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Being and Becoming: Learning, Skill, and Cognition as Exhibited on Painted White Ware Pottery at Sand Canyon Pueblo (5MT765), a Pueblo III Era Community Center in Southwestern Colorado

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Being and Becoming: Learning, Skill, and Cognition as Exhibited on Painted White Ware Pottery at Sand Canyon Pueblo (5MT765), a Pueblo III Era Community Center in Southwestern Colorado

by

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Abstract

The theory of conceptual metaphor through material culture posits that human physical experience with natural and cultural materials serves as the basis for the development of abstract knowledge (Tilley 1999). Apprenticeship theories in archaeology (e.g. Walleart ed. 2012) study how craft knowledge is transmitted generationally. Combining these approaches, this thesis seeks to understand if the "container metaphor" (sensu Ortman 2000a, 2012) was taught by adults and learned by children at the Sand Canyon Pueblo archaeological site in southwest Colorado, by comparing white ware pottery produced by children to those produced by adults. Patricia Crown's (1999, 2001, 2002) 18-point attribute analysis for determining the age and skill level of producers of painted designs of pre-Hispanic southwestern ceramics was adapted and tested on those vessels.

The results of the study show that most ladles and several other vessels exhibit multiple less-skilled techniques that strongly suggest childhood production. It is determined that the attribute analysis can be usefully employed to assess a range of skills not necessarily related to youth production, as it is demonstrated more broadly that relative levels of exhibited skill in painting are tied to specific vessel forms. It is shown that circles are near universally communicated as a design motif on pottery containers by all members of the Sand Canyon community of practice, regardless of age or skill. It is suggested that CIRCLES ARE CONTAINERS was a metaphor learned and experienced during childhood. Possible metaphorical links between ladles and childhood are considered. However, more research is needed to develop these ideas further.

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Chapter 1: Introduction

The Sand Canyon Pueblo site located in southwestern Colorado is associated with the ancestral Pueblo culture area (Figure 1.1). It was extensively excavated by the Crow Canyon Archaeological Center (CCAC) from 1984 to 1989, and 1991 to 1993, with an exhaustive final report and site database published online (Kuckelman 2007a). The excavation of Sand Canyon Pueblo was the centerpiece of a broader, multidisciplinary investigation into the archaeology and history of ancestral Pueblo sites in the region (Varien and Wilshusen 2002; Kuckelman 2007a). Sand Canyon Pueblo consists of 420 rooms, 90 kivas, 14 towers, an enclosed tower, a "D" shaped bi-wall building, and a great kiva (Kuckelman 2007b). Sand Canyon Pueblo was inhabited during the Pueblo III (PIII) period (according to the Pecos classification) between approximately C.E. 1250 and 1280, with a major coalescence within the site between C.E. 1260 and 1270 that coincided with an out-migration of people from the Mesa Verde region culminating in the early-to-mid 1280s (Kuckelman 2007a; Ortman and Bradley 2002; Ortman and Varien 2007, Schwindt, Bocinsky, Ortman, Glowacki, Varien, and Kohler 2016; Varien, Ortman, Kohler, Glowacki, and Johnson 2007). A brief but mortally violent episode occurred at Sand Canyon Pueblo around C.E. 1280, following a wave of intense warfare that swept the region (Bradley 2002; Kuckelman and Martin 2007; Kuckelman 2010a, 2010b; Leblanc 2000). The site was completely abandoned shortly after the attack, coinciding with the depopulation of Puebloan people from the region. After the Pueblo was depopulated, many of the artifacts were left *in situ* in their regular use areas, and are thus considered to be in *de facto* contexts (Till and Ortman 2007). Because the site exhibits astounding depositional integrity – and also because of the high quality scientific and humanistic research into the site – data from Sand Canyon have contributed significant information regarding the relatively sudden coalescence of populations

into and around large villages in the middle of the 13th century, concomitant to and followed by the total migration of Pueblo people from the greater Mesa Verde region by the late 13th century (Kuckelman 2007a; Ortman 2010, 2012; Ortman and Varien 2007; Varien 2010; Varien and Wilshusen 2002).

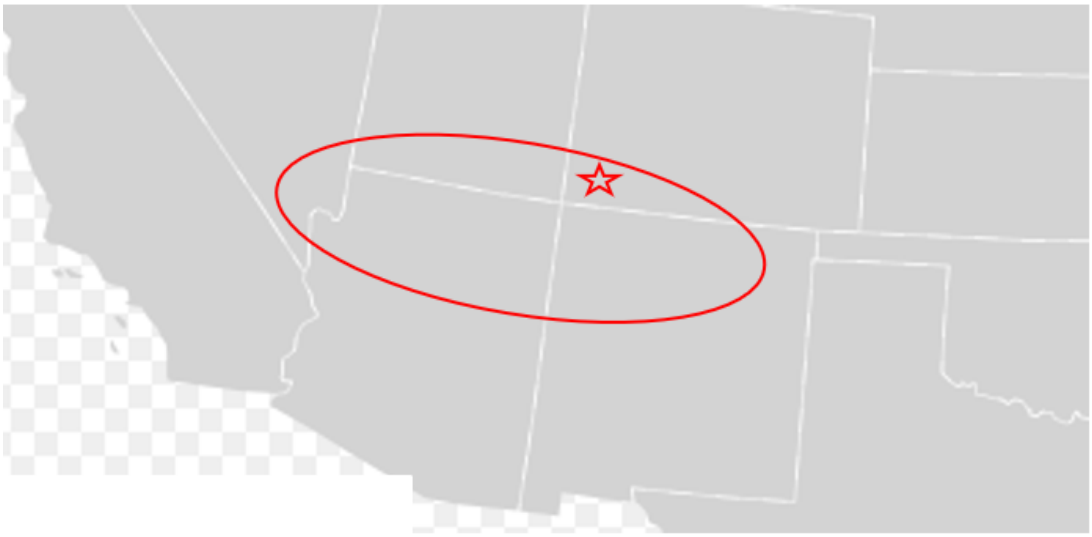

Figure 1.1. Map indicating ancestral Puebloan culture area in red oval, with Sand Canyon Pueblo indicated at the red star. Political map adapted under Creative Commons license (Theshibboleth 2006).

With a large and continuously evolving body of research placing these trends in environmental and demographic contexts, archaeologists are calling for a deeper understanding of the social and cultural milieu of the ancestral Pueblo during this period (Duff, Adams, and Ryan 2010:179; Glowacki 2010; Hill et al. 2010:43; Kohler 2010:119-120; Varien 2010:33; Wright 2010:100). Sand Canyon Pueblo has already helped researchers understand ancestral Puebloan culture during this period. Some examples include studies into identity, ideology, iconography, power, factionalism, community organization, the production, consumption, trade and exchange of tools and crafts; and Indigenous historical knowledge of Sand Canyon and the Mesa Verde region (e.g. Adler 2002; Bradley 1996; Bradley 2002; Glowacki 2010; Kuckelman

2000; Lipe 2002; Muir 2007; Ortman 2000; Ortman 2012; Ortman and Bradley 2002; Pierce, Glowacki, and Thurs 2002; Putsavage 2008; Robinson 2005; Reyna 2000; Thompson 2002; Till and Ortman 2007).

To understand further the cultural life of the PIII ancestral Puebloan people through Sand Canyon Pueblo, this thesis will attempt to discern the teaching and learning of conceptual metaphor through painted pottery designs from adult potters to child potters. In this chapter, previous investigations and theories regarding the social and cultural life at Sand Canyon within an environmental and demographic context will be discussed. It will be determined that children were probably integral social agents at Sand Canyon. Following that, an overview of the theoretical lens of the conceptual metaphor through material culture will demonstrate how that theory is as a viable method for understanding past cultures through archaeology. Then, work by Ortman (2000a; 2012) and Orman and Bradley (2002) utilizing this theoretical framework pertaining to the ancestral Puebloan people of the Mesa Verde region during the PIII era will be discussed. It will be shown that pottery and pottery painting are rich sources for and reflections of cultural metaphor. This chapter will thus demonstrate that archaeologists may be able to understand a fundamental aspect of ancestral Puebloan culture by understanding how metaphor was communicated cross-generationally by examining painted pottery designs.

Environmental Overview

The Sand Canyon Pueblo site is in Montezuma County, Colorado, roughly 20 km northwest of the town of Cortez, Colorado (Figures 1.2 and 1.3). It is located about 10 km north of the northern edge of Ute Mountain, and about 25 km northwest of Mesa Verde proper. The site is located on the northeastern portion of the Colorado Plateau, and is part of the central Mesa Verde region (Varien and Wilshusen 2002). Sand Canyon Pueblo lies on a drainage of McElmo

Creek to the south, which is part of the northern San Juan River basin - a tributary to the Colorado River (Kuckelman 2007b). Situated on sandstone cliffs and talus slopes about the head of Sand Canyon at an elevation of 2,073 meters above sea level, the site encircles a spring which drains into the canyon (Kuckelman 2007b; Ortman and Bradley 2002).

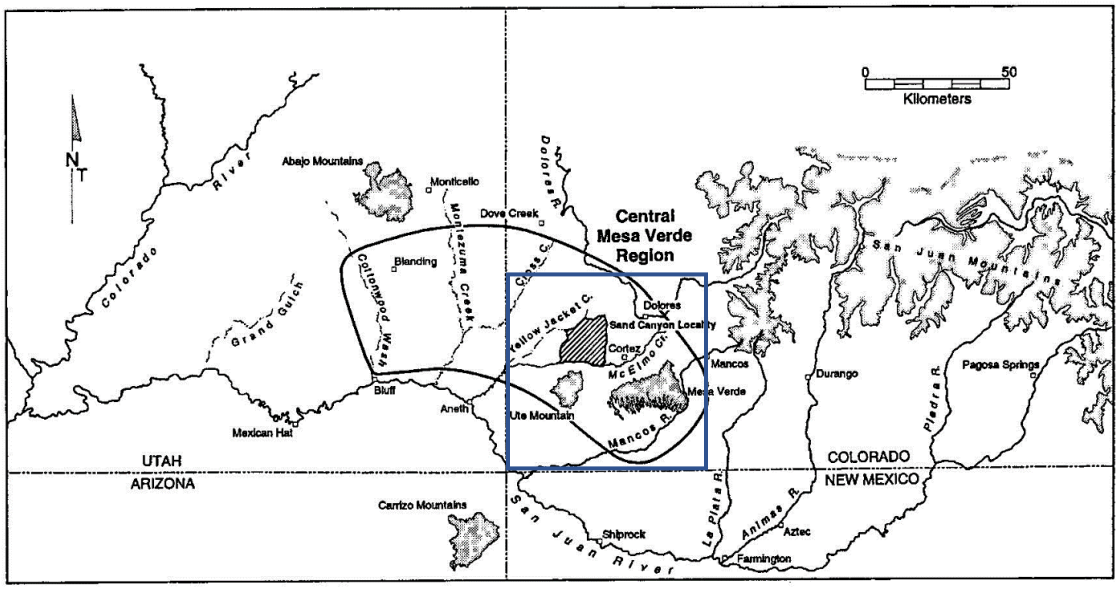

Figure 1.2: Map of the Central Mesa Verde region (Varien and Wilshusen 2002:4). Note: The blue box represents the Village Ecodynamics Project (II) study area (from Varien et al. 2007). Map adapted by permission from Crow Canyon Archaeological Center.

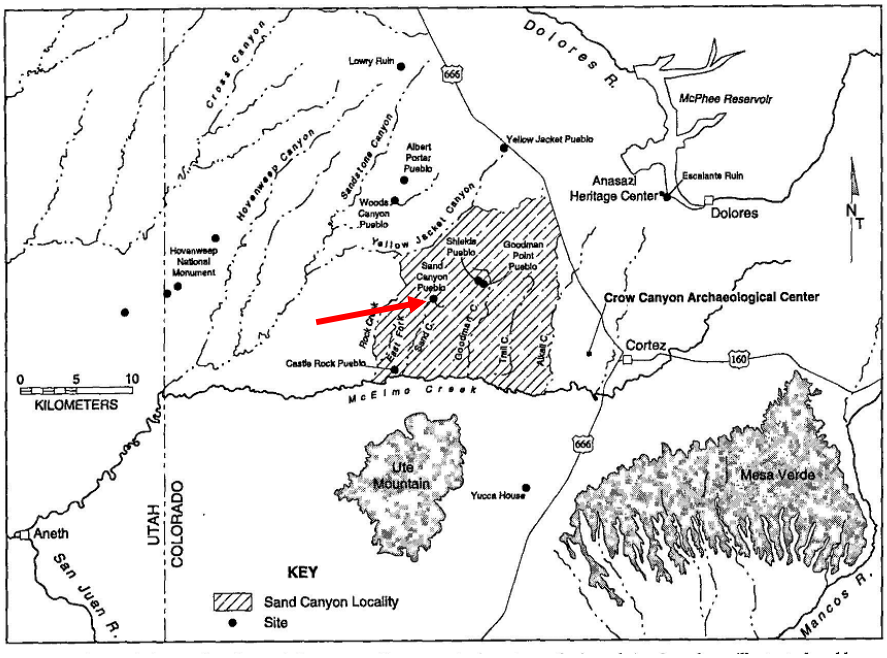

Figure 1.3: Map locating Sand Canon Pueblo (red arrow) and surroundings (from Varien and Wilshusen 2002:5). Adapted by permission from Crow Canyon Archaeological Center.

A variety of wild plants and animals live in the generally hot and dry environment around the vicinity of Sand Canyon. Piñon pine (*Pinus edulis)* and Utah juniper (*Juniperus osteosperma*) characterize the arboreal environment, along with interspersed big sagebrush (*Artemisia tridentate*) (Adams, Kuckelman, and Boyer 2007). Pine and juniper trees were used as construction timbers and as fuel sources (Adams and Boyer 2002; Duff et al. 2010). Grasses (*Gramineae*), mustards (*Cruciferae*), and mallows (*Malvaceae*) dominate the understory, while prickly pear (*Opuntia*) makes its home in especially dry spots (Adams et al. 2007). An important source of hunted game evident in the faunal assemblage at Sand Canyon Pueblo include lagomorph (rabbit), while artiodactyls (deer and other even-toed ungulates) and other large fauna appear prominently at the end of the habitation (Driver 2002; Kuckelman 2010; Muir 2007). However, domesticated floral and faunal resources were crucial sources of food for most of the site's occupation (Adams and Boyer 2002; Driver 2002; Kuckelman 2010; Potter and Ortman 2002). The most important domestic cultigen was maize (*Zea mays*), which was grown using

dry-land farming techniques (Adams et al. 2007). Corn was used to feed domestic turkey (*Meleagris gallopavo*), an important protein source heavily relied upon at Sand Canyon Pueblo (Adams and Boyer 2002:137; Driver 2002; Kohler et al. 2008). Beans were also an important food source (Potter and Ortman 2002). The people of Sand Canyon Pueblo were quite healthy and seem to have had access to quality food for most of their occupation at the site (Adams and Boyer 2002; Bradley 2002; Kuckelman and Martin 2007; Muir 2007).

The Southwest's arid climate impacts how people live in the region. Winter snows and summer monsoon rains are vital sources of precipitation in this area. Subtle climatic shifts are common throughout the Southwest, as climate can vary at different frequencies by sub-region and through time. For example, during the occupation of Sand Canyon Pueblo, the years between C.E. 1252 and 1272 were wet years, immediately followed by a severe drought that lasted until C.E. 1288 (Wright 2010:89-91). Fluctuating climatic conditions affected food and resource procurement strategies, and stressed established social, political, and cultural systems developed over time and during previous climatic conditions. The evident warfare and outmigration experienced by Puebloan peoples during the latter half of the 13th century is often associated with these stressors. However, the nature of these relationships remains a robust and ongoing avenue of research; a topic that exists largely outside the scope of this thesis (e.g. Adams et al. 2007; Dean and Van West 2002; Kohler 2010; Kohler et al. 2006; Kuckelman 2010a, 2010b; Schwindt et al. 2016; Varien et al. 2007; Wright 2010). With that in mind, the following section will outline demographic trends as related to paleoclimate studies during the PIII period in the northern San Juan to contextualize the milieu in which Sand Canyon Pueblo was situated.

Demographic History

Strategies for determining past demographics in southwest Colorado may vary in method, scope, and results. To provide a broad overview relevant to describing the context in which the people of Sand Canyon Pueblo existed, information gathered from the Sand Canyon Archaeological Project and the Village Ecodynamics Project (VEP) study will be described. The VEP is collaborative effort between CCAC and Washington State University aimed at understanding the relationship between the ancestral Puebloans and their environments in the Mesa Verde region in southwestern Colorado.

The population total and density of the Puebloan people in southwestern Colorado as indicated by the VEP study area in Figure 1.2 increased from C.E. 920 up to C.E. 1260, and slowly declined until the population precipitously collapsed in the 1280s (Table 1.1). This growth spurt and decline mirrors a similar but smaller scale demographic trend that occurred in the region between C.E. 600 – 920 during Basketmaker III and Pueblo I periods (Ortman and Varien 2007:15, Figure 3; Varien et al. 2007:283, Figure 4; Wilshusen 2002:105). The population density in the VEP at that peak was about 11 people/km, which is below ratios generally associated with hereditary rule and regional polities in formative Mesoamerica at 15 people/km (Ortman and Varien 2007:18; Lipe 2002). However, Lipe (2002:213) asserts that Puebloan populations may have been experimenting with new social and political methods to regulate the interactions of an increasing number of people in an environment that was constantly changing.

Table 1.1: Population estimates for ancestral Puebloan populations in the VEP study area in southwestern Colorado (from Varien et al. 2007:284, reproduced by permission from American Antiquity).

Period		Database momentary households		Study area momentary households			
Begin (A.D.)	End (A.D.)	Small sites in block surveys	All community centers	Small sites[a]	Total	Total persons[b]	Population Density[c]
600	725	40.4	2.2	302.2	304.4	1826	1.03
725	800	38.3	39.2	286.6	325.8	1955	1.10
800	840	102.6	67.9	767.7	835.6	5013	2.82
840	880	123.8	104.3	925.9	1030.2	6181	3.48
880	920	35.1	107.8	262.6	370.4	2223	1.25
920	980	34.8	28.4	260.4	288.8	1733	0.98
980	1020	83.7	26.6	626.2	652.8	3917	2.21
1020	1060	85.1	35.0	636.3	671.3	4028	2.27
1060	1100	149.1	269.0	1115.6	1384.6	8307	4.68
1100	1140	218.0	309.0	1631.1	1940.1	11641	6.55
1140	1180	225.0	394.0	1683.5	2077.5	12465	7.02
1180	1225	231.0	598.0	1728.4	2326.4	13958	7.86
1225	1260	303.0	967.0	2267.1	3234.1	19404	10.93
1260	1280	123.0	850.0	920.3	1770.3	10622	5.98

[a]Block survey small sites / proportion of study area surveyed.
[b]Total households x 6, after Lightfoot (1984).
[c]Total persons / 1776 km^2 of land below 2400 m (7900 ft.) in study area.

Some of these methods may be reflected in the type, size, and location of villages that people chose to settle. Ortman and Varien (2007:25) distinguish between “communities” and “community centers” in the context of the study area. Communities are defined as smaller village settings that allow for all residents to have face-to-face interactions and access to geographically proximate resources. A community center is a densely settled core village where there is evidence for the practice of distinct and important economic, social, ritual, and political activities. Both communities and community centers exist in the region throughout the Puebloan periods, but the number and proportions of these demographics shift through time. By C.E. 1260, an increased number of people living in the McElmo Dome study area were living in and around community centers, such as Sand Canyon Pueblo (Kuckelman 2007:3; Ortman and Bradley 2002:43; Ortman and Varien 2007:32, Table 16).

Sand Canyon Pueblo was constructed beginning around C.E. 1250, with modifications to the site continuing through the 1270s (Figure 1.4). Sand Canyon Pueblo may have housed up to

600 individuals at a time. (Kuckelman 2007:3; Ortman and Bradley 2002:52-53). The rapid, labor intensive construction and organized layout of Sand Canyon Pueblo suggest the presence of an influential civic entity tasked with directing human action (Lipe 2002; Thompson 2002:259). The architectural layout of Sand Canyon Pueblo suggests that it was a planned community center with complex ritual functions (Ortman and Bradley 2002; Thompson 2002:258). The major features of the built environment that indicate this include the pueblo's distinctive construction surrounding a spring, its public/ceremonial architecture, and defensive fortifications including an enclosing wall and towers. These features suggest a primary concern for access to and control of a permanent water source, which seems to further suggest strained relationships with neighbors during difficult times (Kuckelman 2002: 234; Kuckelman 2010b:498; Wilshusen 2002:105-106). Indeed, there is some evidence to suggest that a large segment of the site-enclosing wall was built in the mid-1260s to early 1270s, which may coincide with increasingly unfavorable climatic conditions and the abandonment of smaller communities described above (Kuckelman, Bradley, Churchill, and Kleidon 2007:169). Another explanation of these features from a Puebloan informant commenting on Sand Canyon Pueblo says the architectural association with water is a purposeful feature because water is a symbolic center place and spiritual source of existence (Thompson 2002:259).

The number of people living in smaller communities also continued to rise until C.E. 1260, then decreased dramatically between C.E. 1260 and 1280. Meanwhile, the number of people living in community centers decreased at a much lesser rate, so that a greater proportion of Puebloans in the McElmo Dome live in community centers during these two decades (Varien et al. 2007:284). Schwindt et al. (2016) attributes the abandonment of smaller communities beginning in C.E. 1260 (at least in part) to the increasing difficulty of Puebloan people to grow

maize in marginal environments where these communities were located (Schwindt et al. 2016; Wright 2010). While drought cycles occurred between C.E. 600 and 1300 in the region, it may be that the social institutions and settlement patterns that developed over time to accommodate population growth and expansion across the landscape were strained in the 13th century (Schwindt et al. 2016:91). Many of the affected people simply relocated. Ortman (2012) provides evidence that many people who migrated from the northern San Juan during this era had settled in the northern Rio Grande in modern-day New Mexico, and are the ancestors of the Tewa. Many of those who stayed until ca. 1280 were victims of lethal violence, before the total abandonment of the region by Puebloan peoples.

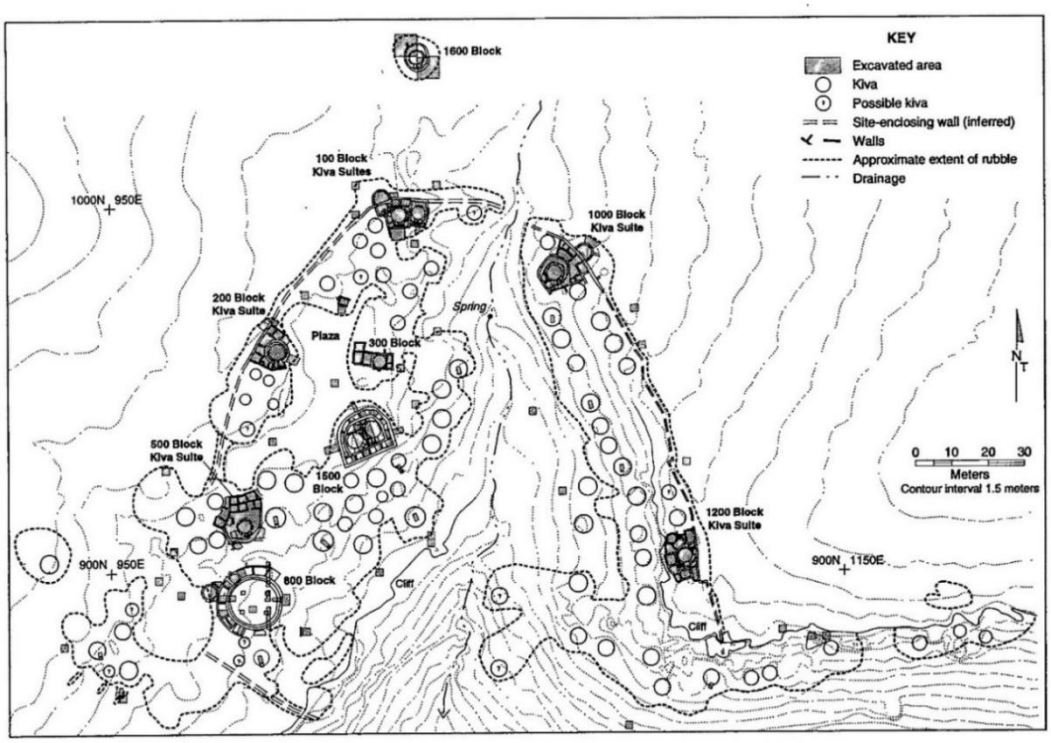

Figure 1.4: Plan map of Sand Canyon Pueblo (from Ortman and Bradley, 2002:42). Reproduced by permission from Crow Canyon Archaeological Center.

Based on the human remains data from Sand Canyon Pueblo, youths probably comprised a large proportion of the population at the site. While it is difficult to extrapolate demographic

trends with confidence from the human remains at Sand Canyon Pueblo, some data are available (Kuckelman and Martin, 2007). Younger people are strongly represented in the Sand Canyon human remains assemblage (Kuckelman 2007c:53). Twenty-one out of 32 individuals whose age and/or sex could be determined were 20-years-old or younger (categorized as "sub-adults") at the time of their deaths (Kuckelman and Martin 2007:17, Table 2). Ten of these sub-adults were adolescents with an estimated age range between 12 and 20 years, another 10 were aged approximately 5 years or less, with the remaining individual aged between 8-12 years. There are different proportions by age when the mortuary contexts are broken up between formal burials and abandonment depositions. "Abandonment depositions" refers to remains of people who perished at the time of the attack on the Pueblo, most of whom were probably residents of the Pueblo. Of the nine formal burials, eight (89 percent) were sub-adults (Bradley 2002; Kuckelman and Martin 2007:18). Six of those 8 individuals were aged 5 years or less, and the other two were aged between 12-20 years (Kuckelman and Martin 2007: Table 2, Table 6). Of the 23 individuals who died in abandonment contexts, 57 percent were 20 years or younger, while 23 percent were aged 5 or younger (Kuckelman and Martin 2007: Table 6). Compared with similar burial assemblages in the region, the proportion of adolescents in abandonment contexts and total sub-adults in burial contexts appears to be high (Table 1.2). However, the total proportion of the skeletal remains of sub-adults falls in the general range of the proportions of sub-adults in larger burial assemblages from other nearby sites (Kuckelman and Martin 2007:17, Table 6). The proportions of children also fall in the range of a figure given by Baxter (2005:10) stating that children (defined without stating an age range) typically comprise between 40 to 65 percent of the population of any given pre-industrial population. Because these data ranges are proportional to other sites, they may indeed roughly represent the demography of Sand Canyon.

However, they could represent an increased participation of youths in the violence at the end of the occupation, or they could indicate that sub-adults were less likely to survive the incident (Kuckelman and Martin 2007:21). Additionally, a study of the pre-adult skeletons at Sand Canyon Pueblo by Bradley (2002) indicates that children at Sand Canyon were generally healthy, suggesting that their good health may have allowed them to be active agents at the site. Therefore, it would be reasonable to theorize that children were involved in the material and social life of the Pueblo.

Table 1.2: Percentage of sub-adults identified in human remains assemblages from various Puebloan sites (from Kuckelman and Martin 2007:17 Table 6). Adapted by permission from Crow Canyon Archaeological Center.

Site Assemblage	Sample Size (number of individuals)	Percent < 20 years old	Percent < 5 years old
Point of Pines	**428**	**41**	**31**
Pecos Pueblo	**587**	**30**	**16**
Mesa Verde	**202**	**40**	**12**
Grasshopper Pueblo	**608**	**67**	**75**
UMUILAP	**63**	**46**	**48**
Yellow Jacket sites 5MT1 and 5MT3	**67**	**54**	**50**
Sand Canyon Pueblo (all human remains occurrences	**32**	**66**	**43**
Sand Canyon Pueblo (formal burials)	**9**	**89**	**75**
Sand Canyon Pueblo (abandonment contexts)	**23**	**57**	**23**

Civic Architecture

The presence of ceremonial architecture indicates that organized social ritual was important to Sand Canyon's occupants (Ortman and Bradley 2002). Excavations at the Pueblo uncovered at least two such spaces: a great kiva, and a D-shaped bi-walled building (Kuckelman et al. 2007; Ortman and Bradley 2002). Great kivas are large, circular spaces that serve as loci of community gatherings in the ancestral Pueblo culture. The first great kivas were constructed by the late 6th century, and were features of community life up to the time of Sand Canyon and the last pueblos in southwestern Colorado (Ortman and Bradley:62; Mark Varien, personal communication). While most kiva suites at Sand Canyon are interpreted as semi-private domiciles, the great kiva is thought to have been a community gathering center (Figure 1.5). The kiva was not roofed, probably because the area was meant as a space to witness public rituals (Ortman and Bradley:64). Ortman and Bradley (2002:64) estimate that up to 250 people could have directly witnessed activities in this space. These activities likely featured ceremonies involving public feasting and the display of painted white ware bowls. Other architectural features also suggest this interpretation as a great kiva (Ortman and Bradley 2002:62-65; Potter and Ortman 2002).

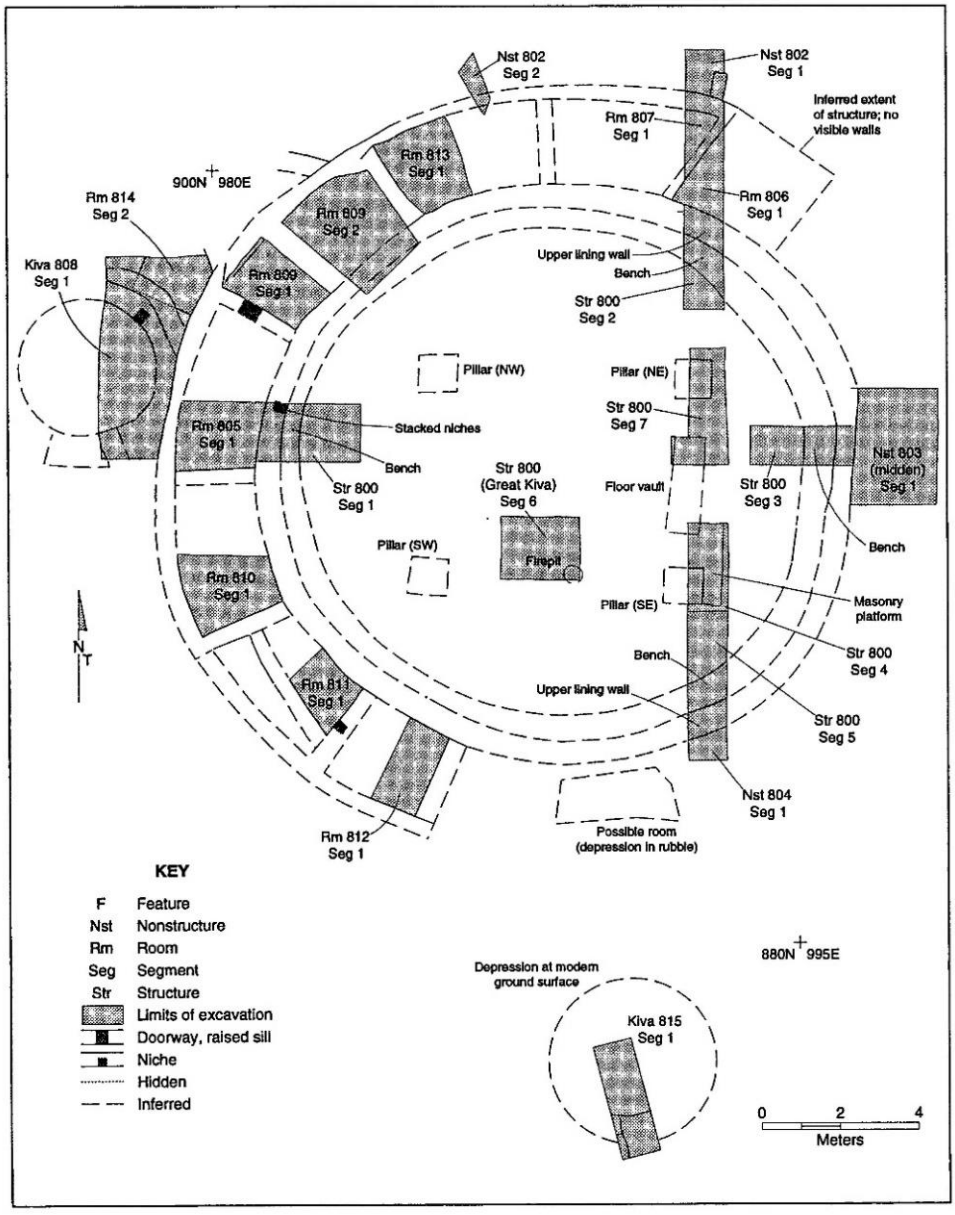

Figure 1.5: Plan map of the great kiva (from Ortman and Bradley 2002:63). Reproduced by permission from Crow Canyon Archaeological Center.

The D-shaped building was likely a more restricted ritual space (Figure 1.7). The appearance of D-shaped buildings is a striking phenomenon characteristic of PIII community centers across the Mesa Verde region. Before Sand Canyon Pueblo was excavated, only two of these structures had ever been excavated. However, the documentation of those excavations was

poor (Bradley 1996:246). The excavation at Sand Canyon provided unprecedented insight into the purpose of these buildings. The structure is situated in a prominently visible location in the village (Ortman and Bradley 2002:55). The D-shaped building contains an inner and outer wall that surround a series of peripheral rooms, which in turn surround two kivas which are roughly aligned east-to-west. While access to the western chamber was open and straightforward, entrance to the eastern kiva was restricted. The passageway to the east kiva was designed circularly, so that the entrant was required to walk in a centripetal pattern in order access this space. This is important because moving in such a pattern reflects modern Pueblo ritual and worldview (Ortman and Bradley 2002:59-60). Ceremonies conducted in the structure may have involved calendric, seasonal rites (Ortman and Bradley 2002:61). Other unique features in these kivas suggest a distinct purpose for the building (Kuckelman et al. 2007:155; Ortman and Bradley 2002). Domestic artifacts were located on both kiva floors, which suggests that the D-shaped building was intended for both ritual and domestic uses (Ortman and Bradley 2002:62).

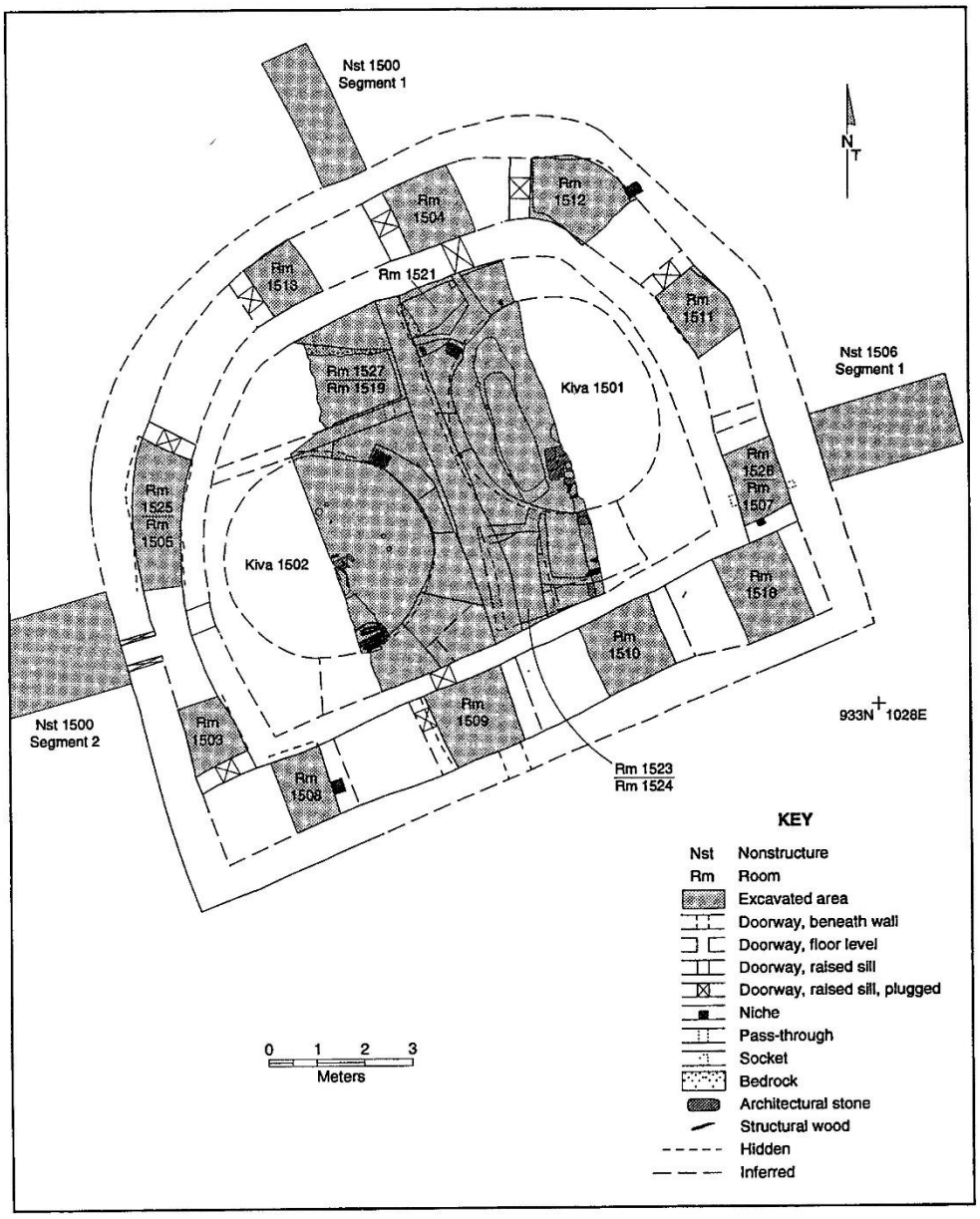

Figure 1.6. Plan map of the D-shaped building (from Ortman and Bradley 2002:56). Reproduced by permission from Crow Canyon Archaeological Center.

Further evidence for a ceremonial function of the D-shaped building is indicated by high quantities of wild bird remains there compared to other areas of the site (Muir 2007:58). These remains likely came from birds such as jays, crows or ravens, falconids and other birds of prey, and songbirds (*Passeriformes*) (Muir 2007:61). Conversely, domestic turkey remnants are

comparatively sparse in this block (Muir 2007:55). Muir (2007:62) suggests the possibility that these types of birds were harvested for their feathers and other parts to be used with ceremonial regalia, and further suggests the possibility that certain wild birds that may be represented in this assemblage were associated with water and ceremonies involving water, as they were for historically documented Pueblos.

Bruce Bradley (1996) argues that the D-shaped buildings and towers across the Mesa Verde region are evidence of a Chaco "revivalism" that swept the region during the latter half of the 13th century, as the D-shape strongly mimics the shape of the influential Pueblo II era (ca. C.E. 900-1150) site of Pueblo Bonito at Chaco Canyon. D-shaped towers are also present at Sand Canyon (e.g. Tower 101) as well as at other sites (Bradley 1996; Kuckelman 2007b:32). Community centers in the Central Mesa Verde region are often associated with D-shaped structures, defensive architecture, and the enclosure of springs (Kuckelman 2010b:519). Bradley (1996) also suggests the appearance of mug ceramic vessels during the PIII are revival forms of Chacoan pitchers, and Putsavage (2008) confirms that mugs at least in part had a special ritual function. These associations could indicate a powerful ideological reason for aggregation in community centers such as an attempted revival of Chaco culture. In order to investigate ideology through the archaeological record, however, a rigorous method for understanding abstract concepts through material culture is needed.

Conceptual Metaphor and Material Culture

One way to understand the cultural values of the ancestral Puebloans is using the theoretical of the conceptual metaphor through material culture. This theory was developed by Christopher Tilley (1999), based on the work of linguist George Lakoff and colleagues (e.g. Lakoff and Johnson 1980), and further refined through a robust body of studies in cognitive

science. Humans primarily understand unfamiliar objects or ideas by associating them with more understandable phenomena (Ortman 2000a:616, 2012:204; Tilley 1999:16). In this way a metaphor is created when a "target" domain is understood by relating it to an already understood "source" domain. For example, when somebody dies, an English speaker might euphemize by saying that the deceased had "reached the end of the road," because LIFE IS A JOURNEY (capitalizing metaphorical statements is a standardization derived from Lakoff and Johnson 1980) is a common cultural metaphor (Ortman 2000a:616). "Life" is an abstract target that could be understood using the more tangible source domain of journeying. Journeying is a physical experience where one sets off from a location to travel, passes through space and time, and then arrives at a destination and no longer journeys. Life is also conceptualized as having a beginning (birth), middle (life), and end (death) (Ortman 2012). Reversing the source and target domains of a metaphor is illogical: JOURNEYING IS LIFE does not make sense as metaphor because the experience of life is more varied, subjective and less tangible. It does not directly inform the specific experience of travelling. Conceptual metaphor is often studied in linguistic terms, but it is a fundamental property of human cognition that is based on his/her embodied experience with the physical world (Ortman 2012:223). Thus, the study of material culture can provide insights into how people understand the world.

Common source domains provide the opportunity for separate cultures to draw corresponding meanings from objects, but context is important. The possibility that LIFE IS A JOURNEY would be shared between any given hypothetical cultures would depend on the specific travel infrastructure (e.g. roads, canals, rail), how infrastructure is utilized (car, bike, pedestrian, etc.) and the environmental and social contexts of travel. Other cultural understandings of "life" may conflict with a metaphorical association with journeying.

Furthermore, a hypothetical sedentary village whose people do not travel would unlikely subscribe to this metaphor. For these reasons, "conceptual metaphors are neither universal and objective, nor radically relative and subjective" (Ortman 2012:206).

Much more could be said about the theory of conceptual metaphor (Gamble 2007; Ortman 2000a, 2012:203-223; Tilley 1999) but it is enough to say that artifacts can be studied to possibly derive meanings precisely because they are accessible crafts. To demonstrate this, the following will discuss a theory that a "container metaphor" was understood during the PIII era in the central Mesa Verde region, that used pottery, baskets, textiles, and dwellings as models for cosmological knowledge (Ortman 2000a; Ortman 2012).

The Container Metaphor

Archaeologists have long noted that the painted designs on ancestral Pueblo pottery are like designs inherent in and represented in basketry (Figure 1.7) (Ortman 2000a:619-620). Ortman (2000a, 2012) posits that this is because ancestral Pueblo people in the central Mesa Verde region understood metaphorically that POTTERY BOWLS ARE WOVEN OBJECTS. Beginning around C.E. 1000, the relatively new and unfamiliar pottery technology was conceptualized by ancestral Puebloans by connecting it to a more ancient and familiar source domain in the basketry industry, because pottery often mirrors the shape and function of baskets (Ortman 2000a:627-629, 2012:226-228; Ortman and Bradley 2002). Furthermore, white ware pottery is also sometimes painted with imagery represented in loom and non-loom woven textiles (Ortman 2012:226-227). This is because pottery, baskets, and textiles are linked source domains for the concept of "containers," whereas all these forms are designed to hold objects inside of them: food and liquids are contained by bowls and baskets, while the human body is contained by textiles (Ortman 2000a, 2012:231; Ortman and Bradley 2002).

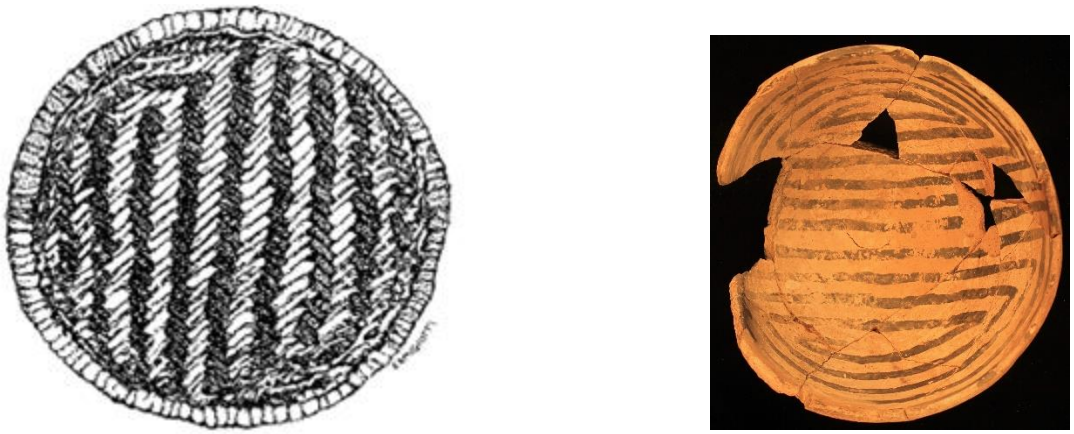

Figure 1.7. Colored twill-plaited basket at left (image courtesy of Crow Canyon Archaeological Center) and analogous black-on-white pottery design (Vessel 186) from Sand Canyon Pueblo (from Ortman 2000a:625 Figure 3).

Ancestral Puebloans utilized these objects as source domains to interpret kivas and villages as containers for people, while the earth and the cosmos were further conceptualized as progressively larger containers (Ortman 2012:212-223; Ortman and Bradley 2002:74-77). This is deduced through multiple lines of inference, and a few of the major indicators will be discussed here. Sand Canyon Pueblo formed a hemispherical pattern around a canyon head. This hemispherical pattern resembles the profile of a ceramic bowl. The Tewa – a descendent population from the ancestral Puebloans – root word *mbe* for "pottery vessel" was also used to form the word for "small canyon head" (*mbe'e*), and "village" (*mbu'u*) (Ortman and Bradley 2002:74-77). Thus, Ortman (2012:215) suggests that THE VILLAGE IS A SERVING BOWL was a material and linguistic metaphor at canyon rim villages like Sand Canyon Pueblo. He further asserts that this metaphor would have been more generally understood by the people as THE COMMUNITY IS A CONTAINER (Ortman 2012:215). Ortman (2000a:640, 2012:236) also notes that select kiva wall murals are painted with landscape iconographies. These murals typically depict the upper ("sky") half of the mural with loom-woven fabric imagery, and the lower ("earth") half depicted with pottery decorations. Ortman (2012:236-241) suggests that these

representations communicate that THE SKY IS A WOVEN OBJECT (CONTAINER) and THE EARTH IS A POTTERY BOWL (CONTAINER), which he further supports by referring to Tewa linguistic and cultural referents for the same metaphors. Finally, Ortman (2012:236-241) asserts that these multiple overlapping "container metaphors" would have been recognized by a restricted number of ritual specialists, who would have known that THE WORLD CONSISTS OF CONTAINERS.

Containers such as pottery (as containers for food), homes (as containers for families), and the earth (as a container for life) also may have been interwoven metaphorically as feminine, nurturing products. Prominent symbols on ceramics shown during public feasting ceremonies may have communicated themes of lifegiving and sustenance, and the ability of the village and its leaders to provide for the people (Potter and Ortman 2002:185; Ortman and Bradley 2002). Chapter 3 will also discuss how pottery vessels were most likely crafted and painted by women at the community center.

Another approach to cognition through pottery design from a different theoretical perspective is given by Washburn, Crowe, and Ahlstrom (2010). These authors suggest that painters may have used certain symmetries apparent on painted symbols to both manipulate and reflect social structures and relationships in the ancestral Puebloan world. Analyzing vessels across culture areas and over 1,000 years (C.E. 600-1600), the authors argue that dominant symmetries changed as social organization and environmental conditions shifted through time, further positing that certain symmetries represented existing or idealized social relationships. For example, bi-fold rotational symmetries may be a symbolic metaphor for reciprocity and sharing (Washburn et al. 2010:744). Dominant symmetries shifted and changed over time on the Colorado Plateau (Washburn et al. 2010:760). Thus, it may have been important for community members to understand and manipulate social customs vis-à-vis pottery design.

Summary

Painted symbols on ceramic vessels represent an aspect of material metaphor that would have served as a basis for understanding and communicating ideas at Sand Canyon for people who largely shared a common culture, but would not necessarily have had close interpersonal relationships (Ortman and Bradley 2002:72). The coalescence in large community centers during times of abundance as well as stress in the 13th century may have been supported by a common understanding of cultural metaphor. Given the status of Sand Canyon Pueblo as a ritual center, it seems a reasonable hypothesis that children would have been brought up to be and become part of this system in which pottery painting was one aspect. Identifying the works of the culture's youngest members may reveal how this symbolic communication was taught and learned, and may help archaeologists gauge how the ancestral Puebloans at Sand Canyon understood their world by possibly gleaning its most fundamental metaphors.

Chapter 2 will overview the painted white ware ceramic vessels that were sampled for this study, including a review of stylistic features, manufacture, and exchange of these objects. Chapter 3 will review the theory and methodology that was developed by Patricia Crown (1999, 2001, 2002) to determine if painted white ware ceramics were painted by either children or adults by ranking observed traits related to how skill in painting progresses as people mature, and will discuss how that method was adapted for this study. Chapter 4 will discuss the results of the study, determining that Crown's framework can unexpectedly be used a method for examining skill at all levels regardless of age, but the age of producer or producers can be deduced as a proxy of exhibited skill along with other lines of evidence. It will be shown that children did paint on vessels recovered from Sand Canyon Pueblo, and that ladles are forms that are generally reserved for children to paint. Furthermore, it will be shown that exhibited painted skill and

specific vessel form are strongly connected. The data will also show that concentric circles are represented overwhelmingly on painted white ware ceramics at Sand Canyon Pueblo, regardless of the age and skill of the potter. Chapter 5 will conclude the thesis by theorizing that CIRCLES ARE CONTAINERS could have been a fundamental metaphor taught and learned – at first implicitly – at the earliest ages, which would have symbolically framed the container metaphor. Ceramic form as a material metaphor will also be discussed, with a theory for how ladles might be a metaphor for the role and status of children at Sand Canyon Pueblo.

Chapter 2: The Sample

The Sand Canyon vessel collection is curated by the Canyons of the Ancients Visitors Center and Museum located in Dolores, Colorado, with some vessels on loan to CCAC in Cortez, Colorado. Over a three-week period in 2013, data from 114 painted white ware vessels were collected from a population of 157 painted whole, partial, or reconstructed painted white ware vessels recovered from Sand Canyon. Several vessels (n = 12) had been repatriated to descendent communities and are not available for study (Till and Ortman 2005:5). Several other vessels were too partial, deconstructed (i.e., reduced to its constituent potsherds), or too faded to be properly assessed. Two vessels are "repeats" of the same vessel, whereas a sherd container was crafted from a still extant vessel, and thus data merged for these two. There are other vessels that were simply missed due to various reasons throughout the process.

The integrity of each vessel in the sample ranges from complete/nearly complete to partial, with some being reconstructed from sherds. Several vessels are sherd containers, which are larger, modified vessel sherds that were recycled for a different purpose. Most partial vessels and sherd containers were assessed, as they appeared more-or-less representative of the whole pattern. Rim-arc diameters were taken to measure diameters of partial vessels, and directly measured when over 50% of the vessel rim was available. Circumferences were taken for vessels such as jars, ollas, and canteens. Circumference measurements are converted to diameters in this thesis. The primary objective of the study was to assess the painted design, rather than to determine if the physical ceramic vessel itself was crafted by a child (cf. Bagwell 2002), though general observations of vessel quality were made.

Many digital photographs were taken of each vessel. These photographs include profile and plan photos, as well as close-up photos of design elements at 10° intervals along the

circumference of the vessels, both scaled and unscaled. These multiple high-quality digital photographs allowed for assessments of the vessels and their work at an exceptional level of detail at any time after the initial study. Each vessel is identified by the Vessel Number (V. #) assigned by CCAC analysts during the initial laboratory analysis.

The initial field research design impacts how artifacts can be interpreted in the laboratory. The sampling strategy employed during data recovery was developed to investigate 13th century pueblos in the McElmo drainage in terms of community organization, regional organization, cultural dynamics, and culture history (Lipe and Kuckelman 2007:26). To achieve these aims, CCAC archaeologists employed four different excavation strategies based on surface interpretations: 1) test excavation of kiva suites (domiciles), 2) test excavation of selected individual kivas within kiva suites, 3) test excavations of buildings possibly associated with public or ritual contexts (e.g. the great kiva and D-shaped building), and 4) random sampling of areas not associated with architectural features (Kuckelman et al. 2007:27). The vessels came from excavations using the first three non-random sampling strategies, and all but two vessels (V. 199 and V. 200) came from domestic rather than ritual contexts. All artifacts found in those units were collected and curated, independent of the apparent technological, formal, or aesthetic qualities they possessed (in other words, "poorly made" artifacts weren't left in the ground by design or bias). Therefore, it is appropriate to use statistical modeling based on random sampling to examine these qualities in the painted white ware population as they relate to questions regarding community and culture.

Northern San Juan Painted White Wares

The painted white ware vessels recovered from Sand Canyon include a variety of vessel forms and were classified by CCAC as one of four observed types: Mesa Verde Black-on-white,

McElmo Black-on-white, Pueblo III White Painted, and Late White Painted (Tables 2.1 and 2.2). The Mesa Verde Black-on-white and McElmo Black-on-white styles are traditional types in the northern San Juan tradition (Ortman, Baxter, Graham, Lyle, Matis, Merewether, Satterwhite, and Till 2005; Wilson 2012a, 2012b). The Pueblo III and Late White Painted are "grouped" types developed by CCAC to categorize pottery that cannot be typed into the first two groups. All four types are similar to black-on-white pottery in neighboring regions, but the vessels and sherds are assumed to be local (Ortman and Till 2007:109; Wilson 2012a, 2012b). No non-local redware vessels were recovered, and few redware sherds were located (Ortman and Till 2007:108-110). Greyware cooking pottery is ubiquitous at Sand Canyon Pueblo, but these local greywares are unpainted and thus not considered in this analysis. The following paragraphs discuss the four white ware styles in terms of their design layout.

Table 2.1. Type definitions of white ware pottery from Sand Canyon Pueblo.

Style	Date Range	Formal Qualities	Design Layout
Mesa Verde Black-on-white	**C.E. 1180-1280**	**Coil and scrape construction method. Fine paste. Usually grog tempered but also igneous rock or sandstone. Well slipped and finely polished. Thick, even vessel walls and squared rims. Usually carbon paint but some mineral. Various vessel types such as bowls, mugs, jars, and ollas.**	**Complex geometric patterns. Various line sizes. May use negative space to create design elements. Rims may also feature complex decorative schema.**
McElmo Black-on-white	**C.E. 1060-1280**	**Similar to Mesa Verde Black-on-white**	**Single-sized brush strokes create banded designs. Simpler and sometimes "sloppier" than Mesa Verde Black-on-white.**
Pueblo III White Painted	**C.E. 1100-1280**	**Similar to Mesa Verde Black-on-white**	**Either intermediate between Mesa Verde and McElmo types, or otherwise is indeterminate. Type can be classified as produced during PIII period**
Late White Painted	**C.E. 920-1280**	**Formal qualities indicative of post-Pueblo I era (e.g. thicker vessel walls, finer pastes, and slips than earlier eras). Usually carbon paints. Category usually reserved for sherds**	**Indeterminate style that can be classified to either PII or PIII period.**

Table 2.2: Vessels from Sand Canyon Pueblo included in study, by type and form.

Pottery Form	Mesa Verde Black-on-white	McElmo Black-on-white	Pueblo III White Painted	Late White Painted	Total
Bowl	14	2	14	1	31
Canteen	3	0	2	1	6
Jar (generic)	0	0	3	0	3
Kiva Jar	4	0	4	0	8
Ladle	1	2	9	0	12
Lid	0	0	1	3	4
Mug	16	0	6	0	22
Olla	2	2	1	1	6
Rectangular Form	0	0	4	0	4
Seed Jar	0	0	2	1	3
Sherd Container (any)	9	0	4	2	15
Total	49	6	50	9	114

Mesa Verde Black-on-white. This type is well known for its intricate and complex design work; it could be said to represent the culmination of technological and decorative achievement for the northern San Juan tradition. Mesa Verde Black-on-white is one of the more well studied and distinguishable southwestern pottery types. Yet, it is akin to contemporaneous black-on-white types from neighboring Chuska and Kayenta traditions (Wilson 2012a).

Mesa Verde Black-on-white design schemas are characterized by one of three templates. These include the “flowing band”, “all over”, and “complex framing” techniques (Ortman et al. 2005:5-15—5-16). The flowing band (Figure 2.4) is characterized by the appearance of banded lines of different sizes which frame a centralized motif that exhibits bifold or rotational symmetry, and the use of negative (unpainted white) design space within the central motif to create distinct design elements. The all over (Figure 2.5) technique features a centralized geometric icon surrounded by hachured motifs, sometimes with other various shapes and lines. They often feature only one singular thick framing line near the rim of the bowl. The complex

framing (Figure 2.6) technique features juxtaposed framing lines of various sizes, sometimes inlaid with other minimal elements such as dots (Ortman et al. 2005; Swink 2004).

Figure 2.1: Vessel 12, a Mesa Verde Black-on-white mug, displaying a flowing band design. Note how the negative space is transformed into a unique design element in the central motif. Vessel height = 10.8 cm

Figure 2.2. Vessel 54, a Mesa Verde Black-on-white bowl, featuring an all over design. Note the patterned rim ticking. Vessel diameter = 30.1 cm

Figure 2.3: Vessel 2, a Mesa Verde Black-on-white bowl, featuring a complex framing design. Scale squares = 1 cm

McElmo Black-on-white. McElmo Black-on-white types typically exhibit painted designs comprised of single-sized brush strokes applied in patterns that do not utilize negative space (Figure 2.7). The design work is sometimes considered "sloppy" in terms of the evenness and precision of the application of paint, but that generalization is not always the case. Other shapes and design elements sometimes occur, but not at the same frequency or elaboration as Mesa Verde. McElmo Black-on-white is often characterized as a transitional type that connects the earlier Mancos Black-on-white to Mesa Verde Black-on-white, as the type is more often found associated with dates beginning earlier to the Pueblo III period (Ortman et al. 2005; Wilson 2012b).

Figure 2.4. Vessel 186, a McElmo Black-on-white ladle. Scale = 10 cm

Pueblo III Painted and Late White Painted. These are the two "grouped" types developed by CCAC for any ceramic that could not be placed confidently within either the Mesa Verde or McElmo Black-on-white traditions (Figures 2.8 and 2.9). Pueblo III Painted wares are characterized by qualities that are either intermediate between McElmo and Mesa Verde or by

qualities that are otherwise indeterminate, but can be confidently dated to the Pueblo III period. The Late White Painted designation is typically reserved for wares whose design type is ambiguous but can be dated after C.E. 900 due to formal qualities (Ortman et al. 2005).

Figure 2.5. Vessel 3: A Pueblo III Painted mug. Vessel height = 9.5 cm

Figure 2.6. Vessel 109, a Late White Painted canteen. Vessel height: 14.7 cm

Pottery Production and Exchange

The recovery of various pottery-making tools at Sand Canyon Pueblo indicates that residents manufactured pottery at the household level, village-wide. Analyses of temper and paste of recovered pottery sherds indicate the raw ingredients to be local to the vicinity of Sand Canyon (Till and Ortman 2007:81-121). It is assumed that painted vessels located at the village were generally crafted by a person for use in their own household, and probably for ceremonies in their own village (Bowser 2000; Crown 1999:29; Walleart 2012). However, there is a fair amount of evidence for some intraregional pottery exchange. Ortman (2000b:77) suggests "modest levels of vessel movement between (local) sites" based on an analysis of comparative frequencies of igneous rock tempers in white ware bowl rim sherds between sites in the central Mesa Verde region, relative to the site's distance from the source location for igneous rock of Ute Mountain. He theorizes that these exchanges would have been informal giftings between kin and friends, rather than formalized distributions via market transactions or centralized

redistributions; furthermore, Sand Canyon Pueblo may have been a hub of such informal exchanges as a large community center (Ortman 2000b:81-83). Pierce, Glowacki, and Thurs (2002) used instrumental neutron activation analyses of temper and paste in sherds located throughout the northern San Juan, and their results indicate some local vessel exchange between the central Mesa Verde region with Mesa Verde proper, though vessels made in the central Mesa Verde were more likely to be found on Mesa Verde proper rather than vice-versa.

If the residents of Sand Canyon Pueblo were major producers of painted white ware vessels, it seems likely many of the vessels found there originated from people of that village. Nevertheless, it is quite possible that some of the studied vessels are local imports from immediate neighbors practicing the northern San Juan tradition. Given these caveats, it is still reasonable to assume that most of the vessels were made in the village, and that all these vessels are representative of the northern San Juan tradition during the Pueblo III period.

Chapter 3: Theory and Methods

This thesis utilizes research methodology developed by Patricia Crown in her essay *Socialization in American Southwest Pottery Decoration* (1999) and elaborated upon in further studies (2001; 2002). Crown (1999) introduces an 18-point attribute analysis for determining the relative age and skill level of the producer of a given painted design. The theoretical and methodological background developed for assessing age and skill level used by Crown (1999, 2001, 2002) will first be assessed in this chapter. Then it will detail how the attribute analysis was adapted from that research for this thesis, which constitutes the core data to be examined in the next chapter.

Theoretical Background

There is no easy way to train an apprentice. My two tools are example and nagging.

– *Lemony Snicket,* Who Could it Be at This Hour?

Children often perform tasks vital to craft production in many cultures. Archaeologists can study how craft production was taught and learned in past cultures to understand how technology changes over time, to study how contexts in which mature artisans dedicate time and energy to teach, to gauge the relative importance of child labor in any given culture, and to learn how children come to gain the knowledge and skills to become productive members of society (Baxter 2005; Crown 2002:108; Kamp 2002; Wendrich 2012a).

Historic and ethnographic accounts serve as a baseline for understanding archaeological contexts for teaching and learning how to make and decorate ceramics. Crown (1999) indicated that a Puebloan child showing interest in pottery would informally apprentice as a potter between ages 5 and 12, becoming proficient by age 15. Puebloan potters were traditionally women and girls. She writes that Puebloan children learned pottery by observing and mimicking adults while they worked, but were rarely given verbal instructions.

Ethnographic research by Walleart (2012) that compares Dowayo potters in Cameroon with San Idelfonso (Tewa) ceramicists in New Mexico also finds that for both cultures, an initial and informal apprenticeship period begins at age 6 and lasts until roughly age 15. In Cameroon, verbal instruction is limited to situations where the adult corrects the child's technique. Otherwise the child is left to figure out the technique on her own.

However, education is a process that extends beyond initial skills acquisition as a young neophyte. In both cultures, a second apprenticeship commences after a woman is married and joins her husband's household. In this arrangement, the mother-in-law strictly enforces certain stylistic standards which the daughter-in-law is pressured to conform. Among the Dowayo, this leads to a situation where the daughter-in-law is motivated by a certain amount of shame and fear to conform to her husband's mother's directions. At San Idelfonso, the daughter-in-law may also feel pressure to conform because she aides her mother-in-law in serving a ritualistic role as potters, grounded in that household's kiva ceremonies. However, in more recent times the daughter-in-law is freer to choose her stylistic preferences, so the second apprenticeship has become more of a way of recognizing and continuing that traditional community-of-practice between mothers- and daughters-in-law. Some men at San Idelfonso are also potters; a recent cultural change likely linked with commercialization of southwestern pottery beginning in the 20th century. Men also occasionally play a role in directing what kinds of decorations should be laid out on painted vessels in certain contexts, though their stylistic preferences are influenced by the women in their lives (Walleart 2012). This thesis utilizes either gender-neutral or feminine pronouns when discussing pottery producers, recognizing the complexity and limitations of gendering past cultures.

Archaeologists have long noted the existence of vessels that broadly stand out as substandard in terms of technological, formal, and design qualities (Crown 2001:452). Crown (1999) hypothesizes that these poorly painted vessels exhibit the types of qualities we would expect from younger, lesser skilled producers. The ubiquity of painted pottery at pre-Hispanic Puebloan village sites suggests that not only would children be surrounded by the media, it would be reasonable to deduce that they also contributed to creating pottery found in the archaeological record (Crown 1999:28).

However, automatically analogizing a "poor" craft with an "unskilled" "apprentice" or "young" producer is problematic, and other explanations for such design work need to be considered (Wendrich 2012b). Crown (2001:452-453; 2002:113-114) considers the merits of five alternatives that may explain vessels exhibiting designs with poor motor control and low cognitive complexity: rushed work, inebriation, advanced age leading to physical or mental decline, work intentionally done sloppily as a form of protest, or work that deviates from the norm for a specific function. Crown largely rejects the first alternative because many poorly painted pots evince a greater effort in painting (in her analysis), rather than a lesser, hurried effort. Crown denies the possibility of inebriation affecting craft execution because there is a lack of evidence relating drugs and craft production in southwestern archaeological context. It is unlikely that elder Pueblo potters created poor works due to declining faculties, as historically documented and modern elder Puebloan potters continue to create high-quality vessels until they can no longer produce crafts effectively (Crown 2001:454). Crown downplays the likelihood of a "pottery protest" because there is no historical or ethnographic evidence of such an event (although the people of Sand Canyon lived during fraught times, it would be extremely difficult

to investigate archaeologically that poorly painted pots at Sand Canyon were some form of silent protest; furthermore, there is no evidence for coerced labor here).

In contrast, it is possible that skilled painters applied simplistic designs to expedient wares for specific functions. Crown (2001; 2002) discusses how Hopi potters will form small pinch pots with expedient designs. These vessels are created as ritualistic offerings which may be consumed in a firing kiln or deposited at clay sources on the landscape. Also, Cooney's (2012) study into ancient Egyptian ostraca – in this context, defined as pottery sherds or limestone fragments with artistic renderings – demonstrates that some seemingly poor sketches may be the work of master craftsmen creatively experimenting ("playing") to develop new techniques and ideas. These types of work can be thought of as 'realms of protected deviation'" (Crown 2001:454). Therefore, to determine if a pottery vessel is the product of a younger, unskilled learner, it is necessary to identify the specific gestural and cognitive hallmarks of design work that are the result of early skill development.

Empirical studies in psychology and education have indicated that drawing ability is based on motor coordination, cognitive maturity, and background experience (Crown 1999:25-27, 31-35; Crown 2001:457). Children tend to exhibit poor motor control – such as shaky linework – and create simplistic designs that are poorly planned. Consequently, skills mastery in drawing is reflected in traits such as smooth, thin lines and complex renderings. While children tend to attain drawing skills in a similar manner with practice and age, a person's specific environmental, biological, and sociocultural factors also influence how their skills develop. A certain tradition could emphasize development of certain skills while de-emphasizing others (cf. Creese 2012). Individual children may be more adept than their peers at some skills, and less adept than others. However, all skills tend to improve with age and experience, and cross-

cultural studies demonstrate regularities in the manner which children refine their capacities (Crown 1999:25-26; Crown 2001:457).

Methodological Development and Application

Crown (1999) uses the results of the educational and psychological studies to develop an 18-point attribute analysis that numerically ranks features of the painted vessel based on discrete observations about the design work. The scoring is ranked so that mature traits receive higher scores and lower scores indicating less mature traits. By making discrete observations regarding the design work and converting those observations numerically, ranked scores can be compared and analyzed statistically. Crown also divides those attributes roughly between those representing "cognitive maturity," and those reflecting "motor control."

In her first study Crown (1999) selected and analyzed 28 pots that qualitatively reflected poor motor skills and cognitive understanding of culturally appropriate design grammar, assuming these were the work of children. These include 9 Mimbres vessels (C.E 1000-1150), 10 Sacaton Red-on-Buff vessels, (C.E. 900-1150), and 9 Salado polychrome bowls (C.E. 1300 – 1450). Five of the Mimbres vessels were associated with children's burials. Each vessel was coded using the attribute analysis. The final scores were divided by the highest possible score that a given vessel could receive to create a normalized total score. Thus, if a vessel could not be coded for a given attribute, an average could be created so that the vessels could still be compared to one another. Crown created an average score for traits coding for motor skills, and another average score for those coding for cognitive maturity for each vessel group. In this way, Crown asks if a painter may have the cognitive ability to complete a culturally appropriate design, but not yet have the motor practice to do so – or vice versa. Finally, she compared the score ranges for each vessel group to determine if painters learned in a tight or loose cohort

based on age and/or skill. Crown (1999) concluded that Mimbres children were taught in a wider age cohort, and were given more freedom of expression, while Hohokam were more restrained in their design choice, and learned in tighter age cohorts. Salado children were found to have the highest overall scores. Overall, the results of the pilot study led Crown to conclude that children had different learning frameworks between the three pottery cultures.

Crown (2001) expanded the research design to include an assessment of the formal qualities of the vessel, use wear, and she looks for potential learning aides, such as lightly painted lines to be traced over, or templates to fill in. This study compares larger assemblages of Hohokam Red-on-Buff vessels and Mimbres vessels (n = 112 and 98, respectively), and includes vessels featuring high-level technological, formal, and design qualities. She divides these vessels between adult/skilled or child/learner for vessels for each tradition, and then examines the vessels with the attribute analysis. The resulting scores were compared using a Pearson correlation analysis. She found that different skills were emphasized between Hohokam and Mimbres adults and children. She also found that adults and children would collaborate on any one vessel by sharing or dividing certain tasks, e.g., an adult may form a vessel for a child to paint on, or create tracing lines or templates for children to fill in.

Crown's next study (2002) investigated collaborative vessels between children and adults, by investigating 845 vessels from 8 ceramic traditions or regions (Chaco area, Chihuahuan Polychrome, Hohokam area, Hopi area, Mimbres area, Reserve area, Salado Polychrome, and White Mountain Redware). These vessels are housed in seven major museum collections. She selected vessels to represent a range of observed formal and design techniques from each tradition (though poorly executed vessels were not common in the collections). Crown

again categorizes the relative age of aspects of production based on an overall summary assessment of attributes. The description of this analysis is worth quoting at length here:

> I assume that a skilled potter made vessels that were symmetrical in shape (except the few unusual forms, such as effigies), exhibited standard forming techniques, had relatively even wall thicknesses, and reflected quality of materials and firing technology. Unskilled learners made vessels that were lumpy, asymmetrical in form, made of poor materials, often used nontraditional forming techniques, and fired poorly (often soft and marred by fireclouds). Similarly, skilled potters carefully executed designs with standard-sized paintbrushes, traditional motifs, typical symmetry patterns, and efficient application of paint, whereas unskilled learners lifted and replaced brushes often in painting lines, could not make lines meet squarely, produced shaky lines, and had difficulty executing complex design elements such as the scroll (Crown 2002:115).

These assessments categorized either vessel form or painted design as having "adult" or "child" characteristics, and the rates at which certain tasks were accomplished by each category was considered and compared between the pottery cultures (the attribute analysis itself was not formally utilized). For example, Crown compared the rates in which a child painted on a vessel crafted by an adult, or in which children and adults worked together to paint a design. This allowed her to gauge the relative involvement of adults in the educational process. She found, for example, a higher percentage of vessels crafted by adults that they guided children through painting in White Mountain Redware and Chihuahuan Polychrome vessels, compared to other traditions. The results of the study led Crown to conclude that Puebloan potters of different cultures were more active, variegated, and contrasting in their teaching methods than what she expected, discovering cross-generational collaborative efforts in her findings (cf. Crown 2007). This aligns with Walleart's (2012:37) conclusion that "apprenticeship in traditional communities… is very complex and involves many different pedagogical tools…"

Analysis of Theory and Method

Crown's work is insightful and revealing. The attribute analysis is grounded in modern, cross-cultural empirical studies, and this thesis builds on her work by examining vessels that are

not intrinsically linked to her initial studies. However, this thesis will be adapted in three important areas. The first change will eliminate “child” or “adult” categories a priori of the attribute analysis. While it may be that many “poor” designs are likely to be the work of youths, the studies of Walleart (2012), Creese (2012), and Cooney (2012) demonstrate that this is not always the case. For this thesis, the attribute analysis will be used to see if the markers of “child” or “adult” can be identified, and to what degree of confidence.

The second alteration will be using non-parametric statistics. Parametric statistical analyses (e.g. comparing means and ranges) are most appropriate to implement when the relationship between the variables is known and equivalent, such as when comparing physical measurements. The current analytical framework, however, uses a ranked analysis based on attributes whose relationships between each other are unknown and probably inequivalent (Drennan 2010). The Gower dissimilarity coefficient represented by hierarchical clustering models will be used. This technique determines cladistic groups based on scored ranks. The Gower dissimilarity coefficient and hierarchical clustering will be discussed further in Chapter 4.

The third adaptation is the attribute analysis itself, which is discussed in the following sections.

Attribute Analysis for Assessing Skill of Pottery Painters

This section details how the analytical framework developed by Crown is described by her, and how this thesis uses and modifies her analysis. The following describes each attribute as quoted from Crown (1999), followed by her original scoring methodology as described in Crown (1999: Table 3.2). A further elaboration of her description is provided afterwards, if necessary. Any modification to the original scoring rubric is given after that elaboration. References to Appendix A for each score provides an example of how each attribute appears in the sample.

This study omits several of the original criteria. Some analyses appeared to autocorrelate to others and were thus redundant, while others were omitted because the analysis could not be applied with confidence based on the description offered by Crown. All analyses were eliminated only after attempting to apply them rigorously and systematically, and understanding source material where appropriate. Omitted criteria are explained after discussing the utilized analyses.

Number of motif units.

> The basis for this attribute derives from two aspects of children's drawings. First, children tend to be economical in drawings, using the same motifs repeatedly rather than many different attributes (Goodnow 1977:150). Elaboration increases with age. Second, Piaget has shown that children cannot copy a complete range of geometric shapes until they reach age 7 (Krampen 1991:37). Therefore, the number of different motifs used in a drawing may reflect the age of the artist (Crown 1999:31, 33).

"Motifs" are often defined as combination of simpler design elements. It is these design elements will be counted for this study. Design elements evident within the Sand Canyon vessels are listed as followed:

- Parallel banded line, first size (Appendix A, Figure 1A)
- Parallel banded line, second size (Appendix A, Figure 2A)
- Zig zag line (Appendix A, Figure 3A)
- Curved line (Appendix A, Figure 4A)
- Spiral (Appendix A, Figure 5A)
- Ticking (quick marks with the brush) (Appendix A, Figure 6A)
- Dot (free-floating filled-in circles) (Appendix A, Figure 7A)
- Polygon (count per type) (Appendix A, Figure 8A)
- Stepped element (Appendix A, Figure 9A)
- Scroll (Appendix A, Figure 10A)
- Perpendicular line (Appendix A, Figure 11A)

Crown's original analysis scored this as a "count per unit," meaning the sum of every individual motif/element would equal the rank. Because the high number of possible elements on any given vessel might skew the ranking system for analysis, this thesis will instead adapt the ranking to be based on a range of total design elements:

4) 7 or more design elements
3) 5 – 6 design elements
2) 3 – 4 design elements
1) 1 – 2 design elements

Motif state.

Young children tend to leave geometric shapes as open as possible, with each unit having its own boundary (Goodnow 1977: 150). They also have problems staying within the lines in filling in larger geometric shapes. For these reasons, empty shapes are more likely to be the products of younger children, followed by solid shapes, and finally hatched shapes. Hatching requires both greater cognitive maturity and motor skills to achieve (Crown 1999:33).

3) Hatched (Appendix A, Figure 12A)
2) Solid (Appendix A, Figure 13A)
1) Empty (Appendix A, Figure 14A)

Crown specifically asserts that filling in distinct geometric shapes with hatched lines is an advanced technique. Many vessels did not indicate shapes that could reasonably be filled in or hatched (e.g., vessels only with banded lines), and those vessels were not ranked for analysis. This analysis was judged as originally described by Crown (1999).

Percent of field used.

Young children tend to render drawings in only one corner of a sheet of paper (Biber 1962), with increasing use of the whole sheet of paper with increasing age (John-Stener 1975: 114-116). In evaluating this attribute, I did not consider the size of the design significant, if it was placed centrally within the vessel; that is, a design might occupy only 25 percent of the total vessel surface, but be given a rating of 100 percent if the design was centrally placed and appropriate within the particular culturally defined decorative repertoire (Crown 1999:33).

4) 100%
3) 75%
2) 50%
1) 25%

The field of appropriate design placement depends on the type of vessel being painted. While mugs are often painted entirely, other exterior painted vessels such as kiva jars do not have painted elements below the inflection point of the body, as those designs are fully expressed from

a plan view. Interior designs on bowls do not often extend into the base of the vessel, but the "all over" designs on Mesa Verde Black-on-white vessels do sometimes fill the base. Some bowls also feature exterior designs. This is an uncommon feature, so vessels were not ranked lower if they lacked exterior designs. The percent of field used was judged largely as a quantitative measure, though I also considered how the design was placed on the specific vessel form, as suggested by Crown. Also, the scoring rubric is slightly modified to asses a percentage range:

4) 100% - 76% (Appendix A, Figure 15A)
3) 75% - 51 % (Appendix A, Figure 16A)
2) 50% - 26% (Appendix A, Figure 17A)
1) 25% or less (Appendix A, Figure 18A)

Type of drawing.

> Young children tend to draw geometric designs with little recognizable pictorial content. The average age at which a child draws something recognizable to an adult is 3 years, 9 months (Biber 1962). It is assumed then that the youngest children would not even have the skill to draw a simple geometric drawing. With increasing age, children would master simple geometric designs, more complex geometric designs (with interlocking motifs, for example), representational designs, and finally designs with both representational figures and geometric patterns integrated into a whole (Crown 1999:33-34).

4) Representational + complex geometric
3) Representational
2) Complex geometric
1) Simple geometric
0) Indescribable

All painted vessels in this collection had at least simple patterns; none were "indescribable." All vessels with representational imagery also contained complex geometries. The ranking system was therefore adapted accordingly:

3) Representational and complex geometric (Appendix A, Figure 19A)
2) Complex geometric (Appendix A, Figure 20A)
1) Simple geometric (Appendix A, Figure 21A)

Grammatical structure.

> All cultures maintain a decorative style characterized by recognizable, repeatable grammatical rules. These include rules concerning proper design placement, relationships of motifs, design structure (layout), and use of symmetry function. Understanding of the grammatical structure of a particular culturally defined decorative tradition is clearly present cross-culturally by ages 7 to 9 (Wilson and Ligtvoet 1992). Correct placement of motifs, embedding of smaller figures within larger motifs, and use of advanced symmetry functions all occur in chronological sequences that begin as early as age 4, but are not likely to be completely acquired until after age 7 (Krampen 1991: 37-39) (Crown 1999:34).

3) Clear, correct grammatical structure
2) Clear, but clumsy attempt at traditional structure
1) No grammatical structure, doesn't follow cultural grammar

Over half of the sampled vessels are defined as either Mesa Verde Black-on-white or McElmo Black-on-white. The remaining vessels are defined as either "Pueblo III White Painted" or "Late White Painted." Pueblo III White Painted is defined as displaying stylistically ambiguous or intermediate features between the two major types of the period, but can be dated to the Pueblo III period. Late White Painted vessels are further indeterminate to the Pueblo III period (see Chapter 2). This analysis was therefore adapted because cultural grammar is already defined as recognizable or not. Vessels receive either a high score for being defined as Mesa Verde or McElmo, and a low score for types not identifiable by a specific grammar:

2) Mesa Verde Black-on-white or McElmo Black-on-white
1) Pueblo III White Painted or Late White Painted

See Appendix A and Chapter 2 for various examples of these types.

Proportions of motifs (highest level).

> Southwestern pottery designs were rarely sketched onto vessels prior to painting. Placement of equivalently-sized motifs in the design from one portion of the drawing to the next was a particularly difficult task, probably possible only with increasing ability to control proportions (Goodnow 1997: 46; Krampen 1991: 39) at about ages 7 to 9 (Crown 1999:34).

3) Motifs of appropriate, equivalent sizes (Appendix A, Figure 22A)
2) Motifs of roughly equivalent sizes (Appendix A, Figure 23A)
1) Same motifs of different sizes, do not fit design (Appendix A, Figure 24A)

While a more precisely mathematical method was attempted in this thesis to measure proportionality, the relative sizes and complexities of elements and motifs between vessels made it impossible to standardize a proportion range. Design proportionality was judged subjective and relative measure, and Crown's original scoring criteria was thus utilized without modification.

Motif symmetry (highest level for any motifs).

> The work of Drora Booth (described in Goodnow 1977:40-42) indicates a sequence for learning symmetry functions cross culturally, from simple repetition (translation) to rotation around a point, to reflection across a vertical or horizontal line, to reflection across a diagonal line (Crown 1999:34).

5) Reflection across a diagonal line
4) Reflection across vertical/horizontal line
3) Rotation around a point
2) Repetition
1) Asymmetrical

These vessels often display motifs that show true rotational symmetries – defined when a pattern appears the same when turned at a specific predetermined angle. This is different from "rotation around a point" which is a circle or repeated elements translated about a circle, which is not strictly defined as a rotational symmetry. Rotational symmetries need not be reflectional, as a look at the attribute examples will show. Also, many vessels show glide symmetries, whereas a shape is rotated and translated across a plane. Crown's research did not uncover any learning progressions for rotational symmetry. Rotational symmetries that are not reflectional symmetries

are assumed to be a more nuanced and advanced mathematical function, and therefore have been lumped in with "reflection across a diagonal line."

The "Highest level for any motif" is also assumed to mean the highest level for any set of motifs, or for the whole design (especially for bowls and jars, where design elements and motifs combine to create a complete and coherent image). This technique allowed this trait to be scored on most partial vessels, especially on flowing band Mesa Verde black-on-white vessels. Symmetry functions were only scored when it was obvious that the designer was attempting a symmetry function. For example, simple isosceles or equilateral triangle design elements were not scored as reflectional symmetries until incorporated into a larger motif symmetry. Thus, a vessel would score rank 5 if it displayed any motif or set of motifs that represented a bifold, glide, or rotational symmetries, or if it displayed a reflectional symmetry off diagonal and vertical/horizonal planes. A 4 was scored if a larger motif was represented as only a reflectional symmetry from a horizontal/vertical line. A 3 was ranked on vessels with only banded lines, with or without simple translated shapes attached to those banded lines. Some vessels lacked banded lines and only featured translated shapes, and those ranked as a 2. No vessels featured strict asymmetry.

5) Reflection across a diagonal line *or* rotational symmetries (Appendix A, Figures 25A, 26A, and 27A)
4) Reflection across vertical/horizontal line (Appendix A, Figures 28A and 29A)
3) Rotation around a point (banded line) (Appendix A, Figure 30A)
2) Repetition (translation) (Appendix A, Figure 31A)
1) Asymmetrical (no examples)

Use of vessel as field.

Young children learn to use a sheet of paper as the field for a drawing by about the age of 3 ½ (Biber 1962). Designs that mold the motifs to the vessel shape are clearly more advanced than designs that ignore the shape of the vessel walls (Crown 1999:34).

3) Uses vessel as field (almost all vessels achieved this score)
2) Clear, but failed attempt to use vessel shape (Appendix A, Figure 32A)
1) No attempt to include vessel shape in field of painting (no examples)

The original rubric as described by Crown (1999) was utilized as described. The results will show that almost all vessels used the vessel as a field, which also matches Crown's (1999:41) observations.

Shapes.

Children learn motifs in a regular sequence, beginning with lines, followed by circles, spirals, dots, and then more complex geometric forms. Highly complex geometric forms are generally not possible before age 7 (Krampen 1991:37-39) (Crown 1999:34).

3) (Lines) plus other geometric shapes (squares, rectangles)
2) (Lines) plus circles, spirals
1) Lines

Most vessels feature banded lines that circumscribe the walls of the vessels completely, creating circles as a result. There were no vessels with only unconnected lines. Therefore, the vessels in this collection either score 2 or 3. No adaptions were needed for this analysis. See Appendix A for various photos of shapes.

Overlapping lines.

Young children or children with little practice drawing are not able to control their muscles to prevent overlapping lines in drawing. With increasing age (up until about ages 4 to 7), children tend to prefer to keep motifs separate, with clear boundaries and no purposeful overlap. By age 7 and up, children are increasingly able to control their muscles to prevent overlapping lines and understand the appropriate use of motifs touching one another according to specific principles of design elaboration (Goodnow 1977: 150) (Crown 1999:34).

3) Appropriate overlapping linework/motifs
2) Each shape to own space
1) Uncontrolled use of space

The study indicated that none of the vessels exhibited "uncontrolled use of space." However, some vessels showed motifs or elements that crossed inappropriately, or were not painted completely within the threaded contour lines for discrete shapes. Therefore, this framework is adapted to note this trend. I am justifying this addition in accordance with Crown's comments in "Motif State," where she states that children have trouble staying within the lines when filling in motifs. The rubric is thus modified in the following way:

> 3) Appropriate overlapping linework/motifs (Appendix A, Figure 33A)
> 2) Each shape to own space *or* inappropriate overlapping linework/motifs (Appendix A, Figures 34A and 35A)
> 1) Uncontrolled use of space (no vessels achieved this score)

Motor control / linework.

> With increasing age and practice, children are increasingly able to limit the number of times they must lift the brush off a vessel to replace the paint, particularly within a single straight line (Crown 1999:35).

> 3) Fine, continuous linework (Appendix A, Figure 36A)
> 2) Fewer brush liftings, some overlaps (Appendix A, Figure 37A)
> 1) Sloppy, overlapping, many liftings of brush (Appendix A, Figure 38A)

Brush liftings are noticeable by a sudden increase in line width at a given point on a line that superimposes the previous portion of the line before continuing again, or by a sudden and short angled line which superimposes a previous line before continuing. This analysis was conducted as initially written.

Line width.

> With increasing motor coordination, children are increasingly able to control the width of their linework, so that individual lines do not vary in width and all lines are of equivalent width, where appropriate. Fine lines of equivalent width are assumed to be the work of older children, or children with more practice (Crown 1999:35).

4) Fine
3) Medium/controlled
2) Medium/variable
1) Fat/variable

This code asks the analyst to judge both the width of the line, and how consistent are the width of lines over the course of its execution. This analysis is adjusted to be somewhat more quantitatively specific:

4) Lines measuring between approximately ≤1mm to 2mm wide (fine) (Appendix A, Figure 43A)
3) Lines measuring between approximately 2mm to 3mm wide (medium/controlled) (Appendix A, Figure 44A)
2) Lines measuring between approximately 1mm to 3mm wide (medium/variable) (Appendix A, Figure 45A)
1) Lines measuring over 3mm wide (fat/variable) (Appendix A, Figure 46A)

This attribute is assessed at the level of the thinnest continuous line element. The measurements were gauged using a 1cm scale taken with the photographs, and thus reading the line width to the millimeter is not precise. Nonetheless, reading width ranges in this way as a standard is accurate enough for this analysis.

Line control.

> Line control is probably largely a function of practice in using paint brushes on vessels. Ethnographies describe techniques such as turning the vessel while holding the brush steady and pulling the brush over the vessel (rather than pushing it) as important in mastering line control on pottery (Fowler 1977: 29) (Crown 1999:35).

3) Controlled, parallel lines (Appendix A, Figure 47A)
2) Better *more controlled*, but not parallel (Appendix A, Figure 48A)
1) Shaky (Appendix A, Figure 49A)

This attribute analysis was applied as originally described by Crown (1999).

Use of study aides. Crown (2001, 2002) notes the possible use of aides or templates created by adults to help children learn to paint. These include the use of lightly painted "ghost lines" that can be traced over, empty motifs that were outlined by skilled painters, to be filled in by younger, less skilled painters; incised lines, and erasures. Indeed, there are some vessels that possibly exhibit some of these traits. Although these could be scored as "presence/absence" variables, they will be assessed as relative to the results of the scored attribute analysis.

Omitted Attribute Analyses

Integration of motifs.

> Children master increasing numbers of geometric figures with age, but they also are increasingly able to integrate these into a coordinated pattern (Biber 1962). Only older children could execute designs that incorporate interlocking or concentric motifs (Crown 1999:34).

3) Integration of 3 or more motifs
2) Integration of 2 motifs
1) No motifs integrated

All studied vessels utilize some sort of integration of design elements to form larger motif units (even as simple as "concentric circles" or "arranged dots") and place those motif units into some type of larger patterns. Moreover, the forming of more elaborate shapes and patterns is examined elsewhere in Crown's framework (e.g. Shapes, Type of Drawing, and Symmetry). It is likely that scoring this attribute will directly correlate to scores in those other attributes. Therefore, this attribute was eliminated from being scored.

Execution.

> Linework using drawing materials follows a clear sequence from scribbling, to single lines, to contour or threaded lines used to outline an entire figure (Biber 1962; Goodnow 1977). Although contouring is considered a more advanced method for outlining motifs, use of paints would limit the amount of contouring possible because of the need to resupply the paint on the brush at intervals. Nevertheless, contoured outlines for motifs were given higher scores than motifs outlined with multiple short lines (Crown 1999:34).

3) Contour (threading) and fill in
2) Outline and fill in
1) Scribble shapes

This attribute is essentially the same as Motor Control/Linework attribute in that the analyst is looking for the number of liftings of the brush. The only difference seems to be that this analysis takes in account the drawing of discrete polygons. Because many vessels in this sample do not have shapes beyond banded lines (circles), this analysis was omitted.

Number of clear errors in painting.

> There is good evidence that adult potters purposely incorporated some errors in some Southwestern pottery designs (Crown 1994; Lindauer 1988). The actual number of errors in pottery designs painted by adults tend to be low and to follow specific rules. For this reason, the rate of errors in these children's designs is believed to relate largely to their ability to execute a design correctly based on age and practice (Crown 1999:34).

4) none
3) 1-5
2) 5-10
1) over 10

Crown is describing purposeful design additions, omissions, or changes – for example, a missing, extra, or misaligned motif– to explain the presence of accidental errors. Indeed, there are several examples of these in the Sand Canyon collection. When they appear, these "errors" rarely exceed more than 1 in number. It is difficult to determine if these are accidental (the sign of a cognitive mistake, and not a motor control issue) or intentional (which Crown explains is the hallmark of a skilled painter). Because this description seems vague, this analysis is being omitted. Most other conceivable "errors" are incapsulated in the other attribute analyses.

Linework / direction.

Goodnow (1977: 87-96) reviews a number of rules followed by children (and adults), cross-culturally in drawing designs. These include drawing horizontal lines left to right, vertical lines right to left, and contouring (threading) lines whenever possible. Such rules are strongly adhered to by age 7, and studies show that children will increasingly turn the paper around to follow the rules, rather than break them in tracing an oddly shaped form (Goodnow 1977: 102). To some extent, these rules are dictated by the medium used and handedness, because incorrect use of the rules might result in smearing of a line if the hand drags over the paint. In literature circles, such rules may be altered with the indoctrination of writing. In evaluating the use of such rules, I accounted for the use of paint as the medium (Crown 1999:35).

3) appropriate (top to bottom, left to right)
2) inappropriate (bottom to top, right to left)
1) random

Occasionally, it is possible to determine the direction of the painted line from the point of view of the observer, but in many cases (especially with well executed lines) it is difficult to judge. This attribute will not be judged because there are too many unknown variables inherent in this analysis. Two of these variables Crown points out herself: the first being the handedness of the painter, and the second is the difficulty of translating this from pen-and-paper to ceramics. Furthermore, the direction the line is travelling relative to the observer may not have been the same direction relative to the painter: she may have been holding any given vessel any number of ways. Indeed, experimental archaeologist and master potter Clint Swink (2004: chapter 11) is pictured holding Mesa Verde Black-on-white replica vessels at a variety of different angles while painting, which seems to suggest the potential for the appearance of variable line directions even if the painter is consistently applying paint in the appropriate fashion.

Direction of spiral.

> With increasing age, children develop rules for drawing specific shapes. These include drawing circles and spirals in a clockwise fashion (Goodnow 1977: 96). This particular rule is abandoned in Western cultures at school age, because teachers instruct their children to make the letter "O" in a counterclockwise fashion (Crown 1999:34).

2) clockwise
1) counterclockwise

There are only a handful of vessels in this sample that utilize spirals. This analysis is similar to the Linework/Direction analysis, and also inherits the same problems recognized in that analysis. Therefore, this attribute is eliminated from this thesis.

Hatched line width and spacing intervals. Both analyses were appended to the original attribute assessment from Crown (1999) into Crown (2001) as part of the list of attributes assessed, but neither of these traits were given a description or framework for analysis. It is assumed the author intends that fine, even, and tightly spaced hachure lines are more mature traits; however, these assessments are already included in the Motor Control, Line Width, and Line Control assessments, thus a specific assessment of hatched lines is not necessary.

Summary

The attribute analysis was applied using the above guidelines and adaptations based on photographs taken after the initial lab analysis of the pottery. Using high quality digital photographs allows the analyst to concentrate on one attribute at a time and instantly compare multiple vessels for consistency, with zooming being a particularly useful feature. The ranking was not segregated based on form, size, or style: i.e., mugs were not scored as a group first, then bowls, then ladles, etc. Usually, one attribute was scored for each vessel numerically starting at Vessel 1 and going through in order, going back-and-forth to standardize ranks relative to other vessels as best as possible.

The next chapter describes the results of the analysis. It will be shown that these data can be analyzed using non-parametric statistics to illuminate patterns at multiple levels of skill. The data indicate that there are a small group of vessels that inhere skills of noticeably lesser quality than most other vessels. It will be shown that several of these vessels were likely made by children, and furthermore it will be shown that most ladle forms were also probably painted by youths. The results also indicate that some other vessel forms are more likely to be painted with a high degree of skill. It will be shown that banded lines were painted ubiquitously by essentially everyone at Sand Canyon Pueblo, regardless of their age and/or skill.

Chapter 4: Results

Using the methods outlined in the previous chapter, each vessel was ranked for each attribute included in the analysis (see Appendix B). This chapter will overview how the ranks are analyzed using the Gower distance measure with hierarchical clustering. Using this technique, three skill "groups" were classified for vessels in this collection. One of these groups of vessels was determined to have notably lesser exhibited skills in terms of design execution than the other two. However, within this group, only certain vessels were determined to have been likely painted by novice children. Most of these vessels are smaller ladles. A further investigation into ladles indicates that most of these forms were likely crafted by children. Moreover, the results indicate that specific forms are linked to relative skill levels in painting, and that some overall lower skill scores are not necessarily indicative of youth. Thus, it will be demonstrated that using non-parametric statistical analyses, the attribute analysis (as adapted here) can tease out specific relationships between executed skills at multiple levels, but relative age can only be guessed at as a function of executed skill, tied to other lines of evidence and inference. Using both relative observed skill and theorized age of producer, these results could be used to model the cross-generational transmission of metaphor through pottery symbology, which will be discussed in Chapter 5.

The Gower Dissimilarity Coefficient

As discussed in Chapter 3, the data collected are non-parametric ranked. While higher ranks indicate higher skill and/or maturity, we cannot assume that these ranks are proportional: a painter who was graded with a "4" score is not exactly twice as "mature/skilled" as another who scored "2" in any one attribute, because such a quantification is impossible to determine (though it should be noted that ranks *could* be assumed to behave in such a manner, which opens the

possibility of using Euclidean or parametric statistics on ranks). Furthermore, each attribute analysis measures a completely different phenomenon: a rank of 3 for Line Thickness (width ranges) is not the same measurement as a rank of 3 for Number of Motifs (count ranges); nor do we know if any one attribute is a stronger controller for age and maturity than any other one. All that can be currently theorized is that higher ranks indicate higher skill and age for any given attribute (Drennan 2010).

Analyzing samples in terms of dissimilarity may aid in determining if their scored batches are different from one another. The Gower coefficient neutralizes the problems of proportional value and categorical heterogeneity. The Gower dissimilarity index is calculated as such in PAST 3.0, the software utilized for the statistical analysis:

$$d_{jk} = \frac{1}{n}\sum_{i}\frac{\left|x_{ji} - x_{ki}\right|}{\max_{s} x_{si} - \min_{s} x_{si}}.$$

Whereas d_{jk}, the distance (or dissimilarity coefficient) between the attribute ranks of two different samples is equal to the inverse of the sum of the absolute value of the difference between every paired rank; divided by the number of possible ranks achieved for each given scored attribute. Therefore, if a pair of vessels have matching ranks for an attribute (such as when a vessel's ranks are compared to itself), the distance between the pair for that attribute is 0. The larger the difference between scores for each attribute, the greater the relative distance between two vessels, which maximizes at 1. The dissimilarity coefficient could in some ways be thought of as a percentage. The equation accounts for larger differences between ranks, but those differences are not proportional to the numerical distance between values. The math normalizes the weight for each category, so the effect of the absolute number of possible ranks in any one

attribute is mitigated. The Gower technique also does not factor unranked attributes into the equation (Drennan 2010; Hammer 2018:128).

Table 4.1 displays the Gower dissimilarity coefficients for each pair of the first 13 vessels (V.) examined. This table is provided to represent a larger pattern reflected in the dissimilarity coefficients between all vessels. While there is no significance value that can be attached to these numbers, these coefficients do provide a relative measure of differences between scores. Table 4.1 shows that most paired vessels have distances between 0.10 and 0.25, which suggests generally low dissimilarities between these vessels. However, much higher dissimilarities are evident for Vessels 14 and 17 compared with many of the rest of the vessels. Yet Vessels 14 and 17 have a dissimilarity of 0.24 to one another. These coefficients reflect what is part of a larger trend for the entire studied population: most vessels are generally similar in terms of skill execution, yet there exists a small group of similar vessels that are dissimilar to those other vessels according to their attribute ranks.

Table 4.1. Gower dissimilarity coefficients for the first 13 ranked vessels (V.)

	V. 1	V. 2	V. 3	V. 4	V. 6	V. 7	V. 9	V. 10	V. 11	V. 12	V. 13	V. 14	V. 17
V. 1	0	0.179	0.192	0.051	0.064	0.090	0.269	0.256	0.154	0.103	0.256	0.472	0.681
V. 2	0.179	0	0.192	0.231	0.115	0.192	0.192	0.179	0.231	0.128	0.179	0.319	0.528
V. 3	0.192	0.192	0	0.244	0.205	0.282	0.179	0.064	0.090	0.141	0.269	0.264	0.472
V. 4	0.051	0.231	0.244	0	0.115	0.038	0.269	0.308	0.154	0.154	0.256	0.528	0.736
V. 6	0.064	0.115	0.205	0.115	0	0.077	0.205	0.192	0.167	0.115	0.192	0.444	0.653
V. 7	0.090	0.192	0.282	0.038	0.077	0	0.231	0.269	0.192	0.192	0.218	0.528	0.736
V. 9	0.269	0.192	0.179	0.269	0.205	0.231	0	0.167	0.167	0.269	0.192	0.361	0.486
V. 10	0.256	0.179	0.064	0.308	0.192	0.269	0.167	0	0.154	0.205	0.256	0.236	0.444
V. 11	0.154	0.231	0.090	0.154	0.167	0.192	0.167	0.154	0	0.154	0.256	0.361	0.569
V. 12	0.103	0.128	0.141	0.154	0.115	0.192	0.269	0.205	0.154	0	0.256	0.361	0.569
V. 13	0.256	0.179	0.269	0.256	0.192	0.218	0.192	0.256	0.256	0.256	0	0.375	0.500
V. 14	0.472	0.319	0.264	0.528	0.444	0.528	0.361	0.236	0.361	0.361	0.375	0	0.208
V. 17	0.681	0.528	0.472	0.736	0.653	0.736	0.486	0.444	0.569	0.569	0.500	0.208	0

Hierarchical Cluster Modeling

Hierarchical cluster modeling is a method to organize and visualize the distances between vessels as expressed by the batches of ranks for their attributes. In PAST 3.0, the Unweighted Pair Group Average (UPGMA) algorithm was utilized. This algorithm creates a bifurcated dendrogram that joins clusters based on the average distance between two groups (Hammer 2018:111). The dendrogram created as a result of this algorithm as performed on this sample's Gower coefficients is presented in Figure 4.1. There, the measure of distance is read along the x-axis, while each vessel is listed down the y-axis. The dendrogram indicates a smaller group of vessels clustered at the top of the y-axis (visualized within a red box, and named "group A"), bifurcated away from a larger group of vessels (indicated by another bifurcated "group B" in green and "group C" in purple) (Table 4.2). The average distance (dissimilarity coefficient) between any vessels in group A with any vessel in group B/C is indicated by the branch on the left of the x-axis that connects those two groups, which in this case is 0.45. This means that on average, vessels in group A have dissimilarity coefficient of 0.45 compared to vessels in group B/C. Then, note how the average distance between any vessel between the bifurcation separating group B from group C is about 0.24. This means that on average, vessels in group A are almost twice as dissimilar from vessels in groups B and C combined than vessels in group B are from vessels in group C. This seems to be a robust difference separating a minority of vessels (group A) from most other vessels (groups B and C). Furthermore, vessels in group C are the most tightly clustered, and thus least dissimilar to one another. Vessels in group B are a bit less tightly clustered, then group A is the least tightly clustered group, suggesting more heterogeneity. Therefore, there seem to be notable differences in the ranks between these defined groups as based on the results of the UPGMA.

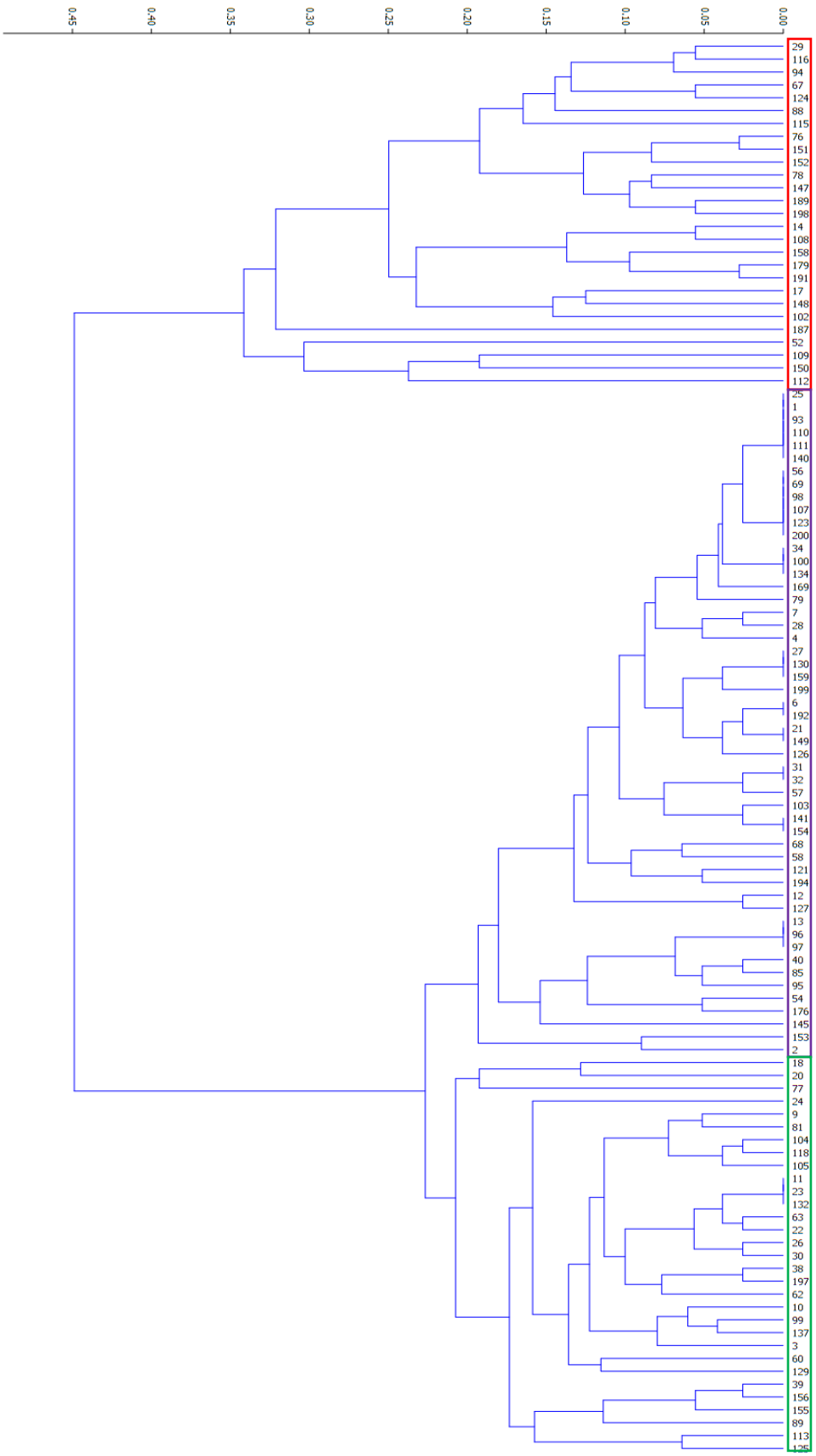

Figure 4.1. Hierarchical clustering model for the Gower coefficients of dissimilarity (x-axis) for the ranked vessels (y-axis). Note: the colored boxes indicate vessels determined to be groupings for analysis (see Table 4.2). Vessels 19, 186, 190, and 195 are outliers removed from this graph for efficient visualization. These vessels were indicated closer to group B but had a somewhat greater dissimilarity that removed them from that larger grouping. Removing these outliers does not change the outcome of the grouping. See Appendix C for that dendrogram.

Table 4.2. Three analytical groups and outliers based on Gower hierarchical clustering. Note: (color) indicates hue of boxed visual aids from Table 4.2.

Group	Vessel #s	# as Fraction of Total and Percentage
A (red)	**14, 17, 29, 52, 67, 76, 78, 88, 94, 102, 108, 109, 112, 115, 116, 124, 147, 148, 150, 151, 152, 158, 179, 187, 189, 191, 198**	**27/114, 24%**
B (green)	**3, 9, 10, 11, 18, 20, 22, 23, 24, 26, 30, 38, 39, 60, 62, 63, 77, 81, 89, 99, 104, 105, 108, 113, 118, 125, 129, 132, 137, 155, 156, 197**	**31/114, 27%**
C (purple)	**1, 2, 4, 6, 7, 12, 13, 21, 25, 27, 28, 31, 32, 34, 40, 54, 56, 57, 58, 68, 69, 79, 85, 93, 95, 96, 97, 98, 100, 103, 107, 110, 111, 121, 123, 126, 127, 130, 134, 140, 141, 145, 149, 153, 154, 159, 169, 176, 192, 194, 199, 200**	**52/114, 46%**
Outliers (not charted)	**19, 186, 190, 195**	**4/114, 3%**

Analysis

Analyzing the grouped clusters in terms of their ranks illuminates why the statistics connected certain vessels together. Table 4.3 examines the medians and modes of ranks of every attribute against their grouping, and the percent of occurrence for attribute ranks for each group. These charts show that group A exhibits the lowest ranks, while groups B and C exhibit markedly higher ranks than group A. It is also apparent that group C has higher ranks overall than group B, with the few cases of higher rankings in group B than in group C (Motor Control and Type of Drawing) being only by a few percentage points. Group C also almost exclusively contains all the vessels typed with a specific cultural grammar (Mesa Verde or McElmo Black-on-white). Almost all vessels in all groups achieved the highest Use of Vessel Field score.

Table 4.3: Medians and modes (top) and percentage (bottom) of ranks for each group. Note: percentages totaling less than 100% indicate unscored attributes.

Group	# of Des. Elem.	Motif State	Field Filled	Type of Drawing	Cultural Grammar	Proportions	Symmetry	Field use	Shapes	Overlapping Lines	Motor Control	Line Width	Line Control
A	Median 1 Mode 1	Median 2 Mode 2	Median 4 Mode 4	Median 1 Mode 1	Median 1 Mode 1	Median 2 Mode 2	Median 3 Mode 3	Median 3 Mode 3	Median 2 Mode 2	Median 2 Mode 2	Median 2 Mode 3	Median 2 Mode 2	Median 2 Mode 3
B	Median 2 Mode 2	Median 2 Mode 2	Median 4 Mode 4	Median 2 Mode 2	Median 1 Mode 1	Median 2 Mode 2	Median 4 Mode 5	Median 3 Mode 3	Median 3 Mode 3	Median 3 Mode 3	Median 3 Mode 3	Median 3 Mode 3	Median 3 Mode 3
C	Median 3 Mode 3	Median 3 Mode 3	Median 4 Mode 4	Median 2 Mode 2	Median 2 Mode 2	Median 3 Mode 3	Median 4.5 Mode 5	Median 3 Mode 3	Median 3 Mode 3	Median 3 Mode 3	Median 3 Mode 3	Median 4 Mode 4	Median 3 Mode 3

Group	# of Des. Elem.	Motif State	Field Filled	Type of Drawing	Cultural Grammar	Proportions	Symmetry	Field Use	Shapes	Overlapping Lines	Motor Control	Line Width	Line Control
A	4 = 0% 3 = 0% 2 = 41% 1 = 59%	3 = 4% 2 = 18% 1 = 4%	4 = 52% 3 = 15% 2 = 18% 1 = 15%	3 = 0% 2 = 7% 1 = 93%	2 = 4% 1 = 96%	3 = 33% 2 = 60% 1 = 7%	5 = 7% 4 = 33% 3 = 48% 2 = 11%	3 = 96% 2 = 4% 1 = 0%	3 = 15% 2 = 85% 1 = 0%	3 = 22% 2 = 78% 1 = 0%	3 = 45% 2 = 37% 1 = 18%	4 = 3.5% 3 = 30% 2 = 63% 1 = 3.5%	3 = 48% 2 = 41% 1 = 11%
B	4 = 10% 3 = 32% 2 = 52% 1 = 6%	3 = 32% 2 = 60% 1 = 0%	4 = 87% 3 = 10% 2 = 0% 1 = 0%	3 = 10% 2 = 84% 1 = 6%	2 = 0% 1 = 100%	3 = 45% 2 = 52% 1 = 3%	5 = 52% 4 = 29% 3 = 19% 2 = 0%	3 = 100% 2 = 0% 1 = 0%	3 = 100% 2 = 0% 1 = 0%	3 = 90% 2 = 7% 1 = 3%	3 = 91% 2 = 6% 1 = 3%	4 = 19% 3 = 55% 2 = 19% 1 = 7%	3 = 71% 2 = 29% 1 = 0%
C	4 = 38% 3 = 52% 2 = 8% 1 = 2%	3 = 58% 2 = 38% 1 = 0%	4 = 100% 3 = 0% 2 = 0% 1 = 0%	3 = 6% 2 = 92% 1 = 2%	2 = 100% 1 = 0%	3 = 69% 2 = 31% 1 = 0%	5 = 50% 4 = 42% 3 = 8% 2 = 0%	3 = 100% 2 = 0% 1 = 0%	3 = 100% 2 = 0% 1 = 0%	3 = 98% 2 = 2% 1 = 0%	3 = 85% 2 = 15% 1 = 0%	4 = 52% 3 = 35% 2 = 11% 1 = 2%	3 = 81% 2 = 19% 1 = 0%

Based on these ranks, could the dendrogram be exhibiting vessels connected by the relative age or skill of the painter, or is there another explanation? Crown (1999) discusses how overall, basic achievements in drawing tend to unfold naturally by certain age milestones, with the ability to use most skills by mid-to-late adolescence. Cultural influence or individual talent could either hurry or delay the acquisition of any given skill for any given individual or cohort, but completely randomized skill development would not be expected. Nor would one expect a child to acquire a necessary skill as a novice, then lose it when she matures while gaining other skills. Thus, we would assume a generally direct variation between attributes within a vessel

(low scores should match with low scores, and high scores with high scores). Inverse variations should be generally unapparent. If the dendrogram shows random clusters that represented weakly correlated dissimilarity coefficients, or if clusters show substantial inverse variations in skill sets between groups, that would not match these assumptions, and other interpretive theories would need to be considered.

Table 4.4 shows that all skill ranks generally exhibit a direct variation on vessels through the entire population. Lower scores match overwhelmingly on vessels in group A, though higher ranks are not uncommon in specific attributes. Lower ratings are rarer in group B, and practically non-existent in group C. These broad patterns fit the behavioral assumptions.

We might also expect that adults would not only be painting at the highest skill, but at the highest quantity. They would have the greatest capability and access to resources to create the most amounts of finished vessels at the highest quality. Indeed, we might expect to find almost *no* children's products, as substandard wares may survive neither the creation process nor the approval process of teachers; making broken sherds in the midden a more likely place to find signs of lesser skilled individuals (Wendrich 2012b). As it is, more than 3 out of every 4 vessels display medium-high to high skill ranks, while less than a quarter display lower ranks. This also seems to suggest that these groups are separated by relative age and skill.

On Autocorrelation

However, it is possible that autocorrelating attributes could also be an explanatory factor for strong direct correlations between ranks. Autocorrelation could be conceptualized as phrasing the same question two different ways, i.e., having two different analyses for a singular skill, thus overemphasizing it mathematically. Already, some of the attributes that were culled from

Crown's prototype were determined to be redundant for this study, but other autocorrelations might still exist.

Figure 4.2 displays a dendrogram for Spearman's Correlation for Ranked Attributes for all investigated vessels. This technique determines the rate at which one rank increases in tandem with another rank's increase in any given attribute with a similarity coefficient. Strong correlations could be indicative of overlapping attributes. A look at the dendrogram indicates that most scores have moderate to low similarity coefficients. The strongest connection occurs between the shapes and type of drawing ranks. Ostensibly the use of polygons is necessary to complete complex patterns. One could imagine a complex design of interlocking circles, though such patterns are not apparent in the sample. On the other hand, some vessels do show simple geometric motifs such as repeating triangles. Replicating and integrating multiple polygons cleanly is a combined and functional skill set (note: the similarity between the two scores with overlapping lines). Thus, rather than autocorrelation, what likely explains the connection between these skills is that they are executed as cohorts specific to these vessels.

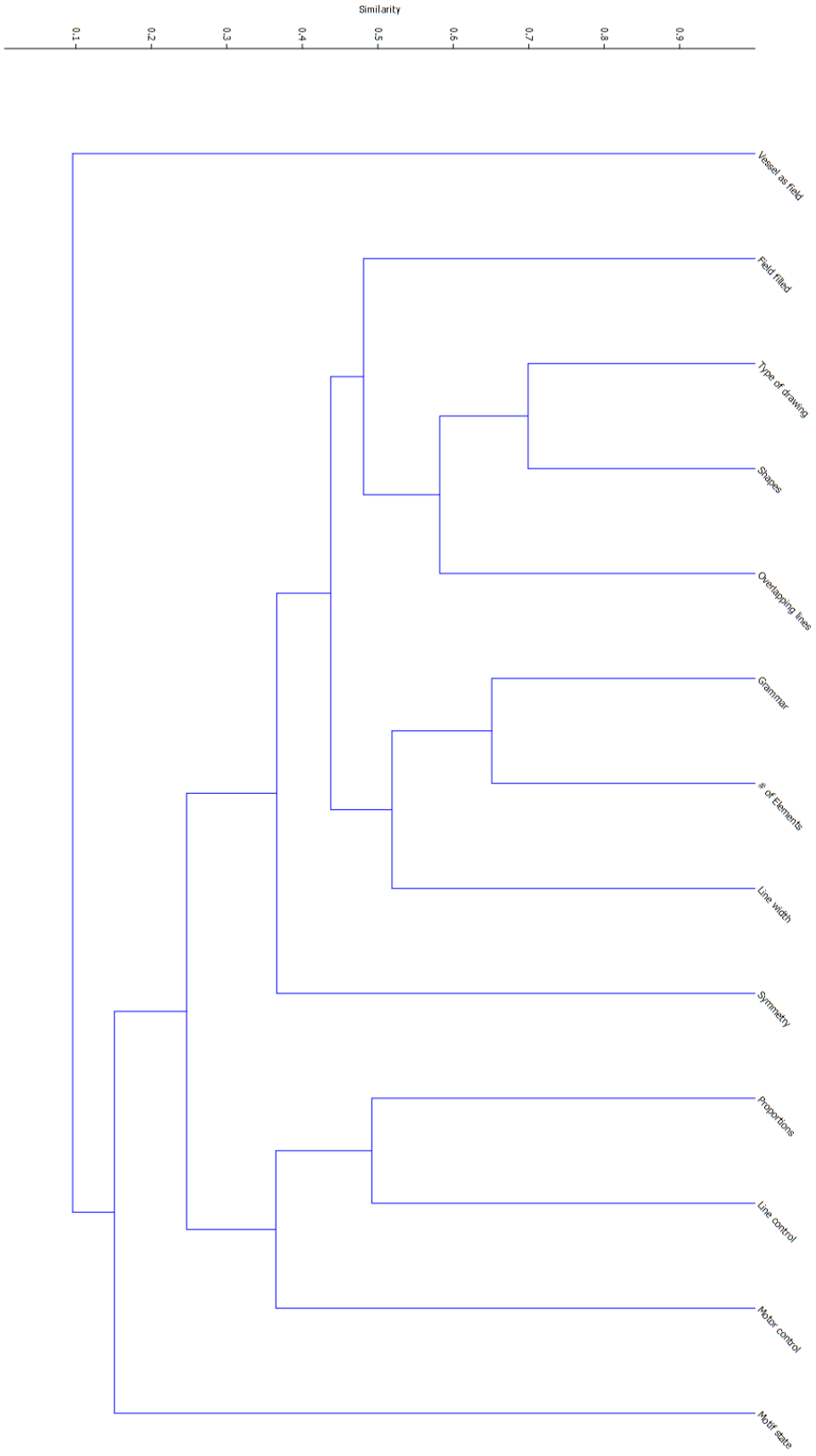

Figure 4.2: Hierarchical clustering model for the Spearman's Correlation for Ranked Attributes similarity coefficients for all ranked vessels.

Grammatical Type and Implicit Skill Recognition

The typing of cultural grammar appears to be strongly correlated with several increased exhibited skills. A look back at Table 4.4. shows that 100% of the vessels in group C are defined by a cultural grammar (48 of which are defined as Mesa Verde Black-on-whites, and 4 of which are defined as McElmo Black-on-whites) while no vessels in group B are typed by a specific style, and only one vessel (4%) in group A is typed (a McElmo Black-on-white). This is a striking pattern that suggests that the hierarchical clustering model could be dividing these vessels according to type. Yet, it is probable that the classification of type here is intrinsically linked to an implicit recognition by archaeologists of high skill execution. For example, the stronger connections between grammar, number of elements, and line width attributes evident in Table 4.5 may reflect the skills needed to execute the design on Mesa Verde Black-on-white vessels, which feature fine, thin framing lines and shape contours, and multiple design elements arranged in complex patterns. Also, the difference in defined grammar does not seem to predominately control for the distance between vessels in group A from the vessels in neither group B nor group C, because group B also does not contain specifically typed vessels. Rather, it seems to be an important factor for the distance between group B and group C. Furthermore, the large distance from group A to both groups B and group C seems related to the lower ranks for all skills in group A, including cultural grammar. Nonetheless, the association between Grammar (mostly Mesa Verde black-on-white) and other higher skills suggests that classic typology may be a function of an implicit recognition of higher skill execution, and as corollary, the grouped types are recognized because they demonstrate overall lower skill executions. It should also be noted that 2 of the 4 outliers are typed: V. 186 is a McElmo Black-on-white and V. 195 is a Mesa Verde Black-on-white.

Group A Containing Vessels of Mixed but Distinct Skill and (Likely) Age Cohorts

It is logical to investigate group A to determine if these vessels are indicative of the youngest painters because these vessels exhibit markedly lower ranks in almost all skills. For those vessels exclusively, the Gower clustering was again applied. The resulting dendrogram (Figure 4.6) rearranges vessels to a modest degree from the original, but the clusters are more robust as a result. From left to right (excluding Vessel 187), group A_1 (orange) provides a cluster with the least range of dissimilarities as a group. Separated from that is group A_2 (aqua), which is larger but a slightly more diverse sub-group. Group A_3, (brown) is the most dissimilar to vessels in its own group as well as any other vessels. Vessel 187 is an outlier which breaks away from all these groups, but this vessel will be addressed later. Group A_1 and group A_2 (Figure 4.7 and Figure 4.8, respectively) will be examined in the following paragraphs.

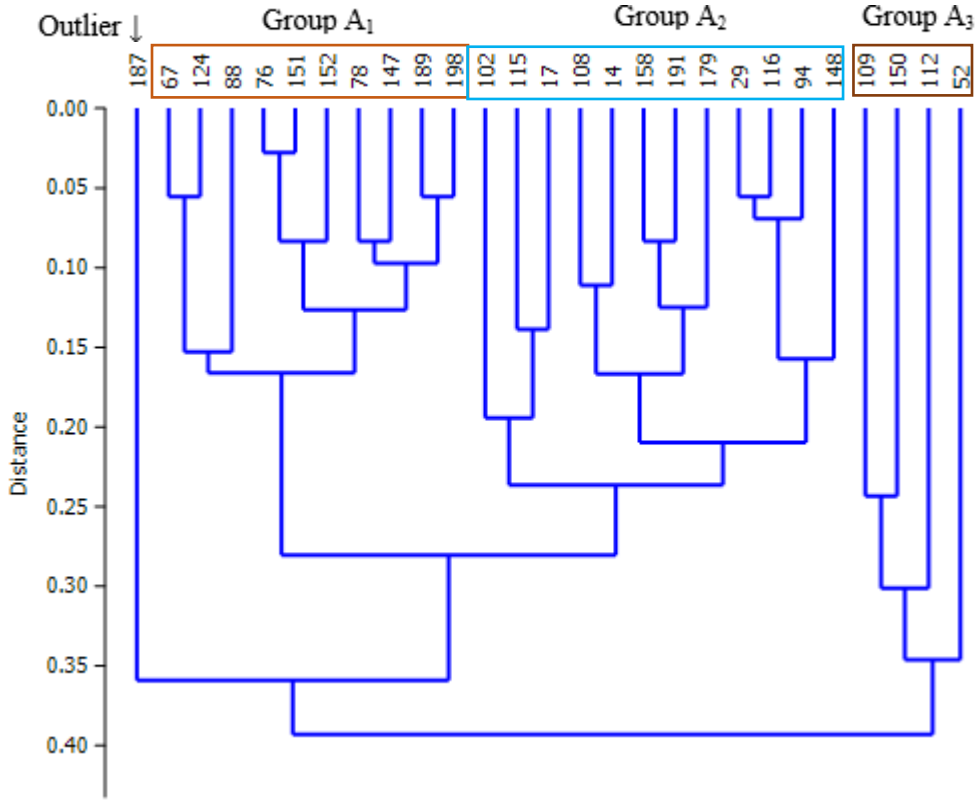

Figure 4.3: Hierarchical clustering for the Gower coefficients of dissimilarity calculated for group A, exclusively.

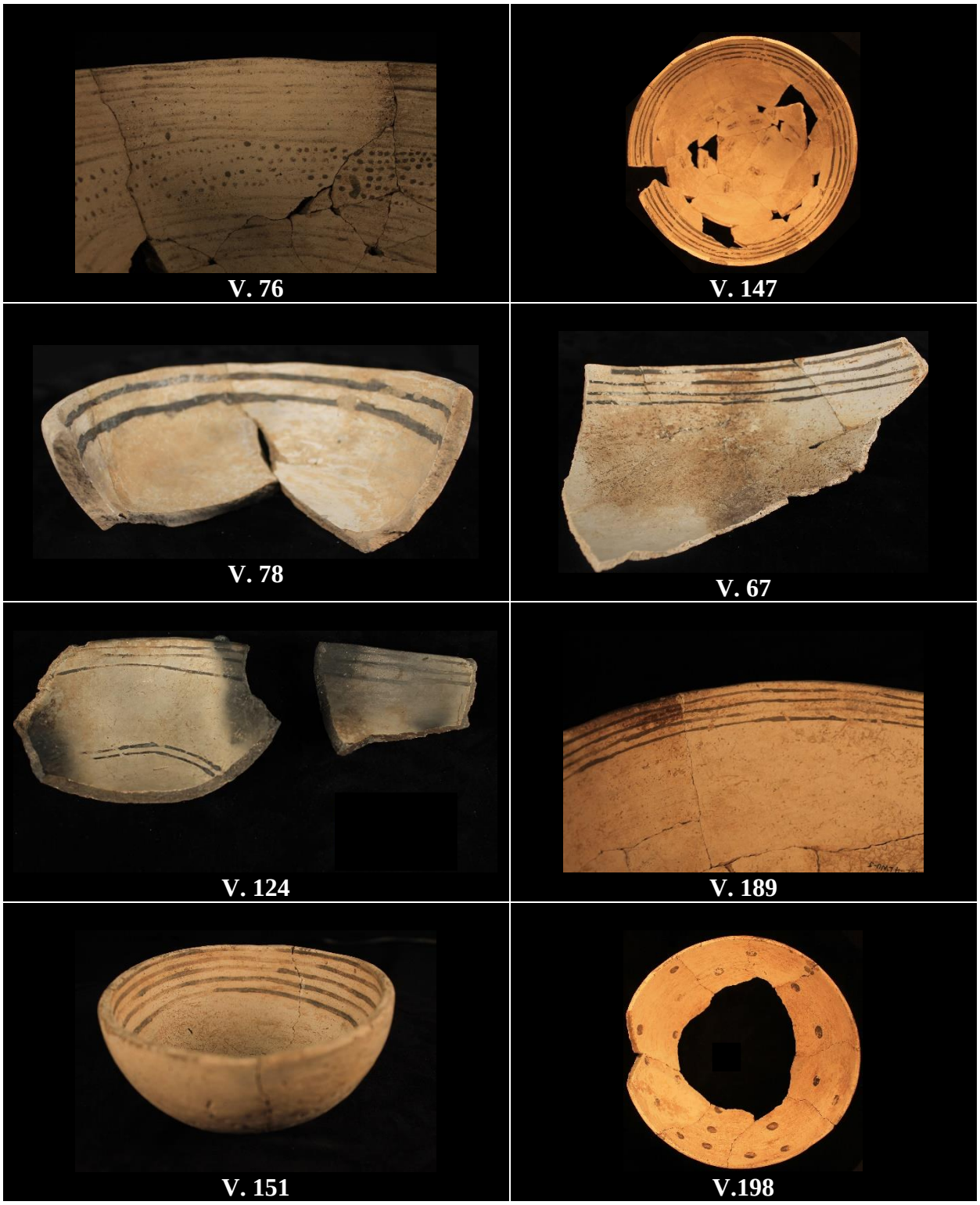

Figure 4.4. Eight vessels from group A_1. Metrics available in Table 4.1.

Figure 4.5: Eight vessels from group A_2. Metrics available in Table 4.10.

Table 4.4 compares ranks between vessels in group A_1 with group A_2. Vessels in group A_1 tend to have high ranks in terms of line control, line width, motor control, and proportions. In fact, these skills achieve similar medians to the more skilled vessels in group B and group C. However, vessels in group A_1 almost exclusively represent the banded line element/concentric circle motif, with rare elaborations (except for Vessels 198 and 152, which exhibit larger filled-in dots as a solitary motif, lacking banded lines). Therefore, shapes tend to remain "in their own space" for the Overlapping Linework attribute here.

Table 4.4. Ranks for vessels in group A_1 (top) and group A_2 (bottom).

A_1

Vessel #	# Elements	Motif state	% Field Filled	Type of Drawing	Grammar	Proportions	Symmetry	Vessel Field	Shapes	Overlapping Lines	Motor Control	Line Width	Line Control
67	1		1	1	1	2	3	3	2	2	2	3	2
76	1		4	1	1	3	3	3	2	2	3	3	3
78	1		2	1	1	3	3	3	2	2	2	2	3
88	1		4	1	1	3	3	3	2	2	2	1	2
124	1		2	1	1	2	3	3	2	2	2	2	2
147	1		2	1	1	3	3	3	2	2	3	2	2
151	1		3	1	1	3	3	3	2	2	3	3	3
152	1	2	4	1	1	2	2	3	2	2	3	3	3
189	1		1	1	1	3	3	3	2	2	3	2	3
198	1	2	1	1	1	3	2	3	2	2	3	3	3
Median	1	2	2	1	1	3	3	3	2	2	3	2.5	3
Mode	1	2	1	1	1	3	3	3	2	2	3	3	3

A_2

Vessel #	# Elements	Motif state	% Field Filled	Type of Drawing	Grammar	Proportions	Symmetry	Vessel Field	Shapes	Overlapping Lines	Motor Control	Line Width	Line Control
14	1		3	1	1	2	3	3	2	3	2	2	3
17	1		3	1	1	2	3	3	2	2	1	2	1
29	2		4	1	1	2	3	3	2	2	2	2	2
94	2		4	1	1	2	4	3	2	2	2	2	3
102	1		4	1	1	1	3	3	2	3	1	2	1
108	2		4	1	1	2	3	3	2	3	2	2	3
115	1	3	4	1	1	2	4	3	2	2	1	2	3
116	2		3	1	1	2	4	3	2	2	2	2	2
148	2		4	1	1	1	4	3	2	2	1	2	1
158	2		4	1	1	2	4	3	2	3	1	2	2
179	1		4	1	1	2	4	3	2	3	3	2	2
191	2		4	1	1	2	4	3	2	3	3	2	2
Median	2	3	4	1	1	2	4	3	2	3	2	2	2
Mode	2		4	1	1	2	4	3	2	3	1	2	2

Vessels in group A_2 demonstrate a cohort containing the lowest ranks in motor control, line width, line control, and proportions attributes. The lowest rank in motor control represents the mode for vessels in group A_2, and that rank for the attribute is exclusive to these vessels. While these attributes are the lowest of any batch, vessels in group A_2 however show a slightly higher design elaboration than vessels in group A_1, resulting in more elements in direct contact with one another. Some of these vessels succeed by staying in the lines (overlapping lines) with elaborations, but others do not. Typically, these designs manipulate the concentric circle motif by adding repeating dots or ticks, or by breaking the design field using parallel and oblique lines, sometimes resulting in more complex symmetries when halving or quartering the field. This latter technique bounds sections in the design field, but falls short of replicating discrete polygons.

The differences in skill execution in each group seems to be related to both the size and the form of the vessels (Table 4.10). Seventy percent of the vessels in group A_1 (7 of 10) are bowls (with one more a sherd container that was originally a bowl), while half the vessels in group A_2 (6 of 12) are ladles. The median diameter of vessels in group A_1 is over two times as large as in group A_2, as bowl diameters are generally larger than ladle diameters. The bowls in group A_1 utilize a minimum percentage of the design field filled, and with the simplest designs and symmetries (circles and dots); yet what is painted is generally executed cleanly (e.g., the median scores for the motor control, line width, line control, and proportions attributes mimic the median for group B). On the contrary, while the smaller ladles, mugs, and jars tend to have slightly more design elements than the vessels in group A_1, they are uniformly executed at the lowest motor skill levels through the entire population of vessels – especially in terms of the motor control attribute. However, the smaller vessels are usually entirely filled with design work.

Table 4.5. Comparison of group A_1 (top) and group A_2 (bottom) by form, location, and size

A_1

Vessel	Form	Location (STR = structure)	Height (cm)	Diameter (cm)
67	sherd container (bowl)	STR 208 / Aboveground Kiva	10	28.0
76	bowl	STR 102, STR 116 / Kiva Corner Room	13	28.2
78	bowl	Non-STR 103 / Midden	7.1	17.0
88	jar, not further specified	STR 506 / Masonry Surface Structure	8.7	10.9
124	bowl	STR 501 / Subterranean Kiva	7.5	16.0
147	bowl	STR 501 / Subterranean Kiva, STR 503 / Masonry Surface Structure	11.7	26.0
151	bowl	STR 512 / Masonry Surface Structure	7.8	16.6
152	olla	STR 504 / Masonry Surface Structure	32	32.2
189	bowl	STR 1205 / Masonry Surface Structure	9.3	26.5
198	bowl	STR 1004 / Aboveground Kiva	12	25.5
		Median	9.65	25.75

A_2

Vessel	Form	Location / Type	Height	Diameter
14	ladle	STR 208 / Aboveground Kiva	5.7	10.5
17	ladle	STR 108 / Aboveground Kiva	5.4	11.6
29	mug	STR 205 / Masonry Surface Structure	9.9	10.0
94	jar, not further specified	STR 506 / Masonry Surface Structure	7.7	10.1
102	ladle	NST 515 / Midden	5	12.3
108	ladle	STR 503 / Masonry Surface Structure	5.4	11.4
115	ladle	STR 506, Arbitrary Unit 519 / Masonry Surface Structure	3.4	8.3
116	sherd container/bowl	STR 506 /Masonry Surface Structure	11.8	25.0
148	mug	STR 504 / Masonry Surface Structure	8.6	9.7
158	bowl	STR 514 / Subterranean Room	7.6	17.2
179	ladle	STR 1202 / Masonry Surface Structure	5.5	7.9
191	seed jar	STR 1205 / Masonry Surface Structure	12	17.2
		Median	6.65	11.0

Vessels in group A_2 are not only smaller, they appear to be less finely crafted than other vessels in the collection. Some appear modestly asymmetrical, lumpy, or generally less sturdy than other vessels (though they would have been basically functional). These qualities are also directly associated with childhood production (Kamp 2002:87, Bagwell 2002:107, Crown 1999). This is a general observation however, and a more detailed assessment of formal qualities (especially vis-à-vis apprenticeship studies, such as provided in Bagwell 2002) would be useful in future research.

The most logical explanation for the overall lower quality of design execution in group A_2 is that most of these vessels were indeed made by children. The smaller vessels in this sub-group would have been easiest to paint yet evince the fundamental efforts in both motor and cognitive execution, though vessels in group A_2 were slightly more ambitious in using different design elements and displaying more complex symmetries than those is group A_1.

It could be that the smallest vessels in either subgroup were painted by children. For example, vessel 88, a small Pueblo White painted miniature jar in group A_1; and vessel 94, an almost identically constructed Pueblo White painted jar that was grouped in A_2, were both located in Structure 506, a masonry surface structure associated with a residential kiva suite (Figure 4.11). Both vessels achieved lower Motor Control, Line Width, and Line Control scores; but the design work on vessel 88 featured solely concentric circles, which led to the vessel achieving ranks in number of elements, overlapping lines, and symmetry that parallels the bowls in group A_1. This resulted in statistically clustering vessel 88 with the larger bowls. Thus, vessel 94 differs from its twin having more complex design schema, but the line execution between the two vessels is similar. Based on exhibited painted skill, vessel size, form, construction quality, and provenience, it seems likely these two vessels were painted by one individual or two very similar people, who were probably children.

V. 88

V. 94

Figure 4.6. Vessel 88 and vessel 94.

Oppositely, it could be that most of the larger vessels in group A_1 and group A_2 were not painted by children. Two of the three largest vessels (V. 116 and V. 158) in Group A_2 are bowls, with the other larger vessel (V. 191) being a seed jar. These vessels do exhibit poorer line work and slightly more complex design choices, and they could represent the efforts of a younger child. However, it seems more likely that the larger vessels were likely painted by larger and more mature girls or women with both more experience *and* greater physical size. Older artisans are more likely to have ability to turn the larger, heavier bowl to while keeping the yucca brush still to create banded lines (Crown 1999, Swink 2004). They would also have been generally more practiced and able to execute lines with higher motor skills. Yet, rather than attempting more elaborate design work, the painters of the larger bowls were mostly painting banded lines, often repeatedly. This could suggest that a certain cohort was practicing that technique.

Ladles as a Form Generally (but not Exclusively) Reserved for Children

The analysis reveals that multiple attributes associated with both poor motor control and lower cognitive skills are often associated with smaller, poorly crafted ladles. Seven ladles belong in group A ($n = 27$), but four ladles are divided between groups B and C, with two of the four outliers also being ladles ($n = 87$). A further analysis indicates that ladles not statistically segregated into group A may also be associated with younger producers (Table 4.6, Figure 4.7).

Table 4.6. A comparison ranks, presence of learning aids, and size for all ladles.

Group	Vessel #	# Elements	Motif state	% Field Filled	Type of Drawing	Grammar	Proportions	Symmetry	Vessel Field	Shapes	Overlap. Lines	Motor Control	Line Width	Line Control	Possible Learning Aides?	Diameter (cm)
A_2	14	1		3	1	1	2	3	3	2	3	2	2	3	Yes	10.5
A_2	17	1		3	1	1	2	3	3	2	2	1	2	1	No	11.6
A_2	102	1		4	1	1	1	3	3	2	3	1	2	1	No	12.3
A_2	108	2		4	1	1	2	3	3	2	3	2	2	3	No	11.4
A_2	115	1	3	4	1	1	2	4	3	2	2	1	2	3	No	8.3
A_2	179	1		4	1	1	2	4	3	2	3	3	2	2	No	7.9
$A_{Out.}$	187	2		1	1	2	3	4	3	2	2	3	3	2	No	12.0
Out.	19	3	3	4	3	1	3	4	3	3	2	2	2	2	Yes	n/a
Out.	186	2		4	2	2	3	4	3	3	3	3	2	3	No	14.2
B	89	2	2	4	2	1	2	4	3	3	3	2	1	2	Yes	11.9
B	125	2	2	4	2	1	2	5	3	3	3	1	2	3	No	8.7
B	156	2	3	4	2	1	2	5	3	3	3	3	2	2	No	13.5
C	169	4	3	4	2	2	3	5	3	3	3	3	3	3	No	13.0
Median		2	3	4	1	1	2	4	3	2	3	2	2	2	-	11.75
Mode		2	3	4	1	1	2	4	3	2	3	3	2	3	-	-

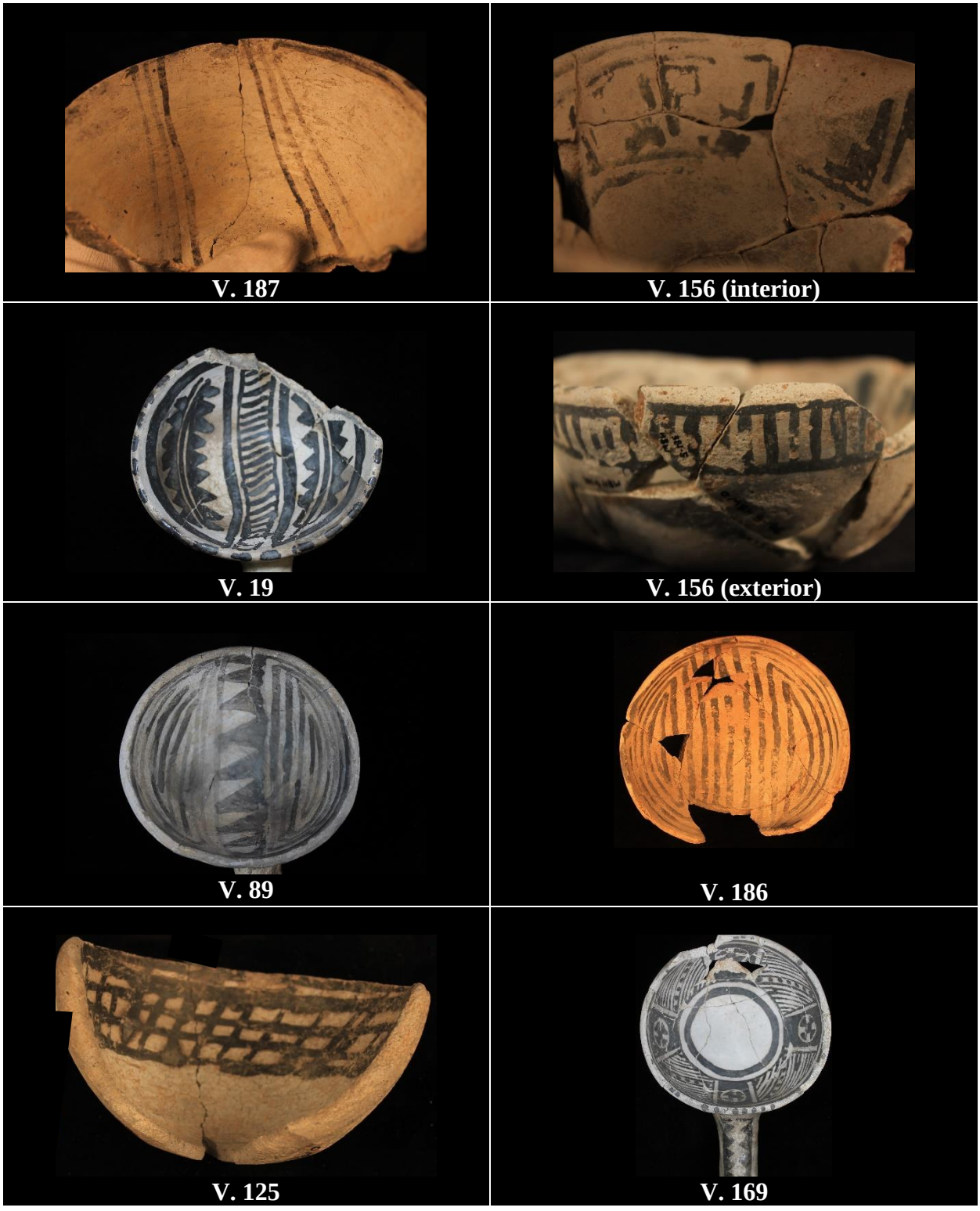

Figure 4.7. Ladles not segregated into group A_2. Metrics provided in Table 4.12.

Three ladles were the only vessels indicated with possible learning aides. Vessels 14 and 89 exhibit evenly executed but washed-out "ghost lines" or templates that are superimposed by darker yet more poorly executed lines (Figure 4.14) (Crown 2001). On vessel 14, there appears to be three banded ghost lines, each superimposed by one or two thinner yet darker and choppier lines. On vessel 89, the application of the paint for the spiral elements on either hemisphere of the vessel interior also appears generally washed out, with only some portions exhibiting darker lines. Some of these darker lines exhibit poorer motor control. They seem to abruptly superimpose upon the lighter linework. The triangle elements also appear to have been superimposed on ghost lines. The execution of the dark, filled-in triangle elements is shaky and disproportionate – especially along the rim, where it appears that the painter had difficulty navigating the changing plane of the curvature at the edge of the wall. The triangles are contoured and filled in, but with a single, thicker brush.

V. 14 V.89

Figure 4.8: Closer view of vessel 14 and vessel 89 demonstrating possible "ghost lines" superimposed by thicker and more poorly executed lines. Metrics provided in Table 4.6.

A reasonable explanation for the appearance of the linework on both vessels could be that the designs were templates laid out with ghost lines by an adult, and then filled in afterwards by a child (Crown 2001, 2002). This would explain the seeming superpositions in paint application on these vessels. Additionally, as with other ladles, these two vessels achieved relatively lower

ranks for the motor control, line thickness, line control, proportions, and number of elements attributes (judged based the darker lines).

The design execution on vessel 19 also may demonstrate an advanced design by a younger artist who may have been helped by an adult. The design schema divides the ladle into two hemispheres (parallel to the axis of the handle) between two large almond shapes. Within each almond shape are three parallel lines drawn along the lengthwise axis of the handle. Along the outer lines, a series of triangles is placed. A hatched motif splits the almond shapes. This design was judged to be representational imagery: two leaves (possibly oak) nestled within either hemisphere of the cross section of a seed (stylistically reminiscent of an acorn). This interpretation boosted its rank for the type of drawing attribute.

Whether or not this speculation is accurate, vessel 19 is executed with generally thick, choppy, and uneven linework, with the thinnest lines on the vessel displaying the greatest choppiness. Several triangles appear to be executed with singular, broad, and less precise brush strokes. However, it does appear that at least some of the triangles may be contoured with thinner lines and filled in, yet the results of some of that fill appears sloppy and blobby (Figure 4.15). The uneven execution may be the result of an adult intervening with the correct method of drawing shapes during production, with more successful attempts at contouring and filling some triangles than others (Crown 2002; also see Chapter 3).

V. 19 – left hemisphere

V. 19 – right hemisphere

Figure 4.9. Two views of vessel 19. Diameter of vessel approximately 12 cm

Vessel 187 features what could be described as “banded wedges,” which seems a reimagining of the banded line motif. The vessel achieved some increased cognitive scores. It is also defined as a McElmo Black-on-white style, achieving the lone high grammar rank for vessels not in group C. Yet the linework is simple, sparse, and evinced poorer line control. The paint also appears inconsistently applied, appearing too lightly over much of the design. The linework appears to be single strokes, rather than a retraced template like on vessel 89.

Vessel 186 – typed as McElmo Black-on-white – utilizes few design elements and a wider brush, but is simply and cleanly executed. It effectively communicates the pottery-as-basketry metaphor vis-à-vis an imitation of basketry patterning (Ortman 2000; see Chapter 1, Figure 1.7). Vessel 186 was charted as an outlier closer to group B and group C.

Vessel 125 features a crosshatched motif on the interior with a stepped motif on the exterior. The interior of the vessel is painted with a thicker brush that seems to lack control applying paint. Although the step elements are somewhat faded and marred by firing clouds, they seem to have been executed without contouring, as they lack sharp, defined edges. The vessel is among the smallest in the collection. It is primarily defined as a recycled sherd container. It was the only recycled ladle of the examined sherd containers.

Vessel 156 displays the stepped element as its primary motif on the interior, a simpler but unique exterior motif about the rim of the vessel, and the remnants of a curvilinear element on the remaining part of the broken handle. Yet it exhibits some notably lower motor skills, especially on the exterior motif. The paint is somewhat worn on the interior of the damaged vessel (which could be due in part to a poorer production quality in conjunction with depositional effects), and thus more difficult to assess.

Lastly, vessel 169 displays very high painted skill and craftwork; following the interpretive model here, it was most likely made by a skilled adult. Defined as a Mesa Verde Black-on-white, the design combines multiple elements into a clear yet sophisticated pattern. The vessel field is once quartered (starting from the handle) with filled-in rectangles that were left unpainted with a circular space that was again filled in with a cruciform motif. These motifs create reflectional symmetries along the vertical, horizontal, and diagonal planes of the vessel. Then, the vessel is again quartered into larger spaces broken up by slightly curved diagonal hatching. Between the two most inner hatched lines in each quarter, small dots are placed in a neat row. The resulting visual effect from these quarters is of a four-fold rotational symmetry that is not reflectional. The painter thus showcases two different symmetries in a unified design. Additionally, the handle is decorated with two different motifs, and the rim is ticked. The vessel itself – despite being a few missing sherds short of being completely reconstructed – is of even thickness, symmetrical, and sturdy; finished with a quality white slip and lustrous polish. It is also the largest ladle (bowl diameter) in the examined population. As a final touch, the hollow handle was filled with small seeds, and thus functions as a rattle. The evidence indicates that this is one of the most skillfully realized vessels in the entire collection, and thus likely crafted by an older, highly skilled ceramicist. The archetypal quality of the design juxtaposed contra the other

ladles that show some of the lowest skills in pottery production throughout all the vessels is striking.

One possible clue that connects this skilled object with childhood craft production is provided in a description of symbolic meanings from 19th century Hopi pottery. Patterson (1994:137) tells that the "Maltese cross" motif, which matches the cruciform motif replicated on vessel 169, is a direct representation of a hairstyle worn exclusively by young Hopi girls. This motif is further indicated on a sketch of a Hopi ladle, amongst other forms. This description from ethnographic sources provides an intriguing possible connection between this vessel, ladles, and childhood (girls') craft production that tangentially supports the theory that ladles were crafted by children; though to tease out the relationships between these data is beyond the scope of this thesis (for example, the precise nature of the historic and cultural connection between the Hopi and Sand Canyon Pueblo is not known to this analyst). Furthermore, the "Maltese Cross" appears on a few other vessels in this collection. Nonetheless, it seems possible that vessel 169 is an important object that somehow connects adult craft production with childhood craft production.

Overall, ladles are more likely to display low-to-moderate painting skills in any category. The ranks for the line control, line width, motor control, and number of elements attributes for ladles in group B and the outlier approximate the ranks for those categories in group A_2. These attributes match other vessels in group A_2 also theorized to be children's products. Three ladles possibly show evidence of techniques associated with teaching and learning, and no other vessel indicates learning aides. Ladles are smaller and may be more poorly constructed, with only vessel 169 displaying a high level of craftswomanship and painted skill. Therefore, it is posited that ladles are generally painted and constructed by relatively less-skilled pre-adults.

Furthermore, the likelihood that certain forms are generally reserved for specific skill and/or age cohorts is further supported when looking at the other attribute groups.

Comparing Form and Painted Skill

Table 4.16 compares groups A, B, and C in terms of their forms. As already discussed, ladles seem almost uniquely reserved for novices. Also suggested was the possibility that the bowls in group A are painted by those in an older, more advanced skill cohort practicing fundamental design techniques. This table suggests other patterns as well.

Table 4.7. Number of forms in each skill group, as a fraction of total vessels in each group.

Group	Bowl	Canteen	Jar (generic)	Kiva Jar	Ladle	Lid	Mug	Olla	Rect. Form	Seed Jar	Sherd Container (any)
A	# / Group 9 / 27	# / Group 2 / 27	# / Group 3 / 27	# / Group 0 / 27	# / Group 7 / 27	# / Group 0 /27	# / Group 2 / 27	# / Group 1 / 27	# / Group 0 / 27	# / Group 1 / 27	# / Group 2 / 27
B	# / Group 5 / 31	# / Group 1 / 31	# / Group 0 / 31	# / Group 4 / 31	# / Group 2 / 31	# / Group 4 / 31	# / Group 4 / 31	# / Group 1 / 31	# / Group 4 / 31	# / Group 2 / 31	# / Group 4 / 31
C	# / Group 16 / 52	# / Group 3 / 52	# / Group 0 / 52	# / Group 4 / 52	# / Group 1 / 52	# / Group 0 / 52	# / Group 16 / 52	# / Group 5 / 52	# / Group 0 / 52	# / Group 0 / 52	# / Group 7 / 52
Outlier	# / Group 2 / 4	# / Group 0 / 4	# / Group 0 / 4	# / Group 0 / 4	# / Group 2 / 4	# / Group 0 / 4	# / Group 0 / 4	# / Group 0 / 4	# / Group 0 / 4	# / Group 0 / 4	# / Group 0 / 4

The strongest ratio of high skill-to-form appears in mugs. Sixteen of the twenty-two mugs belong in the most-skilled group C, while four more belong in the more-skilled group B. This is especially intriguing considering that mugs are associated with a theoretical "Chacoan revival," (see Chapter 1) and thus may be forms of elevated symbolic significance, perhaps therefore worthy of the highest skilled effort in decoration. Yet the portable, cylindrical mug seems to have made them accessible to ceramicists of any age or skill. For example, the two mugs in

group A_2 were likely painted by children (Table 4.8), and some of the mugs in group B seem to be painted by relative neophytes.

Sixteen bowls also belong in group C, with nine in group A, five in group B, and two more represented in the outliers. As discussed above, it seems likely that most of these larger bowls were painted by older craftswomen, due to their larger size and higher linework scores. It might even be possible that the different levels of complexity within bowls is a relative function of age between younger, less experienced teenagers or adults and older, more experienced adults. If the ethnographic analogy from the Tewa example given by Walleart (2012) could be applied to Sand Canyon Pueblo to supply a hypothetical scenario: perhaps bowls with repeated banded lines were delegated by a mother-in-law to her daughter-in-law during the so-called "second apprenticeship" – at least in part – to practice the linework necessary to complete advanced styles (see Chapter 3). Or perhaps any one potter would craft workaday bowls as well as more complex vessels as part of her overall repertoire.

The preponderance of ollas in group C suggests that the form is meant for advanced painters. These vessels are amongst the largest in the collection. They would have required advanced skill to paint at a high level. The only olla in group A_1 features large, filled in dots arrayed in several columns on either side of the vessel. Some dots are connected by drippy lines of paint, but the dots themselves are executed relatively neatly, proportionally, and are aligned evenly. It seems more likely that a larger adult would have a greater capacity to accomplish this design on the larger vessel.

The tall and wide kiva jars are split evenly between groups B and C, and overall appear to involve advanced efforts in painting. Sherd containers also appear in greater proportion in groups B and C than in group A. It may be that sherds with more-skilled design work were more likely

to be recycled. The smaller (and fewer in number) seed jars display more modest skills, and are placed in either group A or group B.

Lids and rectangular forms are only represented in group B. These forms tend to have mostly moderate to higher ranks, but some also display a certain level of error due to their uncommon shapes. It is likely these forms required a more-skilled painter with the skills to navigate around very reduced surface areas (excluding vessel 22), protruding tops on lids, and sharp angles on rectangular forms.

Group A_3

The four vessels in group A_3 are distinct from other vessels not only in terms of skill execution, but also by form. Vessel 52 is the final "jar, not further specified" in the collection. It differs from vessel 88 and vessel 94 as it is much larger and similar in size to the ollas. The sparse and crooked design on this vessel was the only one in the collection which did not achieve the highest rank for the use of vessel field attribute. It seems possible that this vessel was constructed by an adult (or multiple individuals) and painted by a child, multiple children, or even multi-generationally. Perhaps children pushed the brush on the large jar, resulting in uncharacteristic and inconsistent placement of banded lines and motifs. Vessel 52 was located at Structure 508, a masonry room.

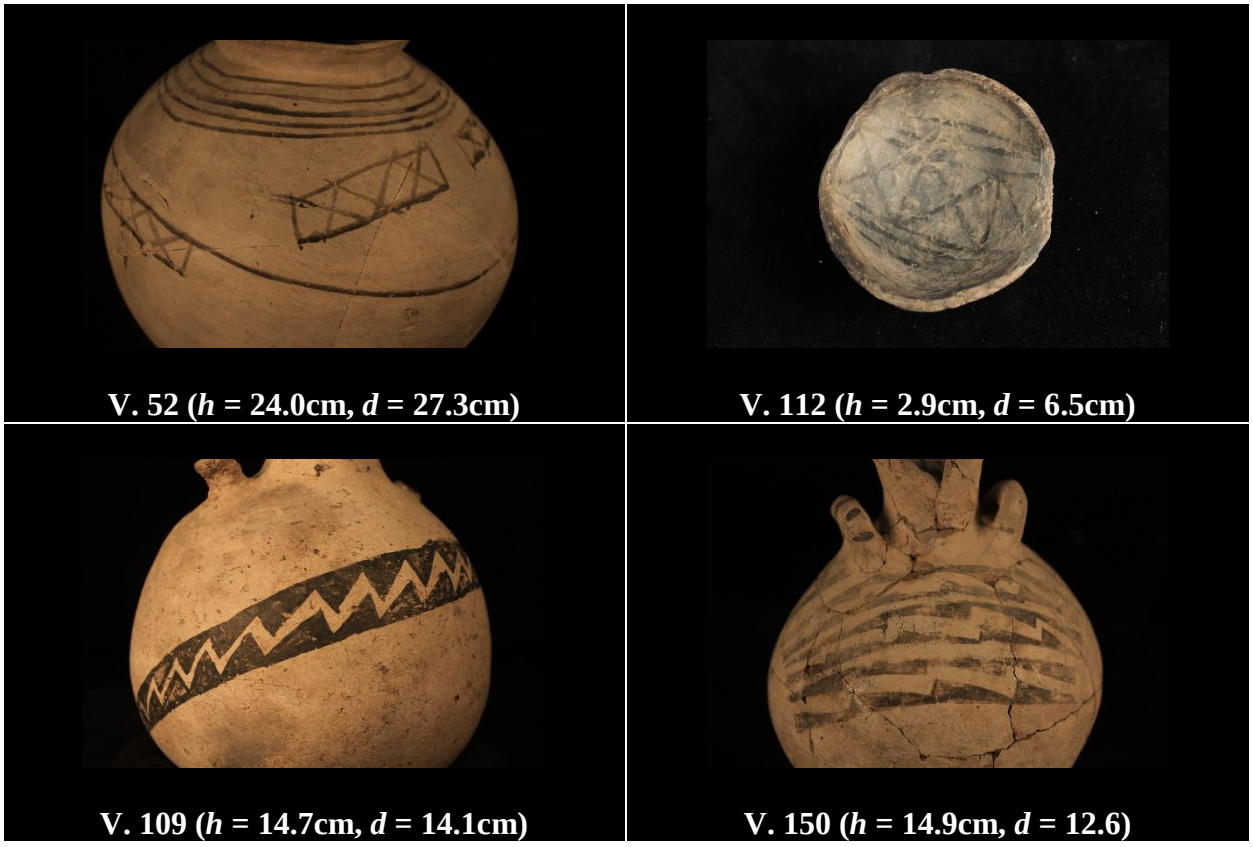

Figure 4.10. Four vessels placed in group A_3.

The two canteens (vessel 109 and vessel 150) in group A_3 represent a third of all canteens located in this collection, which are evenly distributed between all the skill groups. Both canteens in group A_3 are decorated with matching motifs, but do not exhibit banded linework circumscribing the vessel (the other canteens also generally exhibit few banded lines). Both vessels achieved generally higher ranks in the line control, motor control, and line width attributes, like most vessels in the collection but unlike vessels in group A_2. Vessel 109 was recovered from Structure 506 (along with the previously discussed vessel 88 and vessel 94), and vessel 150 was in Structure 504, a masonry room.

Vessel 112 is a tiny pinch pot with a "slapdash" design, matching the description of ritual clay offerings in Crown (1999) (see Chapter 3). The basic and small design nonetheless indicated higher ranks in line control, motor control, and line width. Interestingly, the primary motif

(empty quartered squares) is the same as the one featured on vessel 52. Perhaps the empty-quartered-rectangle motif found on these vessels is a "signature" of painters who lived in the Block 500 kiva suite: vessel 112 was located at Structure 501, a subterranean kiva.

These vessels may match closer to what could be "realms of protected deviation." Except vessel 52, they seem to have been painted by a more practiced artisan with greater brush skills, but again executing relatively constrained designs, such as is argued for the bowls in group A. Unlike the bowls in group A and most of the vessels in the collection, they do not exhibit concentric circles (except vessel 52), and instead only utilize enclosed polygons. These patterns suggest a connection between design choice, form, and skill.

Circles as a Predominate Motif on Sand Canyon White Wares at Every Skill Level

Table 4.7 shows the percentage of vessels exhibiting each given design element within the skill groups. With rare exceptions, banded lines of at least one size that form concentric circles about the circumference of the vessels appear universally at every age and skill level. In group A – the vessels showing the most elementary application of skill, with many of these being children's vessels – circles often exist as solitary motifs, with rare elaborations. The elaborations that do appear tend to be slight modifications of these motifs, such as banded zig-zag lines or perpendicular lines that divide circles into twos or fours. Dots (filled in circles) also exist as solitary motifs or appear with banded lines in group A. While most vessels painted by children featured banded lines, some did not. However, those motifs are typically variations of circles, such as spirals or hemispherical shapes. It is thus likely that a child would have first learned how to reproduce banded lines before she learned to elaborate on that principle.

Table 4.8. Percent of vessels exhibiting given design element for each skill group.

Group	Banded Line 1	Banded Line 2	Oblique / parallel Line	Zig-zag	Curved	Spiral	Polygon (any)	Dots	Ticking	Steps	Scroll	Misc.
A	88.9%	7.4%	33%	22.2%	3.7%	0%	18.5%	14.8%	33.3%	0%	0%	0%
B	87.9%	39.4%	30.3%	30.3%	6.1%	6.1%	78.8%	9.1%	45.5%	30.3%	6.1%	0%
C	98.1%	84.6%	44.2%	61.5%	7.7%	17.3%	80.8%	9.6%	78.8%	42.3%	3.8%	1.9%

Summary

The painted skill execution on ladles examined suggests that most of these vessels were probably crafted and painted by youths. Other vessel forms also indicate novice work. Furthermore, exhibited skill is intrinsically tied to vessel form, and by extension, size. Thus, certain forms are generally (but not exclusively) reserved for cohorts of skill execution at a certain level. While a deeper look at the "more-skilled" vessels is beyond the scope of this thesis, it is possible that further associations and insights between skill and form could be ascertained.

A closer look at locational data would also be revealing. Vessels of all skill levels are distributed across the residential suites excavated, which is not surprising given the theory that pottery production is a household industry. The only two painted vessels recovered from the great kiva (vessel 199), and the D-shaped building (vessel 200) demonstrate very high levels of execution (see Appendix D).

The results have provided enough data to begin to theorize about the teaching and learning of conceptual metaphor through pottery. The final chapter will use these results to suggest a basic and overarching metaphor that was inculcated into pottery painters of Sand Canyon Pueblo – and generally the community as a whole – commencing at the earliest age, based on the common reproduction of concentric circles across both age and skill groups.

Chapter 5: Conclusion

This thesis research examined 114 painted white ware vessels recovered from the Sand Canyon Pueblo site to determine if children painted any of these vessels, using an attribute analysis developed by Crown (1999, 2001). It was theorized that by understanding teaching and learning contexts in painted pottery production, aspects of the "container metaphor" could be discerned as they relate to how a child comes to understand herself, her community, and the broader world around her as she ages and gains experience in pottery painting.

Chapter 4 demonstrated that there are a small group of vessels at Sand Canyon Pueblo that exhibit painted skills of noticeably lesser quality than most other vessels. It was further asserted that the relative level of exhibited skill is connected to the specific ceramic form being decorated, as it was shown the ladle is a form tied to childhood production. Furthermore, the data show that concentric circles are a predominate motif across all skill levels. However, the relative age of producer could only be inferred as a function of skill tied to other lines of inference and evidence, especially the size and form of vessel being painted on. It was theorized that roughly 15 to 20 out of the 114 investigated painted white ware vessels from the Sand Canyon Pueblo were indeed painted by children. It appears that children were largely limited to painting on small ladles, but some mugs and a couple small "toy" jars were also likely painted by youths (and perhaps a few other vessels as well). Children struggled with maintaining parallel lines with smooth, continuous brush strokes; often utilizing fatter brushes to execute lines. Because of this, adults painted "ghost lines" that were traced over by children on two ladles, indicating that adults actively sought to help children master those skills (Crown 2001, 2002). Children generally struggled with keeping design elements proportional. Children also tended to use fewer design elements than most other older, more-skilled ceramicists. These elements were usually limited to

banded lines and other circular shapes. However, children could be innovative in generating motifs (see especially vessel 19), but it seems likely that they would have first learned to replicate banded lines to create the concentric circle motif. While definite age ranges for children at Sand Canyon were not ascertained, it seems reasonable to state that the vessels painted by children were aged from 6 up to the age of 15. This broad age range could be indicated by the relatively wider range of exhibited skill execution on those vessels compared to other, more skilled vessels. More research could be done on discerning more precise age ranges, but it is not necessary for the scope of this study.

Several larger bowls were noted to exhibit solely banded lines that didn't necessarily cover the entire vessel field, but those lines were executed cleanly; indicating an older and more practiced artisan choosing (or perhaps being required to) paint more constrained designs. While it was suggested that these vessels may have been painted by younger married women (perhaps age 15 or older) in their mother-in-law's household during a "second apprenticeship," it is enough to say that simpler designs on larger vessels were overall theorized to have been painted by more-skilled adults (see Chapter 3). Other vessel forms exhibited simpler design traits theorized to be realms of protected deviation (Crown 1999).

Mugs and bowls were often decorated with the most elaborate design work out of any of the vessels. Kiva jars and ollas were also usually decorated with more elaborate designs. It is likely that these vessels were painted by master craftswomen who were older adults, though the possibility that a young savant was active at Sand Canyon should be considered. All the most advanced crafts indicated by the analysis were previously identified by archaeologists as being either Mesa Verde Black-on-white or McElmo Black-on-white, indicating that archaeological typing may implicitly recognize high skill execution. Because the attribute analysis could gauge

skills at multiple levels of execution, it can be utilized as a technique for studying painted pottery to answer broader questions relating pottery production to relative skill masteries. Skilled artistry could be further studied with the attribute analysis using other non-parametric statistical techniques to discern further patterns and observations.

This thesis concludes with a discussion of a theoretical basic metaphor transmitted to child ceramicists at the earliest age. Because circles are painted by all members of Sand Canyon Pueblo starting at the earliest ages and most basic skill execution, continuing to advanced designs that were likely made by skilled adults, it will be theorized that painted circles were a simple, fundamental, and baseline representation of the container metaphor itself (*sensu* Ortman 2000, 2012; Ortman and Bradley 2002). This proposed metaphor is CIRCLES ARE CONTAINERS. The following will show that circles are rarely discussed in archaeological discussions about symbols in pottery, so circles will be reviewed as an icon from a broad, cross cultural perspective. Then, the shape will be discussed as a possibly historically contingent symbol in the ancestral Puebloan milieu. With that background, the proposed metaphor will be integrated into Ortman's (2000a; 2012) "container metaphor" using a rubric for discerning metaphor as presented by Ortman (2012). A possible theory that ladles as a form are metaphors related to childhood will also be suggested. However, more research will be necessary to develop these ideas further. This chapter will finish with other avenues for future research.

Circles as Symbolic Pottery Motifs

Surprisingly, despite the research into patterns, symmetries, and material metaphor in southwestern archaeology and the central Mesa Verde region, circles are not much discussed as a symbolic metaphor for an object, an abstract concept, or a symmetry unto itself. If discussed, they are referenced perfunctorily for more advanced symmetries, patterns, symbols, or metaphor

(e.g. Ortman 2012; Ortman and Bradley 2002; Patterson 1994; Washburn and Crowe 1988, eds. 2004, 2010). It is almost as if circles are ostensibly banal as a motif, and thus not worth explaining. However, this thesis has shown that at Sand Canyon Pueblo, painted circles are the most elementary shapes taught and repeatedly practiced by ceramicists from the earliest age and into adulthood. Therefore, circles are important symbols in themselves – if not *the most important* symbol – because circular and spherical shapes appear everywhere in the built, decorative, and natural environment in and around Sand Canyon.

It could be argued that drawing circles is simply an aesthetic and practical choice. Indeed, carefully executed banded lines are ideal to create the Mesa Verde Black-on-white style. Painting masters may have insisted that children and other younger apprentices practice drawing circles to improve their technique. While this was probably part of the learning process, it is unlikely the only consideration. Shapes, pattern and symmetry embedded in various crafts are the primary means to communicate values and information in cultures where the written word is not ascendant, and even in modern cultures where writing is present (Crowe 2004:3-4). If this were not the case, it would be difficult to even postulate that conceptual metaphor is embedded in material culture. Indeed, the following section will discuss how circles are not perceived as "just so" by the human mind.

Circles as a Universal Symbol

Circles appear as symbols across many cultures and throughout time. Psychologist Carl Jung considered circles to be a primordial shape ingrained in the human psyche, and cognitive science has backed up that assertion with empirical evidence (Radley 2016). For example, people are more drawn to curvilinear objects and imagery than they are to angled ones. This may be an evolutionary mechanism for defense: angled objects tend to be sharp and dangerous, while

curved, smooth objects are less often so (Bar and Neta, 2007). It may also support sociality: human faces and heads are rounded, which both draw an infant's eyes to parents or kin who are likely to nurture the child and attract an older person's eyes to the overly rounded face of an infant (Lima 2017). Because curvilinearity is a fundamental evolutionary pattern in the human brain, circles are often recognized by humans to be intrinsically meaningful (Lima 2017; Radley 2016).

The universal symmetrical properties of circles suggest the possibility – though not the inevitability – for broadly held associations between cultures (Ortman 2012:209). Circles inhere an infinite amount of reflectional and rotational symmetries. The innate appeal of circles along with their symmetrical properties give credence to a description of circles as generically representative of "totality, wholeness, original perfection, the Self (sic), the infinite, eternity, timelessness, all cyclic movement. God." (Protats, Brown, Smith, and Jaffe 2001). This notion of circles as encompassing "the infinite" is unavoidable even in modern, scientific contexts. As an anecdotal example, in 2013 I visited the Denver Museum of Nature and Science in Colorado. There I operated an exhibit where on a large flat touch screen, one could zoom in and out of satellite imagery of the earth as well as a model of the known universe, including different planets, stars, solar systems, and galaxies. As the operator zooms out, the program compresses these layers into concentric circles. Once the operator zooms out as far as the program can go, it represents the entire universe as a series of concentric circles. I mentioned this to a docent who noted (paraphrasing) "we don't know if the universe is actually shaped like a circle/sphere, but it's the only way we can conceptualize it."

Circles and Cultural Astronomy

Indeed, myriad bodies within the cosmos are fundamentally spherical. The sun, moon, earth, and planets in our solar system (and others beyond), and distant stars are all spherical in nature, and appear as two-dimensional circles to the eye. Astronomical phenomena are often observed using circular constructions: the megalithic Stonehenge site in England, and the Woodhenge feature at Cahokia Mounds near present-day Collinsville, Illinois, allowed their builders to track the movement of the sun between equinoxes and solstices as the seasons shifted. Modern observatories are cylindrical towers roofed with a half-dome.

The connection between circular buildings and images with astronomy is also apparent in the ancestral Puebloan world. Great kivas seem to have been linked to astronomical and cosmological associations which were very important at Chaco Canyon during the Pueblo II era in the eleventh and twelfth centuries. For example, the great kiva of Casa Riconada at Chaco Canyon featured four supporting pillars carefully aligned with the cardinal directions. Circular icons and features are associated with astronomical observations at Fajada Butte and Pueblo Bonito. These places would have been practical and symbolic loci for Chacoan leaders to understand and control – or provide a sense of control over – the natural world (Malville and Putnam 1989).

If Sand Canyon Pueblo was a planned community center practicing a Chacoan revival, they may also have associated circles with cosmological knowledge. This could be reflected in the layout of buildings and communities (cf. Ortman 2012). The great kiva at Sand Canyon features pillars staked at the primary intercardinal directions (see Figure 1.7), which was possibly inspired by the layout of Casa Riconada. In a room associated with the great kiva, a Mesa Verde black-on-white olla (Vessel 199, decorated at a high skill level and placed in Group C) was

located, displaying a four-fold rotational symmetry that is not reflectional. This pattern suggests movement, perhaps representing the earth through the four seasons (see Kubovy and Strother 2004 for a discussion on the cognition of movement in rotational symmetries). The D-shaped (hemispherical) building is also theorized to have been an astronomical viewing station associated with ceremonial leaders linked to an ancestral Chaco system (Bradley 1996; Ortman and Bradley 2002:61).

Multiple banded lines appear on pottery at Sand Canyon Pueblo, which could also be associated with Chaco revivalism. Banded lines appear more frequently in later pottery types in the northern San Juan progression than earlier ones (Figure 5.2). Banded lines are not definitive of the earliest Chapin Black-on-white type examples (Ortman et al. 2005:5-8). They begin to appear on Piedra Black-on-white (Ortman et al. 2005:5-9), continuing to be painted on Mancos Black-on-white (Ortman et al. 2005:5-13) and Cortez Black-on-white pottery (Ortman et al. 2005:5-12), but proliferate on later Mesa Verde Black-on-white styles (Ortman et al. 2005:5-16 – 5-17) coinciding with the end of ritual activity at Chaco. While a connection between the proliferation of circular layouts on pottery with the theoretical Chaco revival is intriguing, much more quantitative research into the relative incidences of design elements and motifs on types in the northern San Juan and at Chaco Canyon and elsewhere – as well as a deeper literature review – are needed to explore these ideas further.

Figure 5.1. Seriation of pottery types from the northern San Juan (Crow Canyon 2018). Photos courtesy of the Bureau of Land Management - Canyons of the Ancients Visitors Center & Museum.

Circles Are Containers

Within and around the earth, within and around the hills, within and around the mountains, your authority returns to you.

- *A Tewa Prayer, from Ortiz (1969:13)*

Containers are indicated… by tracing (a circle) around other people and objects.

- *Clive Gamble (2007:135)*

As discussed in Chapter 1, Ortman (2012:236-237) has posited that a deep and nuanced conceptual metaphor for ritual specialists at Sand Canyon Pueblo and its neighbors was THE WORLD CONSISTS OF CONTAINERS. Pottery vessels, baskets, and textiles serve as the source domains for conceptualizing kivas, villages, the earth, and the entire cosmos as "containers." These metaphors show that "Mesa Verde people used actual pots, baskets, blankets, and rooms as models for the larger world around them" (Ortman 2012:237).

This thesis proposes that containers served as the source domain for the representation of painted circles as a target metaphor at Sand Canyon Pueblo. The proposed metaphor reads as CIRCLES ARE CONTAINERS, whereas the spherical shapes of myriad containers can be abstractly represented two-dimensionally with a circle. The fact that circles are repeatedly painted on pottery vessels by all community members beginning at the earliest age and/or at the most basic exhibition of skill, continuing into adulthood and/or advanced skill mastery, suggests that it would have been important for both producers and consumers of pottery vessels to understand circles are an abstract symbol associated with containers, at least on an implicit level. It could be that spherical shapes of containers represented a fundamental cosmological truth for the ancestral Puebloans at Sand Canyon Pueblo, and that truth was expressed abstractly with the circle.

Ortman (2000a:617-618; 2012:211, 213-219, 227-228) provides a method for determining material metaphors using six different analytical principles. The proposed metaphor follows those six principles, as elaborated upon here:

1. The Directionality Principle states that metaphor is mapped from a commonly experienced source referent to more a more abstract target domain (Ortman 2012:213). The spherical shapes inherent in myriad containers and are the source domain for painted geometric representations of circles as an abstract target domain.
2. The Superordinate Principle asserts that target domains are stored in the brain as abstractions, but are expressed on material forms (Ortman 2012:215). Circles are abstract symbols innate to the human mind (as discussed above) and are expressed concretely on spherical container media.

3. The Invariance Principle posits that source domains that conflict with the structure of the target domain are not mapped by the target domain (Ortman 2012:218). Circles are not painted on ovoid non-containers. Ovoid mauls, for instance, are not painted with banded lines in areas where they would not wear with use. Other possible spheroid non-containers at Sand Canyon include hammerstones, manos, and stone disks (Till and Ortman 2007), although some of these objects would not be practical to paint, as paint on hammerstones and manos would likely wear with use.

4. The Constitutive Principle states that metaphorical statements are the reality of the thought itself (Ortman 2012: 218). Circles express the reality of the shape of metaphorical containers. For example, pottery vessels at Sand Canyon are shaped by the coil-and-scrape method. Coils are formed by rolling clay into a cylinder shape, then forming a circle by connecting its opposite ends. Another coil is imposed atop the previous coil, and the joins are smoothed away. Thus, spherical containers are literally formed with concentric circles. The quotation given by Gamble (2007:135) to open this section elegantly states the constitutive principle for the proposed metaphor.

5. The Blending Principle postulates that two source domains can be represented together to communicate the reality of one target domain (Ortman 2012:218). Circles are painted on a variety of different container media associated with blended sources. For example, blended basketry and textile designs bounded between banded lines appear on ancestral Puebloan pottery (Ortman 2000a).

6. The Experiential Principle posits that metaphors are sourced from the direct experience of people in their social and natural worlds (Ortman 2012:219). Circles and spheres are a part of the built and natural environment of both producers and consumers of container media.

While this theoretical metaphor could have been developed without conducting this thesis, the results of the current research both lead to the conclusion that CIRCLES ARE CONTAINERS was probably transmitted to children at Sand Canyon as an introduction to the container metaphor through the production of pottery. Child ceramicists and (possibly) older apprentices first learn that white ware containers must be painted with concentric circles before they can be decorated with anything else. Children and adults may elaborate on this principle further by adding other shapes, symmetries, and motifs; but they rarely deviate from it. In this way children would build on basic principles to develop deeper and more specific symbolic connections as they matured. However, given the ethnographic evidence described in Chapter 3, it seems likely that the metaphor was taught implicitly. Adult women do not typically give girls specific directions on how to paint, and when they do, the directions are corrections of observed errors. Stipulating the proposed metaphor, it seems unlikely then that older painters would outright tell a young apprentice "circles are containers," at least at first. Rather, the metaphor was probably first experienced with practice in painting and constructing pottery vessels with the coil-and-scrape method. It is also experienced as part of the overall *habitus* (sensu Bourdieu 1977) of spherical media in the village and outside environment. Linguistic and other deeper abstracted connections probably followed with age, cognitive maturity, and/or status in the community (Figure 5.2). In this way "teaching" and "learning" may not necessarily be primarily linguistic models of transmission of knowledge in this case, as is often assumed when using

those English verbs. Instead, the ethnographic description of traditional pottery teaching to children by adults is first empirical, then linguistic. This is analogous to the theory of conceptual metaphor stating that abstractions are developed from direct experience with source material.

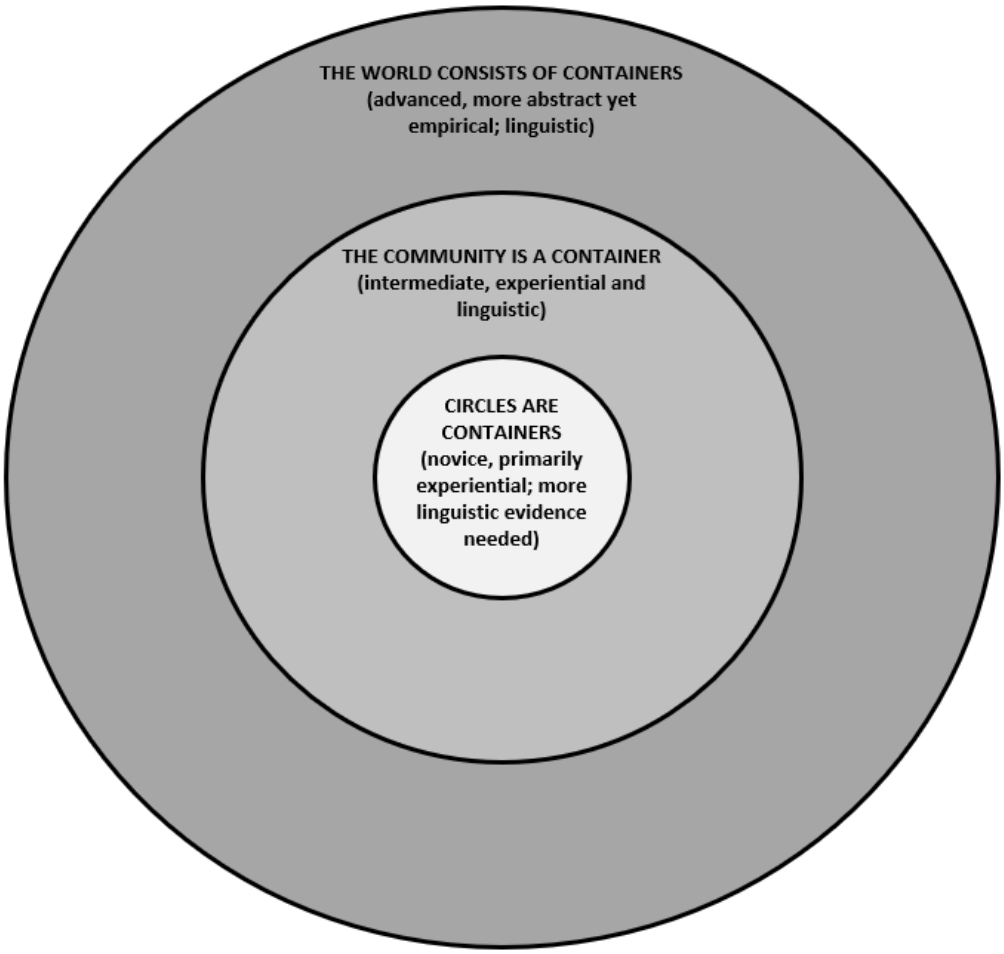

Figure 5.2. An initial model for conceptualizing levels of knowledge of the container metaphor.

Unfortunately, it would be difficult to link other container media to childhood production in the archaeological record to see if this pattern is replicated. For example, the construction of kiva wall murals would likely only be directed by mature adults due to their large size and complexity. Textiles and baskets were likely produced by children, but these artifacts rarely survive in the archaeological record.

Sources from linguistics and ethnography, and collaboration with and input from Puebloan cultural practitioners, scholars, and/or craftspeople will be necessary to develop or reject these ideas further (Ortman 2012). Briefly, Tewa anthropologist Alfonso Ortiz (1969) uses circles as a metaphor to model his culture from an emic perspective. In his accounting of Tewa origins, the surface world existed as an unformed space (perhaps conceptually: the infinite circle) before the Tewa ancestors arose from the underworld; the world only became physical when bounded within the four cardinal directions (Ortiz 1969:13-18, Figure 2). Ortiz (1969) discusses the division of traditional Tewa society into moieties, whose nomenclature (Summer and Winter People) and ritual responsibilities relate to seasonal cycles. He depicts circles split into twos and fours to model these cultural systems (Ortiz 1969: Figure 2, Figure 9, Figure 10), which are also symmetries replicated by children and adults on Sand Canyon ceramics. Other research needed includes a deeper reading and synthesis into how metaphor is learned as humans mature from childhood, to understand how metaphors develop through time.

Pottery Form as a Material Metaphor

The results of this thesis show that painted skill level, age, and vessel form are linked categories, suggesting that metaphorical linkages exist between ceramic form, age, and/or skill of producer. The link between ladles and childhood production will be explored through a theory of conceptual metaphor developed by Clive Gamble (2007).

Gamble (2007:66-70, 88-89) uses the theory outlined by Tilley (1999) to assert that metaphor is primarily related to the embodied experience, and secondarily associated with linguistics. He further asserts that ancient humans would have divided the physical world into a metonymic division between instruments (e.g. sticks, blades, awls) and containers, though objects are not necessarily perceived as strictly dualistic between the two categories. Gamble

(2007:205-274) also theorizes that container metaphors proliferated in increasingly sedentary Neolithic societies in the Old World. Sand Canyon Pueblo represents such a Neolithic culture but in the American Southwest (Varien 1999). Indeed, it is interesting that Ortman (2000a; 2012) and Ortman and Bradley (2002) developed a theory for a container metaphor for a Neolithic culture independent from Gamble (2007), based off the same source material (Tilley 1999). This suggests a possible degree of universality of container metaphors, that might be more differentiated based on specific historic, cultural, and environmental contexts (Ortman 2012:209).

Considering the division between implements and containers, it seems that ladles are used both to contain liquids and as an implement to serve them, perhaps delivering boiled stews from greyware cooking jars to white ware serving bowls, or from larger white wares to smaller ones (Potter and Ortman 2002:180-181). It could be that children also were perceived as both instruments and containers in some metaphorical sense. Perhaps they reflect the status of children (or specifically girls) in the community; that is, they are meant "to provide." An imaginative scenario could envision children using their personally crafted ladles to provide foods to higher status adult kin, allies, or even strangers and rivals during semi-private family meals or public feasting ceremonies at Sand Canyon Pueblo. Or, children may have used their own ladles to provide food for themselves, learning to be self-sufficient in the process. Again, the proposed metaphor may have been understood more explicitly by adults, but implicitly understood and taught experientially by children until they grew in understanding. These ideas however are rudimentary, and much more research and theorizing are necessary.

Other Avenues of Future Research

Patricia Crown's framework for assessing skill level transcends the child/adult duality and could be adapted and utilized to assess the incidence of skill at any number of levels, as touched upon in Chapter 4. It could be modified to assess painted skill on potsherds, which expands the amount of data that could be analyzed to answer other questions regarding apprenticeship in ceramic painting. For example, the rate of error in apprenticeship production could be examined by comparing the incidence of less-skilled vessels broken and tossed into middens to complete vessels apparently utilized in *de facto* contexts at Sand Canyon Pueblo and elsewhere (Crown 1999:43). Northern San Juan types could be assessed relative to skill level to determine if banded lines in fact appear at a great frequency. The study could be expanded from southwestern contexts: Neolithic cultures from across the planet could be compared to gain a global comparative perspective of apprentice pottery production. Finally, other artifact types could be examined to examine the development of metaphor as a function of age and/or skill. For example, chipped stone tools could possibly be assessed for production age/skill (e.g. Bamforth and Finlay 2008), and then could be analyzed for patterns based on criteria such as form/function, material, or flaking patterns.

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Appendix A: Attribute Examples

Figure 1A: Vessel 151, a Pueblo III Painted bowl, displaying an example of a straight/banded line (first size) design element. These lines often form circles about the vessel, often "framing" motifs between the lines. On this vessel the concentric framing lines appear as a solitary motif. McElmo Black-on-white vessels utilize only a single-sized brushstroke in their patterns (see image 5). Vessel diameter = 11.7 cm

Figure 2A: Vessel 2, a Mesa Verde Black-on-white bowl, displaying a straight/banded line (second size) design element. Note how the thicker lines are used to frame the thinner lines.

Figure 3A: Vessel 109, a Late White Painted canteen, displaying a zig-zag line motif. This example shows the design element created through negative space. Vessel height = 14.7 cm

Figure 4A: Vessel 199, a Mesa Verde Black-on-white olla, displaying the curved line design element (central motif at scale). The arc breaks below the level plane of the circumference.

Figure 5A: Vessel 186, a McElmo Black-on-White ladle, displaying the “spiral” design element. Vessel height = 7.8 cm

Figure 6A: Vessel 98, a Mesa Verde Black-on-White mug, displaying the “ticking” design element. Ticking is defined as a mark made with a short stroke of the brush. Ticking often appears on vessel rims, as shown here. Vessel diameter ~ 8cm

Figure 7A: Vessel 152, a Late White Painted olla, displaying the “dot” design element. Dots are defined as free-floating spheroids which are different from ticking because of their more precise circular shapes.

Figure 8A: Vessel 60, a Pueblo III White Painted kiva jar, displaying some polygons (painted triangles and quadrilaterals in the negative background). The occurrence of each different polygon type is counted as a separate design element (1 count for triangles and 1 count for quadrilaterals). Vessel height = 23.4 cm

Figure 9A: Vessel 176, a Mesa Verde black-on-white mug, displaying the “stepped” design element. The element is often displayed in bi-fold symmetries. The steps often display multiple right angles, but also can be stylized using different shapes, angles, or other effects. Vessel height = 6.5 cm

Figure 10A: Vessel 99, a Pueblo III White Painted seed jar, displaying “scroll” design elements. Vessel height = 9.9 cm

Figure 11A: Vessel 94, a Pueblo III Painted jar, displaying perpendicular line design elements. The same lines are featured 180° on the other side of the vessel, breaking the design field in two. Vessel height = 7.7 cm

Figure 12A: Vessel 1, a Mesa Verde Black-on-white mug, as an example of a “hatched filling” attribute. Note the multiple cross-hatched lines filling in the triangles.

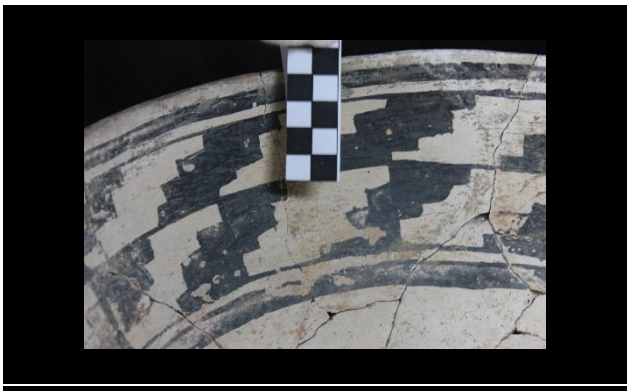


Figure 13A: Vessel 9, a Pueblo III White Painted bowl, as an example of "solid filling" attribute. The stepped polygons are inked-in.

Figure 14A: Vessel 112, a Pueblo III White Painted bowl (pinch pot), as an example of "empty" attribute. The triangle shapes are left unpainted (while the linework is thin and precise for such a small field, it is not "hatched" per se). Vessel diameter = 6.5 cm

Figure 15A: Vessel 110, a Mesa Verde Black-on-white bowl, showing a "76% - 100%" attribute for the "Amount of Vessel Field used" analysis. The entire field of the vessel is filled up to the bottom, the rim is ticked, and the exterior surface features design work as well (not pictured). Vessel diameter = 30.3 cm

Figure 16A: Vessel 10, a Pueblo III painted bowl, showing a "51% - 75%" attribute for the "Amount of Vessel Space used" analysis. While most bowls begin the bottom framing line at the joint between the base and the body, this design begins about halfway up from the edge of the base. A sizable empty space is apparent at the base when viewed from above. The design is otherwise painted with continuous, full designs. Vessel diameter = 28.2 cm

Figure 17A: Vessel 109, a Late White painted jar, showing a “50%” attribute for the “Amount of Vessel Space used” analysis. A full design is placed centrally in the painting field, but a large amount of the viewing surface remains unpainted. A similar design is present on the opposite hemisphere of the vessel. Vessel circumference = 44.2 cm

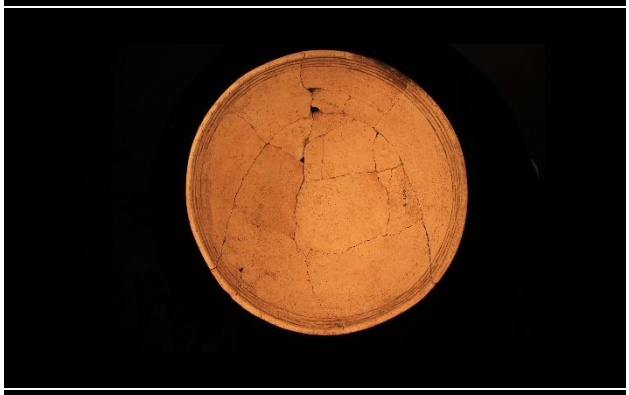


Figure 18A: Vessel 189, a Pueblo III Painted bowl, showing a “25%” attribute for the “Amount of Vessel Space used” analysis. Only a few thin banded lines are placed under the rim of the bowl. Vessel diameter = 25.0 cm

Figure 19A: Vessel 18, a Late White Painted lid, showing a “representational” attribute. The underside of this lid features a representation of a turkey. The top of the lid (not pictured) features a complex geometric design. The motif itself is a combination of design elements (scroll, half-circle shape, various lines). Vessel diameter = 9.5 cm

Figure 20A: Vessel 93, a Mesa-Verde Black-on-white canteen, displaying a “complex geometric” attribute. The painter effectively utilizes a variety of interlocking shapes and painting techniques. Vessel circumference = 40.5 cm

Figure 21A: Vessel 2, a Pueblo III painted sherd container, displaying a “simple geometric” attribute. The vessel repeats triangles hanging off a banded line on this exterior motif, which is a fairly simple design. The interior features banded lines of different thicknesses (not pictured).

Figure 22A: Vessel 149, a Mesa Verde Black-on-white bowl, displaying the “motifs of appropriate, equivalent sizes” attribute. Note the equal execution of the triangles, creating a consistent zig-zag motif in negative space. The banded lines overall are consistently spaced. Each triangle has a roughly 1 cm height.

Figure 23A: Vessel 54, a Mesa Verde Black-on-white displaying the “Motifs of roughly equivalent sizes” attribute. Note the somewhat varied dimensions of the three quadrilaterals. The stepped motifs stemming from the triangle’s corner have different shapes. The spacing between the hatched lines is uneven. Rectangular motifs of varying proportions sizes line the exterior of the bowl (not pictured). Vessel diameter = 30.1 cm

Figure 24A: Vessel 20, a Pueblo III Painted rectangular form, displaying the “same motifs of different sizes, do not fit design” attribute. The three pairs of interlocking steps vary in both size and shape. Two stepped elements are placed in the bottom right hand corner, which do not fit the pattern. Vessel height = 3.8 cm

Figure 25A: Vessel 199, a Mesa Verde Black-on-white olla, displaying rotational symmetry. The vessel has the same symmetry when turned 90°, but it does not feature reflectional symmetry. Vessel diameter = 37.7 cm

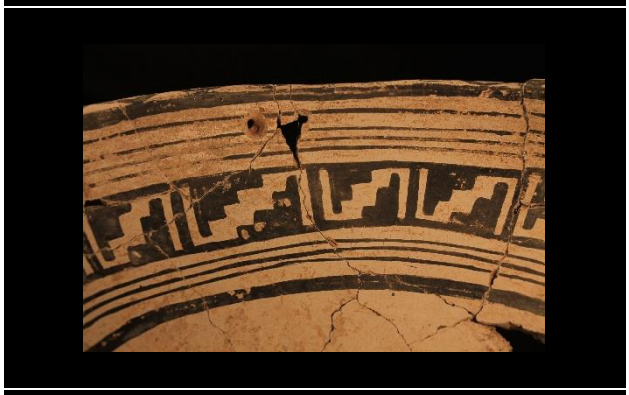


Figure 26A: Vessel 4, a Mesa Verde Black-on-white painted bowl, displaying a rotational glide symmetry. For each motif unit in the center, the stepped design element is rotated 180° and then shifted over. This motif is translated across the face of the vessel. Each motif unit looks similar to a reflection across a diagonal line, but they are not. Each motif unit measures roughly 2.5 cm high.

Figure 27A: Vessel 197, a Mesa Verde Black-on-white painted bowl, displaying additional examples of rotational glide symmetries. The triangles in the central motif measure about 1 cm high.

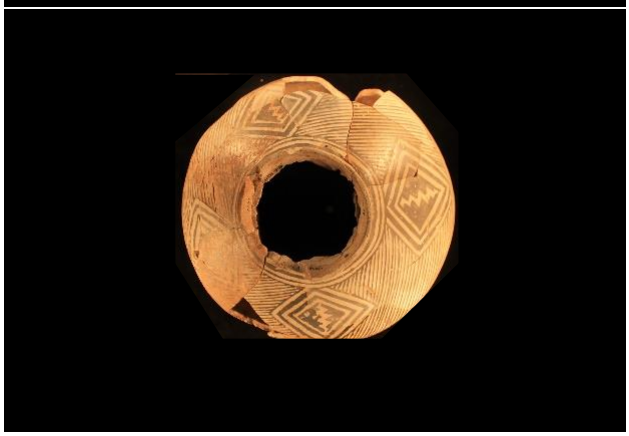


Figure 28A: Vessel 25, a Mesa Verde Black-on-white kiva jar, displaying a reflection off a diagonal axis score. Note that the entire vessel can be reflected diagonally between the large square motifs, and straight through the square motifs (both on a whole vessel level and through the individual square motifs). The vessel also has a 90° rotational symmetry. Vessel diameter = 29.5 cm.

Figure 29A: Vessel 19, a Pueblo III Painted ladle, displaying a “reflection across vertical/horizontal line (90 degree angle)” attribute. The angle of the central hachure cleverly throws off the perfection of the reflection by a touch, but the overall effect of symmetry remains. Vessel diameter = 13.6 cm

Figure 30A: Vessel 88, a Pueblo III white painted jar, displaying a “rotation around a point” attribute. Orifice diameter = 7.0 cm

Figure 31A: Vessel 198, a Pueblo III white painted bowl, displaying a “repetition (translation)” attribute. The solitary dot element is repeated quasi-regularly through the interior of the vessel. Each dot measures roughly 1 cm in diameter.

Figure 32A: Vessel 52, a Pueblo III White painted olla, displaying the “clear, but failed attempt to use vessel shape” attribute. The painter(s) uses the circumference of the vessel to create banded lines near the top, but the center banded line and rectangle motifs are haphazardly placed. Vessel height = 24.0 cm

Figure 33A: Vessel 12, a Mesa Verde Black-on-white mug, displaying “appropriate overlapping linework/motifs.” The scrolling elements are neatly and cleanly filled in to make precise shapes. Vessel height = 10.8 cm

Figure 34A: Vessel 19, a Pueblo III Painted ladle, featuring “inappropriate overlapping linework/motifs.” Several of the triangle elements in the leaf motif are sloppily filled, thus the painted lines do not overlap properly. Many of the hatched lines in the central motif cross over the perimeter lines. Vessel diameter = 13.6 cm

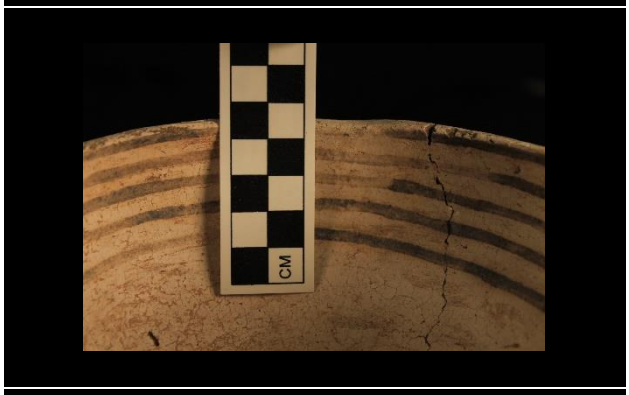


Figure 35A: Vessel 151, a Pueblo III White painted bowl, featuring the “each shape to own space” attribute.

Figure 36A: Vessel 21, a Mesa Verde Black-on-white painted mug, featuring the “fine, continuous linework” attribute. The banded lines display economical, contiguous brushwork. Vessel height = 8.1 cm

Figure 37A: Vessel 95, a Mesa Verde Black-on-white painted mug, featuring the “fewer brush liftings, some overlap” attribute. Vessel height = 8.5 cm

Figure 38A: Vessel 17, a Pueblo III White painted ladle, displaying the “sloppy, overlapping, many liftings of brush” attribute. For a relatively small vessel (5.6 cm high x 11.6 cm diameter) a lot of brushstrokes were necessary to create the banded lines. The strokes are messy and overlap frequently.

Figure 39A: Vessel 79, a Mesa Verde Black-on-white mug, displaying the “fine/continuous” linework attribute. The thinnest framing lines are no more than 1 mm wide and are finely executed.

Figure 40A: Vessel 2, a Pueblo III Painted sherd container (bowl), displaying the “medium/controlled” linework attribute. The thinnest lines are about 2 mm wide but are smooth and even.

Figure 41A: Vessel 29, a Pueblo III painted mug, featuring the "medium/variable" linework attribute. Each line varies between thin and medium, and feature a fair amount of choppiness, especially within a short distance of travel.

Figure 42A: Vessel 88, a Pueblo III painted jar, featuring the "fat" linework attribute. Each line measures roughly 3 mm to 5 mm and are unpaired with smaller lines.

Figure 43A: Vessel 98, a Mesa Verde Black-on-white mug, featuring the "controlled, parallel lines" attribute. Each line is meticulously placed; this is one of the finer examples of this attribute. Vessel height = 8.3 cm

Figure 44A: Vessel 176, a Mesa Verde Black-on-white mug, featuring "better, more controlled, but not parallel. The painter had difficulty maintaining parallel framing lines across the field of the vessel, despite maintaining smooth brushstrokes. This also had the effect of throwing off the proportions of the motifs. Vessel height = 8.4 cm

Figure 45A: Vessel 14, a Pueblo III painted ladle, featuring “shaky” linework. The lines do not remain parallel and occasionally overlap. Vessel measures 5.6 cm high x 11.6 cm diameter.

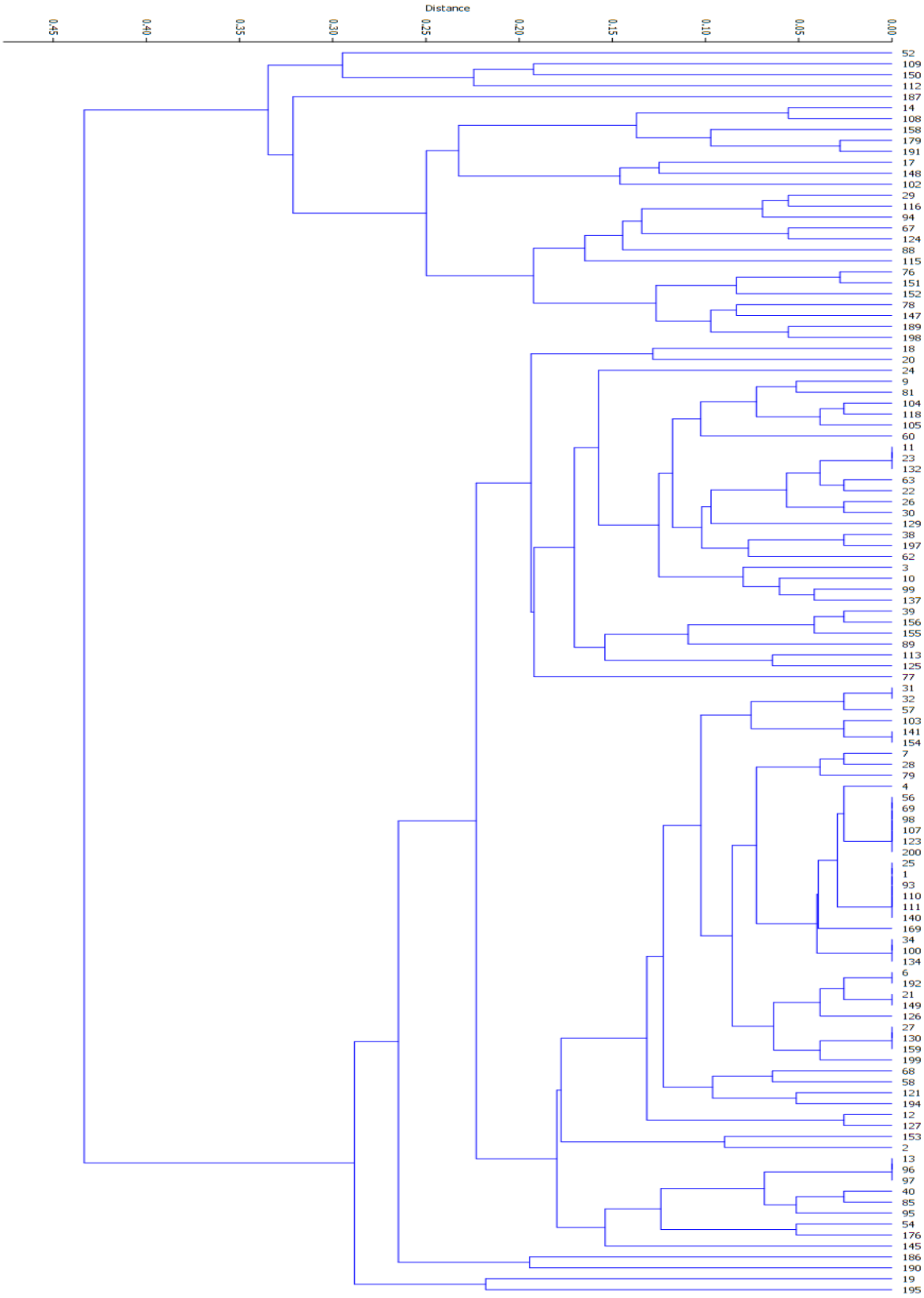
Appendix B: Table of All Ranks

Data Dictionary					
Attribute	**Ranks**				
	5	4	3	2	1
Number of design elements	-	7 +	5 - 6	3 - 4	1 - 2
Motif state	-	-	hatched	solid	empty
Percent of field filled	-	76 - 100	51 - 75	26 - 50	1 - 25
Type of drawing	-	-	representational	complex geometric	simple geometric
Grammatical structure	-	-	-	Mesa Verde or McElmo	Pueblo III or Late White Painted
Proportions of motifs	-	-	proportional	somewhat disproportionate	disproportionate
Symmetry	diagonal reflection or rotational	horizontal / vertical reflection	rotation around a point	translational	asymmetric
Use of vessel as field	-	-	uses vessel as field	clear but failed attempt to use vessel as field	does not use vessel as field
Shapes	-	-	polygons	circles	lines
Overlapping lines	-	-	properly overlapping lines	each shape to own space / improperly overlapping lines	uncontrolled use of space
Motor control	-	-	smooth controlled lines	some brush liftings, less controlled lines	multiple brush liftings. Sloppy
Line width	-	fine	medium / controlled	medium / variable	fat
Line control	-	-	even, parallel lines	somewhat unparallel lines	shaky lines

	Numbe of Design Elements	Motif State	Amount of Field Filled	Type of Drawing	Grammatical Structure	Proportions of Motifs	Symmetry	Use of Vessel as Field	Shapes	Overlapping Lines	Motor Control	Line Width	Line Control
V. 1	4	3	4	2	2	3	4	3	3	3	3	4	3
V. 2	2	2	4	1	2	2	4	3	3	3	3	3	3
V. 3	3	3	4	2	1	2	3	3	3	3	3	3	3
V. 4	4	3	4	3	2	3	5	3	3	3	3	4	3
V. 6	3	2	4	2	2	3	4	3	3	3	3	4	3
V. 7	4	2	4	3	2	3	5	3	3	3	3	4	3
V. 9	2	2	4	2	1	2	5	3	3	3	3	4	2
V. 10	3	2	3	2	1	2	3	3	3	3	3	3	3
V. 11	3	3	4	2	1	3	5	3	3	3	3	3	3
V. 12	2	3	4	2	2	3	3	3	3	3	3	3	3
V. 13	3	2	4	2	2	2	5	3	3	3	2	2	2
V. 14	1	?	3	1	1	2	3	3	2	3	2	2	3
V. 17	1	?	3	1	1	2	3	3	2	2	1	2	1
V. 18	4	3	4	3	1	2	4	3	3	3	3	4	2
V. 19	3	3	4	3	1	3	4	3	3	2	2	2	2
V. 20	3	2	4	3	1	1	4	3	3	3	3	3	2
V. 21	3	2	4	2	2	3	4	3	3	3	3	3	3
V. 22	2	3	4	2	1	3	5	3	3	3	3	3	3
V. 23	3	3	4	2	1	3	5	3	3	3	3	3	3
V. 24	4	3	4	2	1	3	3	3	3	3	3	4	3
V. 25	4	3	4	2	2	3	4	3	3	3	3	4	3
V. 26	3	2	4	2	1	3	5	3	3	3	3	3	3
V. 27	3	3	4	2	2	3	4	3	3	3	3	3	3
V. 28	4	2	4	3	2	3	4	3	3	3	3	4	3
V. 29	2	?	4	1	1	2	3	3	2	2	2	2	2
V. 30	2	2	4	2	1	3	5	3	3	3	3	3	3
V. 31	3	2	4	2	2	2	5	3	3	3	3	4	3
V. 32	3	2	4	2	2	2	5	3	3	3	3	4	3
V. 34	3	3	4	2	2	3	5	3	3	3	3	4	3
V. 38	2	2	4	2	1	3	4	3	3	3	3	4	3
V. 39	2	3	4	2	1	2	4	3	3	3	3	2	2
V. 40	3	2	4	2	2	2	4	3	3	3	3	3	2
V. 52	2	2	2	1	1	2	5	2	3	2	2	2	2
V. 54	4	3	4	2	2	2	5	3	3	3	3	2	2
V. 56	4	3	4	2	2	3	5	3	3	3	3	4	3
V. 57	3	2	4	2	2	2	4	3	3	3	3	4	3
V. 58	4	2	4	2	2	3	4	3	3	3	2	3	3
V. 60	3	2	3	1	1	2	5	3	3	3	3	3	3
V. 62	2	2	4	2	1	3	4	3	3	3	3	3	2
V. 63	2	3	3	2	1	3	5	3	3	3	3	3	3
V. 67	1	?	1	1	1	2	3	3	2	2	2	3	2
V. 68	4	3	4	2	2	3	3	3	3	3	2	3	3
V. 69	4	3	4	2	2	3	5	3	3	3	3	4	3
V. 76	1	?	4	1	1	3	3	3	2	2	3	3	3
V. 77	4	2	4	3	1	3	4	3	3	3	3	1	3
V. 78	1	?	2	1	1	3	3	3	2	2	2	2	3
V. 79	4	2	4	2	2	3	5	3	3	3	3	4	3
V. 81	2	2	4	2	1	2	5	3	3	3	3	2	2
V. 85	3	2	4	2	2	2	5	3	3	3	3	3	2
V. 88	1	?	4	1	1	3	3	3	2	2	2	1	2
V. 89	2	2	4	2	1	2	4	3	3	3	2	1	2
V. 93	4	3	4	2	2	3	4	3	3	3	3	4	3
V. 94	2	1	4	1	1	2	4	3	2	2	2	2	3
V. 95	3	2	4	2	2	2	4	3	3	3	2	3	2
V. 96	3	2	4	2	2	2	5	3	3	3	2	2	2
V. 97	3	2	4	2	2	2	5	3	3	3	2	2	2
V. 98	4	3	4	2	2	3	5	3	3	3	3	4	3
V. 99	2	2	4	2	1	2	3	3	3	3	3	3	3
V. 100	3	3	4	2	2	3	5	3	3	3	3	4	3
V. 102	1	?	4	1	1	1	3	3	2	3	1	2	1

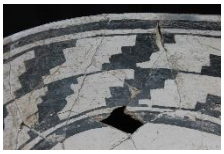
	Numbe of Design Elements	Motif State	Amount of Field Filled	Type of Drawing	Grammatical Structure	Proportions of Motifs	Symmetry	Use of Vessel as Field	Shapes	Overlapping Lines	Motor Control	Line Width	Line Control
V. 103	3	3	4	2	2	2	4	3	3	3	3	3	3
V. 104	2	2	4	2	1	2	5	3	3	3	3	4	3
V. 105	3	2	4	2	1	2	5	3	3	3	3	3	3
V. 107	4	3	4	2	2	3	5	3	3	3	3	4	3
V. 108	2	1	4	1	1	2	3	3	2	3	2	2	3
V. 109	1	2	2	2	1	2	2	3	3	2	3	3	3
V. 110	4	3	4	2	2	3	4	3	3	3	3	4	3
V. 111	4	3	4	2	2	3	4	3	3	3	3	4	3
V. 112	2	1	4	1	1	3	5	3	3	2	3	3	3
V. 113	1	2	4	2	1	2	5	3	3	3	2	2	3
V. 115	1	3	4	1	1	2	4	3	2	2	1	2	3
V. 116	2	?	3	1	1	2	4	3	2	2	2	2	2
V. 118	2	2	4	2	1	2	5	3	3	3	3	3	3
V. 121	3	2	4	2	2	3	5	3	3	3	2	4	3
V. 123	4	3	4	2	2	3	5	3	3	3	3	4	3
V. 124	1	?	2	1	1	2	3	3	2	2	2	2	2
V. 125	2	2	4	2	1	2	5	3	3	3	1	2	3
V. 126	3	2	4	2	2	3	5	3	3	3	3	3	3
V. 127	1	3	4	2	2	3	3	3	3	3	3	3	3
V. 129	1	2	4	1	1	3	5	3	3	3	3	3	3
V. 130	3	3	4	2	2	3	4	3	3	3	3	3	3
V. 132	3	3	4	2	1	3	5	3	3	3	3	3	3
V. 134	3	3	4	2	2	3	5	3	3	3	3	4	3
V. 137	2	2	?	2	1	3	3	3	3	3	3	3	3
V. 140	4	3	4	2	2	3	4	3	3	3	3	4	3
V. 141	3	3	4	2	2	2	5	3	3	3	3	3	3
V. 145	3	3	4	2	2	2	5	3	3	2	3	2	2
V. 147	1	?	2	1	1	3	3	3	2	2	3	2	2
V. 148	2	?	4	1	1	1	4	3	2	2	1	2	1
V. 149	3	2	4	2	2	3	4	3	3	3	3	3	3
V. 150	2	2	4	2	1	2	4	3	3	2	2	4	3
V. 151	1	?	3	1	1	3	3	3	2	2	3	3	3
V. 152	1	2	4	1	1	2	2	3	2	2	3	3	3
V. 153	2	3	4	1	2	2	4	3	3	3	3	1	3
V. 154	3	3	4	2	2	2	5	3	3	3	3	3	3
V. 155	2	?	4	1	1	2	4	3	3	3	3	2	2
V. 156	2	3	4	2	1	2	5	3	3	3	3	2	2
V. 158	2	?	4	1	1	2	4	3	2	3	1	2	2
V. 159	3	3	4	2	2	3	4	3	3	3	3	3	3
V. 169	4	3	4	2	2	3	5	3	3	3	3	3	3
V. 176	4	3	4	2	2	2	5	3	3	3	3	4	2
V. 179	1	1	4	1	1	2	4	3	2	3	3	2	2
V. 186	2	?	4	2	2	3	4	3	2	3	3	2	3
V. 187	2	?	1	1	2	3	4	3	2	2	3	3	2
V. 189	1	?	1	1	1	3	3	3	2	2	3	2	3
V. 190	3	?	4	4	1	3	5	3	2	3	3	2	3
V. 191	2	?	4	1	1	2	4	3	2	3	3	2	2
V. 192	3	2	4	2	2	3	4	3	3	3	3	4	3
V. 194	3	2	4	2	2	3	3	3	3	3	2	4	3
V. 195	3	2	4	2	2	3	5	3	3	2	2	4	2
V. 197	3	2	4	2	1	3	4	3	3	3	3	4	3
V. 198	1	2	1	1	1	3	2	3	2	2	3	3	3
V. 199	3	3	4	2	2	3	4	3	3	3	3	3	2
V. 200	4	3	4	2	2	3	5	3	3	3	3	4	3

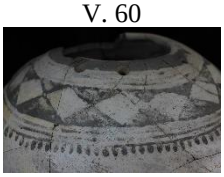
Appendix C: Figure of Gower UPGMA Cluster Model Including Outliers

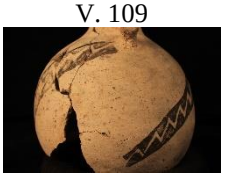
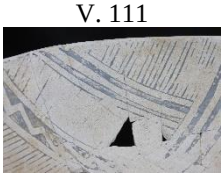


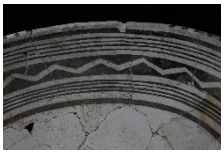
Appendix D: Thumbnail Photographs of All Studied Vessels

Key
MV B-W = Mesa Verde Black-on-white
McE B-W = McElmo Black-on-white
PIII = Pueblo III White Painted
LWP = Late White Painted
SC = sherd container
h = height, *d* = diameter, *l* = length

V. 1  MV B-W Mug *h* = 11.4 cm	V. 2  MV B-W Bowl SC *d* = 15.9 cm	V. 3  PIII Mug *h* = 9.5 cm	V. 4  MV B-W bowl *d* = 28.9 cm
V. 6  MV B/W Bowl SC *d* = 26 cm	V. 7  MV B-W Bowl SC *d* = 38 cm	V. 9  PIII Bowl *d* = 30.4 cm	V. 10  PIII Bowl *d* = 28.2 cm
V. 11  PIII Bowl *d* = 27.7 cm	V. 12  MV B-W Mug *h* = 10.8 cm	V. 13  MV B/W Mug *h* = 9.2 cm	V. 14  PIII Ladle *d* = 10.5 cm
V. 17  PIII Ladle *d* = 11.6 cm	V. 18  LWP Lid *d* = 9.5 cm	V. 19  PIII Ladle *d* = 13.6 cm	V. 20  PIII Rect. Form *l* = 9.9 cm
V. 21  MV B-W Mug *h* = 8.1 cm	V. 22  PIII Rect. Form *h* = 9.4 cm	V. 23  PIII Mug *h* = 9.3 cm	V. 24  PIII Kiva Jar *d* = 25.0 cm
V. 25  MV B-W Kiva Jar *d* = 29.5	V. 26  PIII Bowl *d* = 17.8 cm	V. 27  MV B-W Mug *h* = 11.1 cm	V. 28  MV B-W Bowl *d* = 29.3 cm
V. 29  PIII Mug *h* = 9.9 cm	V. 30  PIII Mug *h* = 10.0 cm	V. 31  MV B-W Mug *h* = 7.6 cm	V. 32  MV B-W Mug *h* = 7.7 cm

V. 34  MV B-W Mug *h* = 9.2 cm	V. 38  LWP Lid *d* = 10.0 cm	V. 39  LWP Lid *d* = 9.2 cm	V. 40  MV B-W Bowl *d* = 29.8 cm
V.52  PIII Jar (generic) *h* = 24.0 cm	V. 54  MV B-W Bowl *d* = 30.1 cm	V. 56  MV B-W Bowl *d* = 30.7 cm	V. 57  MV B-W Bowl *d* = 30.1 cm
V. 58  MV B-W SC Bowl *d* = 12.1 cm	V. 60  PIII Kiva Jar *h* = 23.4	V. 62  PIII Olla *d* = 10.1 cm	V. 63  PIII Canteen *h* = 31.5 cm
V. 67  LWP SC Bowl *d* = 28 cm	V. 68  MV B-W Olla *d* = 26.1 cm	V. 69  MV B-W Mug *h* = 9.9 cm	V. 76  PIII Bowl *d* = 28.2 cm
V. 77  PIII SC Bowl *d* = 16.0 cm	V. 78  PIII Bowl *d* = 17.0 cm	V. 79  MV B-W Mug *h* = 9.9 cm	V. 81  MV B-W Kiva Jar *d* = 20.2 cm
V. 85  MV B-W Bowl *d* = n/a	V. 88  PIII Jar (generic) *h* = 8.7 cm	V. 89  PIII Ladle *d* = 11.4 cm	V. 93  MV B-W Canteen *h* = 12.1 cm
V. 94  PIII Jar (generic) *d* = 10.1 cm	V. 95  MV B-W Mug *h* = 8.5 cm	V. 96  MV B-W Mug *h* = 10.0 cm	V. 97  MV B-W Canteen *h* = 16.7 cm

V. 98  MV B-W Mug *h* = 8.3 cm	V. 99  PIII Seed Jar *d* = 16.5 cm	V. 100  MV B-W Mug *h* = 9.0 cm	V. 102  PIII Ladle *d* = 12.3 cm
V. 103  MV B-W Mug *h* = 8.8 cm	V. 104  PIII Rect. Form *l* = 7.9 cm	V. 105  PIII Rect. Form *l* = 9.9 cm	V. 107  MV B/W Bowl *d* = 23.0 cm
V. 108  PIII Ladle *d* = 11.4 cm	V. 109  LWP Canteen *h* = 14.7 cm	V. 110  MV B-W Bowl *d* = 30.3 cm	V. 111  MV B-W Bowl *d* = 30.4 cm
V. 112  LWP Bowl *d* = 6.5 cm	V. 113  PIII Lid *d* = 9.5 cm	V. 115  PIII Ladle *d* = 8.3 cm	V. 116  PIII SC Bowl *d* = 25 cm
V. 118  PIII SC Bowl *d* = 17 cm	V. 121  MV B-W Kiva Jar *d* = 24.8 cm	V. 123  MV B-W SC Bowl *d* = 21 cm	V. 124  PIII Bowl *d* = 16 cm
V. 125  PIII SC Ladle *d* = 8.7 cm	V. 126  MV B-W Bowl *d* = 26 cm	V. 127  McE B-W Bowl *d* = 18.1 cm	V. 129  LWP Seed Jar *h* = 10.2 cm
V. 130  MV B-W Canteen (partial vessel)	V. 132  PIII Seed Jar *h* = 18.4 cm	V. 134  MV B-W Kiva Jar *d* = 26.2 cm	V. 137  PIII SC Olla n/a

V. 140  MV B-W SC Bowl *d* = 29 cm	V. 141  MV B-W Kiva Jar *d* = 22.7 cm	V. 145  McE B-W Bowl *d* = 29.0 cm	V. 147  PIII Bowl *d* = 26.0 cm
V. 148  PIII Mug *h* = 8.6 cm	V. 149  MV B-W Bowl *d* = 28.9 cm	V. 150  PIII Canteen *h* = 14.9 cm	V. 151  PIII Bowl *d* = 7.8 cm
V. 152  PIII Olla *d* = 32.2 cm	V. 153  McE B-W Olla *d* = 33.4 cm	V. 154  McE B-W Olla *d* = 32.8 cm	V. 155  PIII Mug *h* = 8.6 cm
V. 156  PIII Ladle *d* = 13.5 cm	V. 159  MV B-W Olla *d* = 32.3 cm	V. 169  MV B-W Ladle *d* = 13.0 cm	V. 176  MV B-W Mug *h* = 8.4 cm
V. 179  PIII Ladle *d* = 7.9 cm	V. 186  McE B-W Ladle *d* = 14.2 cm	V. 187  McE B-W Ladle *d* = 12.0 cm	V. 189  PIII Bowl *d* = 17.2 cm
V. 190  PIII Bowl *d* = 31.7 cm	V. 191  PIII Seed Jar *d* = 17.2 cm	V. 192  MV B-W SC Bowl *d* = 17.2 cm	V. 194  MV B-W Bowl *d* = 20.0 cm
V. 195  MV B-W Bowl n / a	V. 197  PIII Bowl *d* = 29.3 cm	V. 199  MV B-W Olla *d* = 37.7 cm	V. 200  MV B-W Bowl *d* = 29.3 cm