54	Hachure B-2	4	11		
55	Hachure B-3	4	239		2
56	Hachure B-4	2	445	6	2
57	Hachure C		42		
58	Hachure B-5	1	7		
59	Hachure B-6	3	113	1	1
60	Hachure A-3	12	42	5	11
61	Hachure B-7		18		
62	Countercharge		18		
63	Hatched Checkerboard	5	73		
64	Heavy Gallup Squiggle	5	27	1	
65	Hatched Pendants		11	2	11
70	Squiggle Lines	292	1	20	
71	Interlocked Frets	3	3		
72	Anthro/Zoomorphs	1	4		2
73	Solid Ticked Triangles	500	62	48	3
80	Painted Motif on Rim Interior				
81	Exterior Bowl Motif	42	50	1	
82	Jar Neck Motif	24	33	1	1
83	White Exterior Design		3		
84	Unslipped Motif Area Polychrome				
85	Narrow Sosi Style	38	14	1	13
86	Narrow curvilinear	3	3		
87	Interlocking Ticking	134	2		
995	Others, Solid	13	15		
996	Others, Hatched	12	129		
	Sum of Sherds	5512	3100	522	317

Table 4 displays the percentages of designs observed on pottery from Chaco Canyon and the Pojoaque Grant Site. The percentages presented in this table reflect the differences in the selection process of potters. The 0% in the table do not always indicate that the designs were completely absent. Occasionally the use of the designs is so infrequent that when the percentage is calculated, it rounds to 0%. Design category 70 appears more frequently on Red Mesa Black-on-white pottery from Chaco Canyon than any other category across pottery types and regions. Already trends in the design data begin to emerge more clearly when presented in terms of percentages. For example, the new tabulation reveals how spread out the designs are.

Table 4 This table displays the percentages of times designs were observed on pottery from each pottery type and place based on the raw counts.

Design Code	**Design Code Title**	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
1	Isolated single elements	0%	0%	0%	0%
2	Hooks, Flags	0%	0%	0%	0%
3	Nested Isolates	0%	0%	0%	0%
4	Unnested isolates	0%	0%	0%	0%
5	Stars, Suns	0%	0%	1%	0%
6	Overlapping steps	0%	0%	0%	0%
7	Non-overlapping steps	0%	0%	0%	0%
10	Parallel Lines	8%	2%	4%	0%
11	Cribbed Parallel Lines	1%	1%	0%	0%
12	Banded Framers	0%	0%	0%	0%
13	Pendant Parallel Lines	4%	3%	4%	0%
14	Framers with unticked solids	2%	0%	0%	0%
15	Framers with ticked solids	3%	0%	0%	0%
16	Irregular wide lines	0%	0%	1%	0%
17	Ticking	0%	1%	1%	0%
18	Corner triangles	0%	0%	1%	3%
20	Scrolls	10%	3%	6%	0%
21	Framed solids	0%	0%	0%	0%
22	Dots	0%	0%	0%	0%
23	Other Framed Isolates	0%	0%	0%	0%
24	Framing Dots	0%	0%	0%	0%
25	Linear Dots	0%	0%	0%	0%
26	Dotted Lines	4%	1%	2%	0%

Design Code	Design Code Title	Chaco Red Mesa	Chaco PEG	LA835 Red Mesa	LA835 Kwahe'e
27	Thick Wavy Lines	1%	0%	0%	0%
29	Parallelograms	0%	1%	1%	0%
30	Dots in Parallelograms	0%	0%	0%	0%
31	Dotted Checkerboard	0%	0%	0%	0%
32	Checkerboard	5%	6%	8%	0%
33	Eyed Solids	0%	2%	1%	0%
34	Sawteeth	4%	6%	6%	0%
35	Barbs	1%	13%	9%	1%
36	Elongated Scalloped Triangles	0%	3%	2%	0%
37	Wide Sosi Style	0%	20%	13%	1%
38	Heavy Dotted Lines	0%	0%	1%	0%
39	Heavy Curvilinear Lines	0%	3%	4%	1%
40	Solid Band Design	22%	11%	9%	0%
41	Hatched Band Design	0%	0%	1%	2%
42	Isolated Triangles	0%	1%	0%	0%
43	General Solids	6%	9%	7%	3%
44	Bold Bisecting Lines	0%	0%	0%	0%
50	Hachure A-1	6%	0%	0%	0%
51	Hachure B-C	0%	0%	0%	8%
52	Hachure A-2	0%	0%	0%	1%
53	Hachure B-1	0%	0%	2%	17%
54	Hachure B-2	0%	0%	1%	0%
55	Hachure B-3	0%	0%	1%	11%
56	Hachure B-4	0%	0%	0%	22%
57	Hachure C	0%	0%	0%	2%
58	Hachure B-5	0%	0%	0%	0%
59	Hachure B-6	0%	0%	1%	5%
60	Hachure A-3	0%	0%	1%	2%
61	Hachure B-7	0%	0%	0%	1%
62	Countercharge	0%	0%	0%	1%
63	Hatched Checkerboard	0%	0%	0%	3%
64	Heavy Gallup Squiggle	0%	0%	0%	1%
65	Hatched Pendants	0%	0%	0%	0%
70	Squiggle Lines	5%	0%	0%	0%
71	Interlocked Frets	0%	0%	1%	0%
72	Anthro/Zoomorphs	0%	0%	0%	0%
73	Solid Ticked Triangles	9%	6%	2%	1%
80	Painted Motif on Rim Interior	0%	0%	0%	0%
81	Exterior Bowl Motif	1%	2%	1%	2%
82	Jar Neck Motif	0%	1%	1%	1%

Design Code	Design Code Title	Chaco Red Mesa	Chaco PEG	LA835 Red Mesa	LA835 Kwahe'e
83	White Exterior Design	0%	0%	0%	0%
84	Unslipped Motif Area Polychrome	0%	0%	0%	0%
85	Narrow Sosi Style	1%	0%	3%	0%
86	Narrow curvilinear	0%	0%	0%	0%
87	Interlocking Ticking	2%	0%	1%	0%
995	Others, Solid	0%	0%	0%	1%
996	Others, Hatched	0%	1%	1%	6%
	SUM	5512	3100	522	317

Brainerd-Robinson Analysis

Looking at the reformatted data, several patterns emerged. The comparison of Red Mesa Black-on-white in Chaco Canyon versus that at LA 835 revealed their similarity (see Appendix F-M for the coefficients and p-values). There is more similarity between the designs on LA 835 Red Mesa Black-on-white and LA 835 Kwahe'e Black-on-white than there is between Chaco Canyon's Red Mesa Black-on-white and Chaco Canyon's PEG. The Brainard-Robinson coefficients between Red Mesa Black-on-white and Kwahe'e Black-on-white at LA 835 were higher across the board than those between Chaco PEG and LA 835 Kwahe'e Black-on-white (as seen in Appendix F-M). This shows that the pace of change in pottery design was slower in the Northern Rio Grande than in the Chaco system. The analysis revealed that the pottery at LA 835 is more consistent over time than the divergence between LA 835 and Chaco Canyon. The similarity of designs declined more over time in Chaco Canyon than it did in the Northern Rio Grande. A portion of the decline in the similarity between Chaco Canyon and the Northern Rio Grande is due to the more consistent design use in the Northern Rio Grande. However, the Northern Rio Grande still displays declining similarity with Chaco over time. The results of the Brainerd-Robinson analysis demonstrates that there is a divergence in the uses of decorative

elements over time, which is consistent with a declining interaction between Chaco and the Northern Rio.

The use of this mid-level grouping scheme allowed the proportional representation of each category in the data to increase, which enables the Brainerd-Robinson difference to be more significant. Appendix G shows that differences between the Red Mesa Black-on-white pottery in Chaco and LA 835 are two-thirds likely to be due to chance, which supports that the regions were stylistically consistent in the 900s. The table also shows that there is a 92% probability that the differences between LA 835 Kwahe'e Black-on-white and Chaco PEG are real and significant (Appendix G). Across all four groupings, the results of the Brainerd-Robinson coefficient tests revealed that the Kwahe'e Black-on-white compared to Red Mesa Black-on-white from LA 835 was higher than that of the Red Mesa Black-on-white from Chaco compared to Chaco's PEG (Appendix F, H, J, L). These results suggest that decoration in the Northern Rio Grande diverged less over time than it did within Chaco Canyon. This increase in the departure shows that conservatism in the Northern Rio Grande relative to Chaco.

The Brainerd-Robinson coefficient also revealed that the likelihood that my sample size was adequate to conclude that the differences between sites and periods were not due to sampling error. This is reflected in the p-value generated by running the data through the script. Appendix F-M presents the Brainard-Robinson coefficients and the p-values for each set of tests run. The sample size of my project and Mathien's (1997) project vary drastically. I collected information for 839 designs from the Pojoaque Grant Site, but the Chaco Canyon Project data encompasses 9,181 designs. Even though there is some difference between the presence of designs and the number of sherds of each of the pottery types, it was essential to compare the totals from each region.

Discussion of the Results

The results of my study suggest that there are differences in the designs used over time in each region and that these differences are not likely due to chance. Each re-grouping of Mathien's (1997) design categories illuminates specific trends in the design selection process. The groupings highlight underlying trends that are difficult to see in Mathien's (1997) original design categories. The figures that detail the results of each grouping to illuminate the trends in design element selection over time and across pottery types.

Figures 8 and Figure 9 display the data based on Grouping 1 and present the percentages of the designs over time in each area. In Appendix B, the titles and codes associated with Grouping 1 are displayed. When looking at the figures, it is interesting to see how the trends between the comparable pottery types and the data from each region vary. In Figure 8, the prominence of squiggles (code 1) on Red Mesa Black-on-white from both Chaco and LA 835 is directly contrasted with the low usage of squiggles on PEG from Chaco and Kwahe'e Black-on-white from LA 835, as seen in Figure 9. Code 3, slanted hachure, appeared much more frequently on PEG from Chaco than Kwahe'e Black-on-white from LA 835 as seen in Figure 9. Grouping 1 highlights some of the more significant design decisions made across the regions and throughout the use of different pottery types.

Figure 8. This is a display of design percentages on Red Mesa Black-on-white at Chaco Canyon and the Pojoaque Grant Site based on Grouping 1.

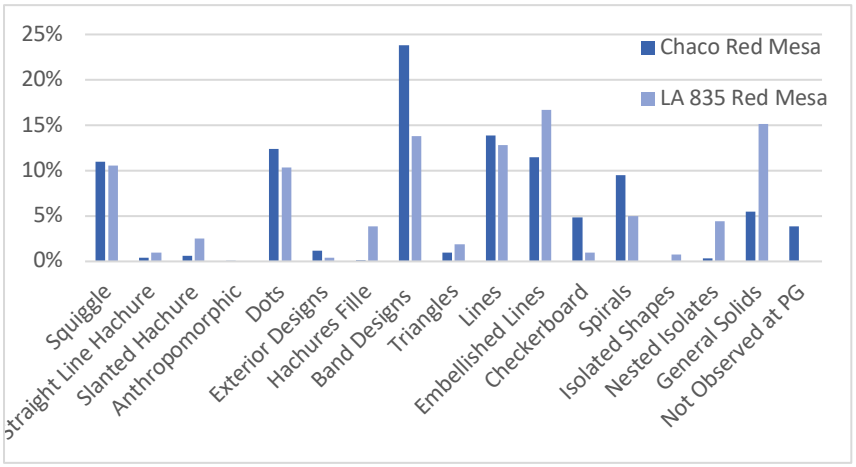


Figure 9. This is a display design percentages on Puerco, Escavada, and Gallup Black-on-white (PEG) from Chaco and Kwahe'e Black-on-white from the Pojoaque Grant Site based on Grouping 1.

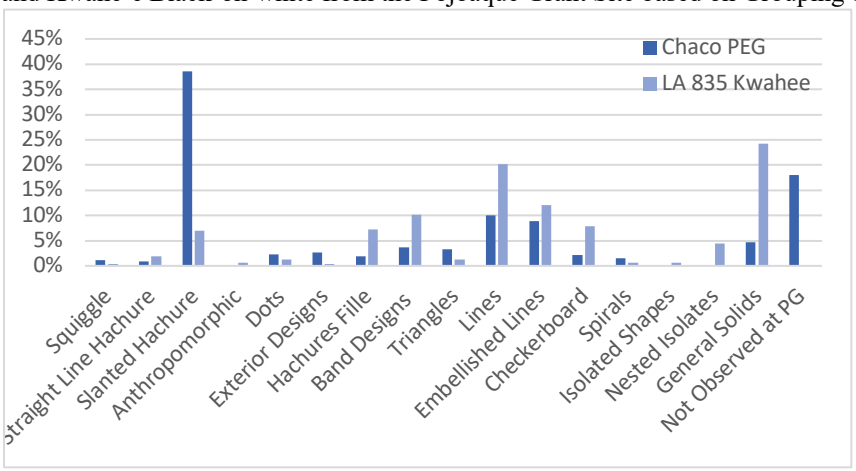


Figure 10 and Figure 11 display the data after it was further consolidated by the grouping attempt. The goal of Grouping 2 was to cover broad design trends in as few categories as possible. Appendix C lists all of the codes and their corresponding titles. As evidence by the comparison of Figure 10 and Figure 11, the first three design categories vary more between PEG from Chaco and Kwahe'e Black-on-white from LA 835 than between the Red Mesa Black-on-white from Chaco and LA 835. Similar to evidence in Figure 9, the use of squiggles (represented by code 1 in Figure 11) was not a prominent design motif on PEG from Chaco or Kwahe'e

Black-on-white from the Pojoaque Grant Site. Grouping 2 worked to lump large portions of design elements into reasonable categories, which led some of the changes in design selection to appear less drastic than those in Grouping 1.

Figure 10. This is a display of design percentages on Red Mesa Black-on-white at Chaco Canyon and the Pojoaque Grant Site based on Grouping 2.

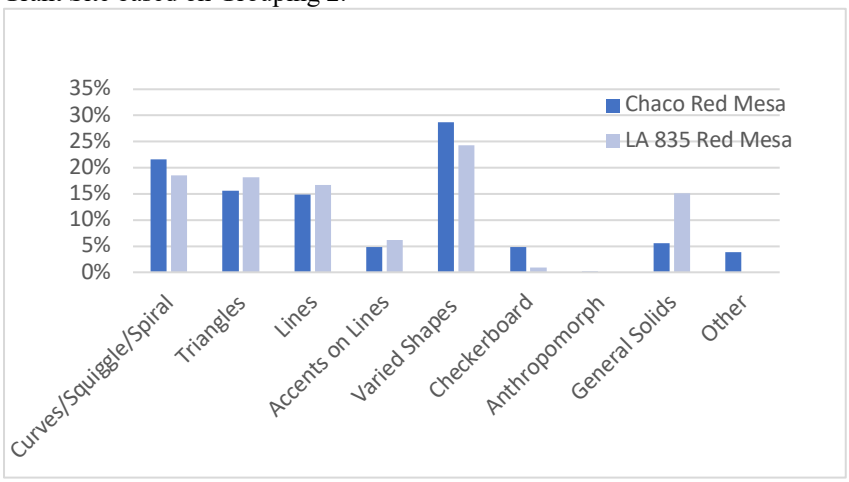
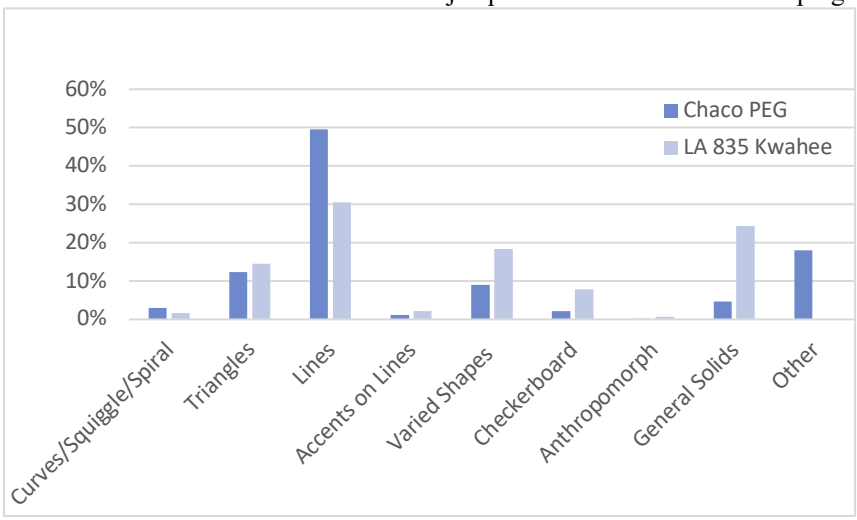


Figure 11. This is a display design percentages on Puerco, Escavada, and Gallup Black-on-white (PEG) from Chaco and Kwahe'e Black-on-white from the Pojoaque Grant Site based on Grouping 2.



Grouping 3 highlights the design elements that use straight lines as part of their design composition. As listed in Appendix D, codes 3 and 4 refer to categories that were unchanged

across all three grouping configurations. The pottery from LA 835, across both pottery types, had more sherds without continuous or straight lines than those from Chaco. As evidenced by the rates of code 1 across Figure 12 and Figure 13, designs with straight lines appeared more frequently on Chacoan pottery. Tracking the usage of lines underscored the prominence of straight lines on Chacoan pottery.

Figure 12. This is a display of design percentages on Red Mesa Black-on-white at Chaco Canyon and the Pojoaque Grant Site based on Grouping 3.

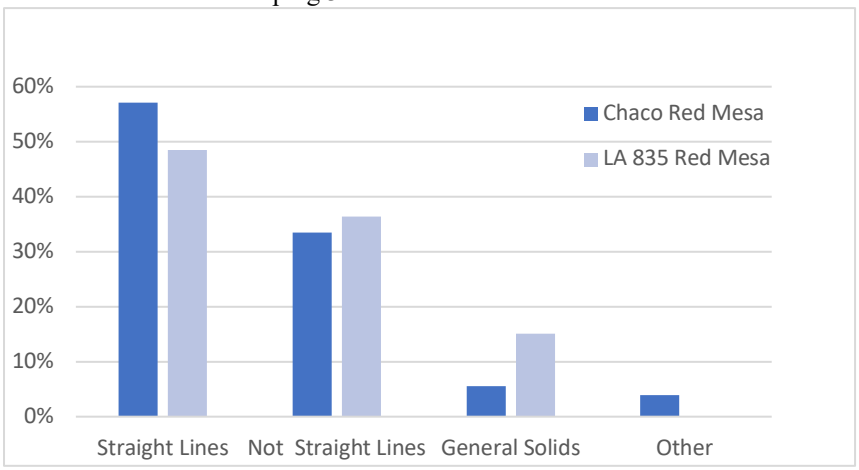
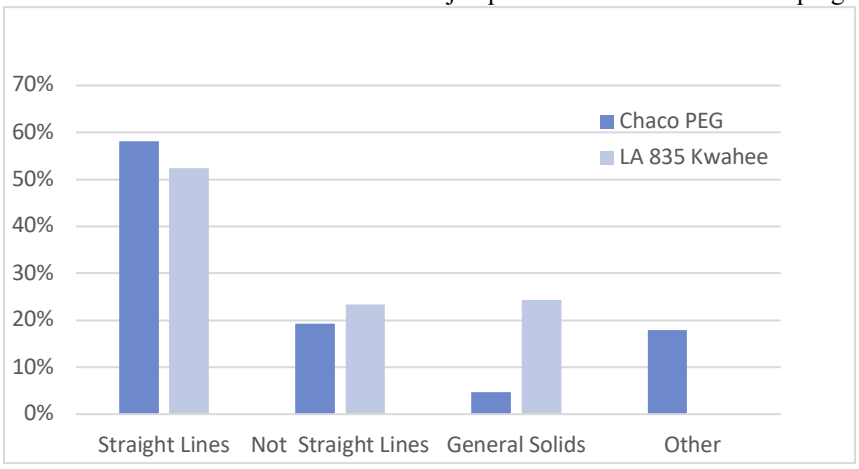


Figure 13. This is a display design percentages on Puerco, Escavada, and Gallup Black-on-white (PEG) from Chaco and Kwahe'e Black-on-white from the Pojoaque Grant Site based on Grouping 3.



In a similar vein to Grouping 3, Grouping 4 worked to highlight the use of one specific design element across pottery types, hachure. Also, like the figures for Grouping 3, design code

3 and code 4 represent design elements that are not being compared in the analysis of hachure usage. Appendix E details the Grouping 4 codes and their corresponding titles. The uses of hachure across Chaco, as evidence by Figure 14 and Figure 15, show an increase in the hachure element usage across pottery types. Figure 14 shows that Red Mesa Black-on-white sherds from LA 835 had more hachures than those from Chaco. Also, the use of hachure at LA 835 increased over time, as evidenced by Figure 14 and Figure 15.

Figure 14. This is a display of design percentages on Red Mesa Black-on-white at Chaco Canyon and the Pojoaque Grant Site based on Grouping 4.

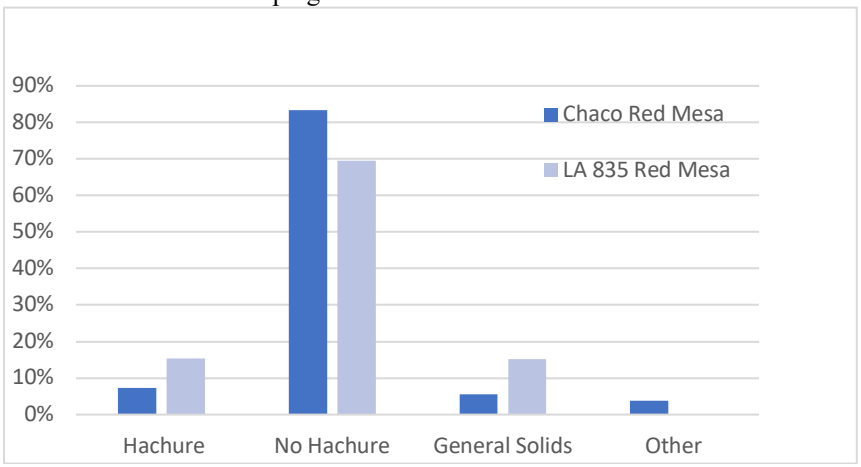
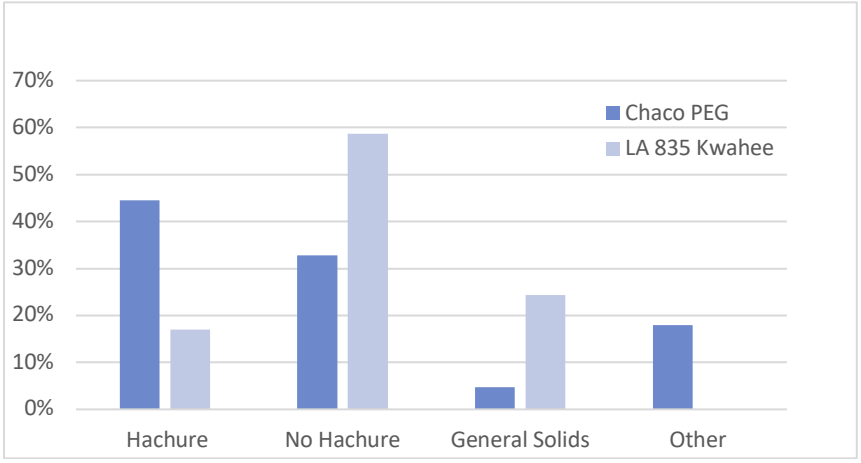


Figure 15. This is a display design percentages on Puerco, Escavada, and Gallup Black-on-white (PEG) from Chaco and Kwahe'e Black-on-white from the Pojoaque Grant Site based on Grouping 4.



Summary

This chapter presents the results of my data analysis. The chapter reveals how I interpreted this data and what it means for specific design categories. One section detailed how the Brainerd-Robinson coefficient illuminated the trends in the data from a statistics perspective. Within these sections, I discussed what each of these data analysis steps revealed about my data. Analyzing my data in this way allowed me to discuss the results concerning my research question. The results of my data analysis found that there is a decline in the similarity of design selection over time, and this is apparent even when several groupings of the data are applied. My findings are generally consistent with those of Schillaci et al. 2020, who found that much of the Red Mesa Black-on-white from LA 835 was sourced elsewhere whereas Kwahe'e Black-on-white was locally sourced.

Chapter 5 – Conclusions

Introduction

This final chapter presents a comprehensive review of the information presented in this thesis. I start with an overview of my chapters, which illustrates how my project was able to answer my primary research question: how the relationship between the people of Chaco Canyon and those of the Northern Rio Grande changed over time-based. In this chapter, I will also discuss the results of my study and how that relates to the nature of the interactions of people from the Pojoaque Grant Site and Chaco Canyon. I end the chapter with potential research opportunities for further inquiry into the quality of the relationship between these two places over time and why the change may be significant.

Overview of My thesis

In the first section of my thesis, I outlined what the parameters of my project were and why I was conducting this form of research. I presented information on the areas I would be analyzing to approximate their social relationships. This chapter presented information on the Chaco Regional System and the relationship between the system and the Northern Rio Grande. The last section of the chapter introduced the parts of the thesis that followed. Chapter 1 presented the goals of this project.

Chapter 2 was dedicated to situating my project within the relevant archaeological literature. I touched on the advancements in regards to anthropological understanding made at Chaco Canyon. Another section of my literature review was dedicated to the knowledge about Chaco Canyon and the Northern Rio Grande relationship to each other and in the context of the American Southwest. This chapter also covers portions of the literature on the Northern Rio

Grande with an emphasis on the Pojoaque Grant Site. The final section in the literature review is dedicated to the scholarship on the ability to interpret stylistic choices on pottery. My review focused on the question of how style can be analyzed in archaeology to understand social behaviors. Reviewing prior literature in the field allowed my project to be contextualized within the discipline.

The methods used in my attempt to gain an understanding of the possible social association between people of Chaco Canyon and the Northern Rio Grande were discussed in Chapter 3. I also delved into the context for the selection of my methods. I detailed how I placed the design elements, as defined by Mathien (1997), into other categories, to improve my ability to compare the data from Chaco Canyon and Pojoaque Grant. Limitations and constraints associated with my study were also included in this section. How the data was analyzed was also covered in Chapter 3.

Chapter 4 presented the results of my data analysis. This chapter detailed what these results mean regarding my research question. Chapter 4 discusses the raw data, percentages based on raw data, and the results of the data being placed in grouping fields. The information gleaned from the Brainerd-Robinson coefficient was also included in this chapter. My results indicated that there was a difference in the designs used on pottery over time from Chaco Canyon and the Northern Rio Grande. Within each region, there was also a transition in the design elements present on the pottery. Overall, Chapter 4 demonstrates that there is a decline in the similarity of designs used on the pottery types evaluated in this study over.

Discussion of My Results

As discussed in the previous chapter, my results indicated that over time there was an increasing difference in the mix of designs painted on pottery at Chaco Canyon and the Pojoaque Grant Site. With the introduction of Kwahe'e Black-on-white into the Rio Grande, pottery designs present on Kwahe'e vessels were less similar to those on the Puerco Black-on-white, Escavada Black-on-white, or Gallup Black-on-white varieties that were popular in Chaco Canyon, than they had been in the previous century when the Red Mesa style characterized both areas. The pottery type Red Mesa Black-on-white was initially unified the pottery traditions of the two areas, but over time the ceramic traditions diverged. The divergence in pottery types used after Red Mesa Black-on-white was already known to archaeologists. My study adds to the discussion in archaeology by quantifying that Kwahe'e Black-on-white is less different from Red Mesa Black-on-white than PEG. This provides a newfound sense of a conscious boundary between the two regions. The shift in designs used on Kwahe'e Black-on-white could suggest a deliberate divergence of the Northern Rio Grande from the Chacoan regional system over time.

Where Research Can Continue to Expand Knowledge of People from Chaco and the Rio Grande

The information presented here is just one small line of inquiry in the larger sphere of debate surrounding Chaco Canyon and the Northern Rio Grande. There is excellent potential for further investigation in this specific area of Southwestern Archaeology. When reflecting on my project, I had several thoughts as to projects that could continue to fill the gap in the academic knowledge base. More sampling of sites in the Northern Rio Grande using the same techniques displayed in Mathien could provide further evidence of trends seen here, or new patterns could emerge. Also, LA 835 is the largest site in the region, and it has a great kiva, so the early connection to Chaco may be higher here than across the Northern Rio Grande. More studies in the Northern Rio Grande would be useful to understand if the trend in design divergence I

observed at LA835 is consistent across the region. Scholars highlight the need for more studies of Developmental Period sites in the Northern Rio Grande in general (Schillaci et al. 2020). Previous studies or ethnographic data could provide an understanding of the potentially culturally significant reason for the selection of those designs. It also would be interesting to observe which designs were not used on pottery in relation to the design elements that are associated with the pottery types themselves. The cultural decisions people made is something scholars can learn more about by connecting with current potters to understand the cultural significance of design usage and why certain designs continue to be implemented in pottery. The divergence in pottery designs represents more than just a boundary, it indicated that there is a behavioral pattern underneath that can be traced and understood. Several possible studies can be formed to investigate the ways Chaco and the Rio Grande diverge culturally and relationally.

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Appendix

Appendix A. Groupings of Mathien's Design elements by me.

Design Code	Design Code Title	Grouping 1	Grouping 2	Grouping 3	Grouping 4
1	Isolated single elements	17	17	17	17
2	Hooks, Flags	11	5	1	2
3	Nested Isolates	15	5	2	2
4	Unnested isolates	14	5	2	2
5	Stars, Suns	17	17	17	17
6	Overlapping steps	17	17	17	17
7	Non-overlapping steps	10	3	1	2
10	Parallel Lines	10	3	1	2
11	Cribbed Parallel Lines	10	3	1	2
12	Banded Framers	8	3	1	2
13	Pendant Parallel Lines	10	3	1	2
14	Framers with unticked solids	8	5	1	2
15	Framers with ticked solids	5	5	1	2
16	Irregular wide lines	10	3	1	2
17	Ticking	11	4	2	2
18	Corner triangles	9	2	2	1
20	Scrolls	13	1	2	2
21	Framed solids	17	17	17	17
22	Dots	5	1	2	2
23	Other Framed Isolates	17	17	17	17
24	Framing Dots	17	17	17	17
25	Linear Dots	17	17	17	17
26	Dotted Lines	11	4	1	2
27	Thick Wavy Lines	11	1	2	2
29	Parallelograms	17	17	17	17
30	Dots in Parallelograms	17	17	17	17
31	Dotted Checkerboard	17	17	17	17
32	Checkerboard	12	6	1	2
33	Eyed Solids	9	2	2	2
34	Sawteeth	11	2	2	2
35	Barbs	11	2	2	2
36	Elongated Scalloped Triangles	11	1	2	2
37	Wide Sosi Style	10	3	1	2
38	Heavy Dotted Lines	5	4	1	2
39	Heavy Curvilinear Lines	17	17	17	17
40	Solid Band Design	8	5	1	2
41	Hatched Band Design	7	5	1	1
42	Isolated Triangles	9	2	2	2
43	General Solids	16	16	16	16
44	Bold Bisecting Lines	17	17	17	17
50	Hachure A-1	1	1	1	1
51	Hachure B-C	17	17	17	17

Design Code	Design Code Title	Grouping 1	Grouping 2	Grouping 3	Grouping 4
52	Hachure A-2	2	3	1	1
53	Hachure B-1	3	3	1	1
54	Hachure B-2	17	17	17	17
55	Hachure B-3	3	3	1	1
56	Hachure B-4	3	3	1	1
57	Hachure C	17	17	17	17
58	Hachure B-5	17	17	17	17
59	Hachure B-6	3	3	1	1
60	Hachure A-3	3	3	1	1
61	Hachure B-7	17	17	17	17
62	Countercharge	17	17	17	17
63	Hatched Checkerboard	17	17	17	17
64	Heavy Gallup Squiggle	1	5	2	1
65	Hatched Pendants	7	2	2	1
70	Squiggle Lines	1	1	2	2
71	Interlocked Frets	17	17	17	17
72	Anthro/Zoomorphs	4	7	2	2
73	Solid Ticked Triangles	5	2	2	2
80	Painted Motif on Rim Interior	17	17	17	17
81	Exterior Bowl Motif	6	5	2	2
82	Jar Neck Motif	6	5	2	2
83	White Exterior Design	17	17	17	17
84	Unslipped Motif Area Polychrome	17	17	17	17
85	Narrow Sosi Style	10	3	1	2
86	Narrow curvilinear	17	17	17	17
87	Interlocking Ticking	17	17	17	17
995	Others, Solid	17	17	17	17
996	Others, Hatched	17	17	17	17

Appendix B. Grouping 1 codes and titles

Grouping 1 Codes	Grouping 1 Titles
1	Squiggle
2	Straight Line Hachure
3	Slanted Hachure
4	Anthropomorph
5	Dots
6	Exterior Designs
7	Hachure Fill
8	Band Designs
9	Triangles
10	Lines
11	Embellished Lines
12	Checkerboard
13	Spirals
14	Isolated Shapes
15	Nested Isolates
16	General Solids
17	Other

Appendix C. Grouping 2 codes and titles

Grouping 2 Codes	Grouping 2 Titles
1	Curves/Squiggle/Spiral
2	Triangles
3	Lines
4	Accents on Lines
5	Varied Shapes
6	Checkerboard
7	Anthropomorph
8	General Solids
9	Other

Appendix D. Grouping 3 codes and titles

Grouping 3 Codes	Grouping 3 Titles
1	Straight Lines
2	No Straight Lines
3	General Solids
4	Other

Appendix E. Grouping 4 codes and titles

Grouping 4 Codes	Grouping 4 Titles
1	Hachure
2	No Hachure
3	General Solids
4	Other

Appendix F. Grouping 1 Brainard-Robinson Coefficient Matrix

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	200	150.829	70.78328033	128.8759	99.82894
Chaco Red Mesa	150.83	200	83.50976169	146.6324	101.688
Chaco PEG	70.783	83.5098	200	81.75232	86.41885
LA835 Red Mesa	128.88	146.632	81.75231739	200	134.2229
LA835 Kwahe'e	99.829	101.688	86.41884604	134.2229	200

Appendix G. Grouping 1 Brainard-Robinson P-values (1000 runs)

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	0	0.696	0.003	0.463	0.173
Chaco Red Mesa	0.696	0	0	0.698	0.584
Chaco PEG	0.003	0	0	0.013	0.083
LA835 Red Mesa	0.463	0.698	0.013	0	0.499
LA835 Kwahe'e	0.173	0.584	0.083	0.499	0

Appendix H. Grouping 2 Brainard-Robinson Coefficient Matrix

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	200	145.435	123	136.9219146	129.6585507
Chaco Red Mesa	145.4348004	200	102	169.5246595	123.7303869
Chaco PEG	123.2825988	102.264	200	95.57162279	123.192022
LA835 Red Mesa	136.9219146	169.525	95.6	200	138.7033613
LA835 Kwahe'e	129.6585507	123.73	123	138.7033613	200

Appendix I. Grouping 2 Brainard-Robinson P-values (1000 runs)

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	0	0	0	0	0
Chaco Red Mesa	0	0	0	0.008	0
Chaco PEG	0	0	0	0	0
LA835 Red Mesa	0	0.008	0	0	0
LA835 Kwahe'e	0	0	0	0	0

Appendix J. Grouping 3 Brainard-Robinson Coefficient Matrix

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	200	157.8854842	159.92	136.0194	143.8164
Chaco Red Mesa	157.8854842	200	169.7948	174.9465	162.45
Chaco PEG	159.9200363	169.7948406	200	144.7413	152.5383
LA835 Red Mesa	136.0193729	174.9464769	144.7413	200	173.8908
LA835 Kwahe'e	143.8163682	162.4500373	152.5383	173.8908	200

Appendix K. Grouping 3 Brainard-Robinson P-values (1000 runs)

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	0	0	0	0	0
Chaco Red Mesa	0	0	0	0.008	0
Chaco PEG	0	0	0	0	0
LA835 Red Mesa	0	0.008	0	0	0
LA835 Kwahe'e	0	0	0	0	0

Appendix L. Grouping 4 Brainard-Robinson Coefficient Matrix

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	200	186.30031	85.33121308	154.2213048	132.491
Chaco Red Mesa	186.3	200	97.35526008	164.7335802	143.0033
Chaco PEG	85.3312	97.35526	200	105.6190829	109.0371
LA835 Red Mesa	154.221	164.73358	105.6190829	200	178.2697
LA835 Kwahe'e	132.491	143.00328	109.0371426	178.269698	200

Appendix M. Grouping 4 Brainard-Robinson P-values (1000 runs)

	Chaco Early Red Mesa	**Chaco Red Mesa**	**Chaco PEG**	**LA835 Red Mesa**	**LA835 Kwahe'e**
Chaco Early Red Mesa	0	0	0	0	0
Chaco Red Mesa	0	0	0	0	0
Chaco PEG	0	0	0	0	0
LA835 Red Mesa	0	0	0	0	0.005
LA835 Kwahe'e	0	0	0	0.005	0