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Chapter 4

Material Choice and Interaction on Brown's Bottom

Mark A. Hill, Mark F. Seeman, Paul J. Pacheco, Jarrod Burks, Eric Olson, Emily Butcher, and Kevin C. Nolan

The nature of Ohio Hopewell settlement has been a long-standing issue in Middle Woodland archaeology. A number of scenarios have been advanced, including mobile hunter gatherers, aggregated populations in the earthworks, and dispersed settlements with vacant ceremonial centers. Recent advances have allowed us to understand that these settlements included dispersed communities interacting through large ritual centers and perched between foraging and farming as the foundation of their subsistence economy. Work by Pacheco and colleagues (2005; 2009a; 2009b; this volume; see also Kanter et al. 2015) at the sites of Brown's Bottom #1 and Lady's Run have enhanced our understanding of the nature of these dispersed settlements as clusters including a limited number of houses.

Brown's Bottom #1 and Lady's Run are located on the floodplain of the Scioto River approximately ten kilometers south of Chillicothe, Ohio. Excavation at Brown's Bottom #1 revealed one large square house that was defined by post mold patterns, and a number of earth ovens and other features located on a slight rise on the floodplain (Pacheco et al. 2005; 2009a; this volume). Approximately 100 meters to the northwest, and separated from Brown's Bottom #1 by a shallow swale, the site of Lady's Run contains one square house feature and one rectangular house feature that were defined by post mold patterns, pit features, and a notable secondary refuse deposit filling the buried paleochannel on the west side of Lady's Run Structure 1 (Pacheco et al. 2009b; this volume; see also Kanter et al. 2015).

The questions posed by these two sites situate within the larger issues surrounding Hopewell settlement and the relationships between households, communities, and ritual contexts. In the case represented here, these questions specifically involve the relationship between these Hopewell residences and the three houses that they contain. Are they contemporary households that are part of a kinship-based unit or are they remains of noncontemporary households that periodically shifted their location on the floodplain (Pacheco et al. 2009b:29)? Do they participate in similar activities and networks external to this residential complex? Do they share similar modes of production and resources use? Are they contemporary households, part of a sequence of related households that develop and change through time, or unrelated and noncontemporary households that happen to occupy the same geographic locations. Existing radiocarbon dates from these two sites (Pacheco et al., this volume) and newly produced dates (Nolan et al. 2017) suggest that these two sites represent a short period of occupation in the third to fourth centuries AD. However, these dates overlap substantially and are insufficient to answer the core question of contemporaneity.

While radiocarbon dating may not be adequate on its own to discern the relationships between these two sites and three households, differences in material culture may provide additional views regarding patterns of resource use, production, and participation in external networks. Here we examine raw material attributes of lithic diagnostic and non-diagnostic artifacts, and several attributes of ceramics, to gain insight into the variability expressed between households and what that variability may mean in terms of the nature of Hopewell households, Hopewell settlement, and the larger Hopewell world.

METHODS AND MATERIALS

Our collection includes 483 ceramic sherds from Lady's Run, 448 ceramic sherds from Brown's Bottom #1, 463 lithics from Lady's Run, and 682 lithics from Brown's Bottom #1 (Tables 1 and 2). We use "sherds" in this analysis not to ignore the larger issues of the relationships between sherds and the vessels from which they come, but to specifically describe ceramic features and characteristics at the most fundamental level of observation.

Table 1. Lady's Run Ceramics and Lithics.

Context	Ceramics	Diagnostic Lithics	Non-diagnostic Lithics
Surface	0	7	0
Plow zone	2	30	19
Structure 1 pits and posts	104	5	63
Structure 1 floor/ refuse	113	3	16
Structure 2	96	9	34
Secondary refuse midden	129	41	198
Exterior pits	35	5	33
Unknown provenience	4	0	0
Total	483	100	363

Table 2. Brown's Bottom #1 Ceramics and Lithics.

Context	Ceramics	Diagnostic Lithics	Non-diagnostic Lithics
Plow zone/Unknown	0	82	306
Structure pits and posts	108	8	32
Exterior pits	340	85	169
Total	448	175	507

Several attributes were analyzed for each category of material culture. Lithics analysis focused on the identification of source material and the degree of heating. Ceramics were analyzed across thirteen categories of observable or measurable traits, including surface treatment, maximum and minimum thickness, cordage twist, interior, core, and exterior Munsell color, temper type, temper size, temper density, decoration type, location of decorative elements, paste, and weight. Each of these has a subset of additional attributes.

Surface treatments observed in the sample included the following: plain, cord-marked, burnished, slipped, brushed, simple stamped, complex stamped, and surface other. Maximum and minimum sherd thickness data were gathered with calipers precise to 0.01 mm. Out of the three measurements made, the largest and smallest were used for maximum and minimum thickness, respectively.

Cordage twist records the directionality of cordage used in cord marking or cord impressions on the ceramic vessels. While the impressions on the ceramics represent a "negative" of the cordage, the "positive" of the cord was obtained by taking an impression of the surface treatment using modeling clay. The resulting impression was then examined to determine the twist—either S or Z—of the cordage used in ceramic production.

Cordage spacing was recorded if cord marking was applied at regular intervals. This was then determined by taking the average of three measurements.

Munsell colors were visually identified to hue, chroma, and value using LED lighting. Colors most frequently fell within the, 2.5YR, 5YR, 7.5YR, 10YR, and 2.5Y hues.

Observed ceramic temper types include the following: grit, grit/grog, grit/pyrite, grit/sand, grit/unknown, grog, limestone, sand, and unknown. Temper types were identified as the majority type, with a minimum of three inclusions to be considered a potential temper. The temper type recorded was required to comprise more than two thirds of the macroscopically observable temper. Temper sizes were taken from the Munsell Granular and Crumb Structures chart, and included the categories of very fine, fine, medium, and coarse. Temper density was estimated using the Munsell charts for estimating proportions of mottles and coarse fragments. Due to the resolution of these charts, density was measured in five percent intervals.

Decoration types included incised-hard, incised-soft, dowel impressed, cord impressed, rocker stamped (short and tall), dentate rocker, dentate linear, punctates, and rim decorations. The following categories further differentiated rim decorations: crosshatched, dentate stamped, parallel incised, punctates, and rim strips. Rim decorations were identified on the lip or rim of the vessel, sometimes extending to the neck of the vessel when the sherd was large enough to observe.

Ten percent of all samples were randomly selected to be double checked by a second observer. In these double checks, maximum and minimum thickness measurements were required to match within +/- 0.10 mm, and temper density values were to be within +/- 5 percent. The interior, exterior, and core hues, values, and chroma were to be consistent within a block of nine, so that a given value/chroma number is within one block of the first observer.

Elemental composition of ceramics was also assessed. Using an Olympus DELTA Premium portable X-ray fluorescence analyzer, readings of elemental composition were taken from three locations on each sherd; 1) exterior surfaces, 2) interior surfaces, and 3) sherd cores. Each of these locations represents a differ-

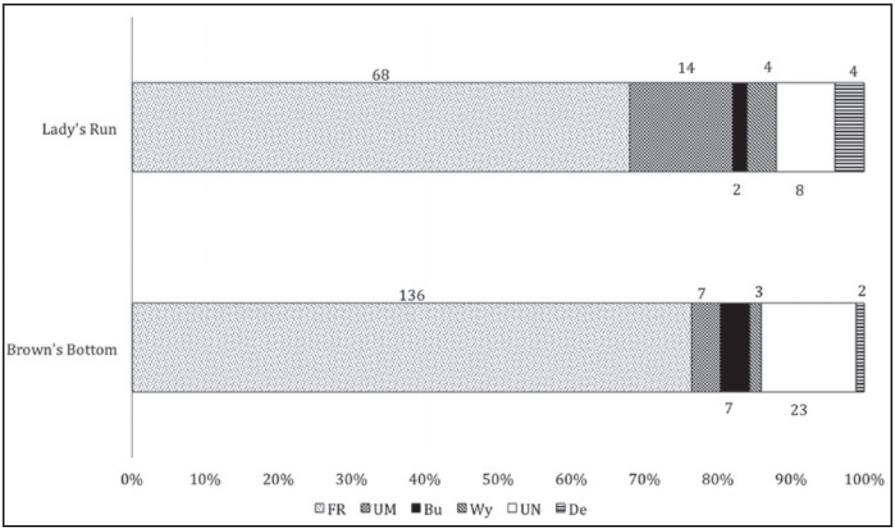

Figure 1. Diagnostic lithic raw materials by count.

ent aspect of manufacture and use as the interiors are predominantly affected by production and the materials stored or processed in the vessel, exteriors are affected by production and the exterior contexts of use such as hearth environments, while sherd cores may retain a stronger signature of production. The multiple readings per sherd allowed for analysis that incorporates differences in clay, temper composition, and source, as well as differences in manufacture and use.

RESULTS

Examining the Brown's Bottom #1 and Lady's Run assemblages across all attribute types, one is first struck by their overall similarities. Yet several distinct differences in materials and traits suggest the presence of frequently minor but distinct differences in the modes of production and participation in external social networks between these two sites.

Production of diagnostic and non-diagnostic lithics used the same raw materials at both sites, with slight differences in frequency. Flint Ridge is the raw material of choice for diagnostic lithics at both sites, comprising 68.0 percent by count and 61.6 percent by weight of the assemblage at Lady's Run and 76.4 percent by count and 66.4 percent by weight of the assemblage at Brown's Bottom #1 (Figures 1 and 2).

More distant raw materials such as Wyandotte and Burlington chert indicate long distance interactions that show a degree of variability between the two sites.

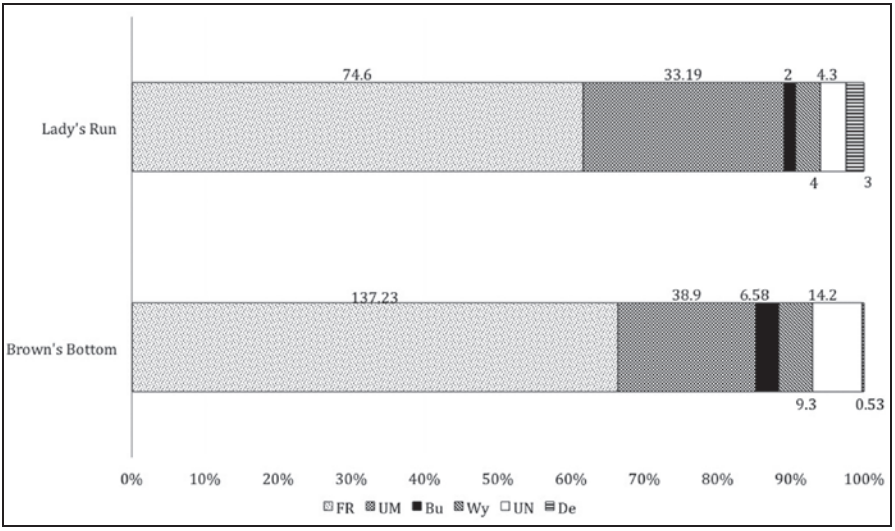

Figure 2. Diagnostic lithic raw materials by weight (grams).

By count, Wyandotte chert is more common than Burlington chert at Lady's Run while the opposite holds true at Brown's Bottom #1. However, of particular note is the fact that Wyandotte comprises a larger percentage by weight at Brown's Bottom #1, indicating that the average size of Wyandotte diagnostic artifacts is larger at that site than at Lady's Run.

For non-diagnostic lithics, (Figures 3, 4) both sites again feature the same range of raw materials, but unlike the diagnostic lithics, Delaware chert is prominently featured at both sites. However, Delaware makes up a larger percentage at Brown's Bottom #1, while Upper Mercer is more common at Lady's Run. Wyandotte is present at Lady's Run, but appears absent from the Brown's Bottom #1 sample.

Some of the ceramic traits fall within a common range of variability across all contexts at Lady's Run and Brown's Bottom #1. Surface treatments (Figure 5) at both sites are largely cordmarked with similar percentages of plain, though burnished sherds are more common at Lady's Run. Temper types (Figure 6) show much the same range of variation at both sites, though grit/chert is present only at Lady's Run and grit/sand is more common at Brown's Bottom #1. Temper size (Figure 7) and density (Figure 8) are also quite similar between both sites, as is the frequency of S and Z-twist in the cord impressions. Decorative elements, however, differ notably between the two sites (Figure 9). Brown's Bottom #1 exhibits a more varied set of decorative elements, with punctates being most common,

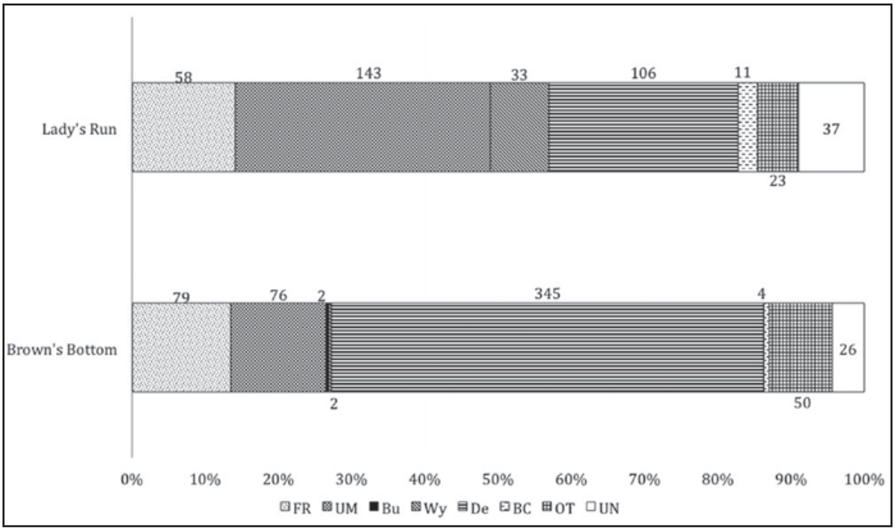

Figure 3. Non-diagnostic lithic raw materials by count.

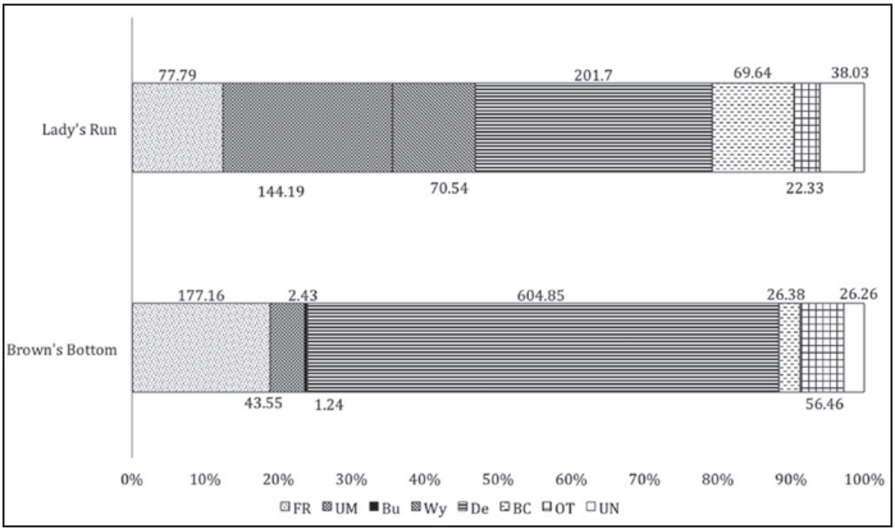

Figure 4. Non-diagnostic lithic raw materials by weight (grams).

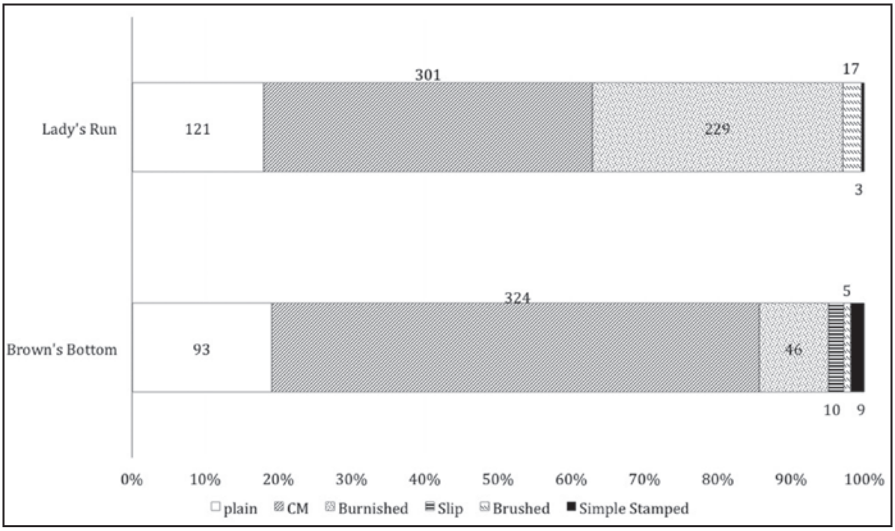

Figure 5. Ceramic surface treatment frequencies.

while the majority of the Lady's Run ceramics featured cord-impressed elements. However, it must be noted that our sample sizes for decorated sherds is quite small (Lady's Run n=5; Brown's Bottom #1 n=10), undermining the heuristic value of any observed differences.

Elemental composition of ceramic cores also found highly similar uses of raw materials for production (Figure 10). Sherds were grouped by the context from which they were recovered, as shown in Figure 10, and discriminant function analysis then resulted in seven functions (Wilks' lambda 0.541), with Functions 1 and 2 accounting for 59.2 percent of the variance. Differences in elemental composition exist from context to context, as Nolan et al. (this volume) noted, but the overall picture reflects similarities in clay acquisition sources and preparation methods. This is reflected in the low reclassification rate, with only 39.3 percent of the cases correctly classified to their original context and only 33.7 percent of the cross-validated cases correctly classified. Few identifiable differences are therefore observed in the elemental composition of clays used for ceramic production at Brown's Bottom #1 and Lady's Run, suggesting a reliance on similar clay and temper sources throughout the occupation of both sites. Yet one trend is noted; sherds recovered from the floor of Lady's Run Structure 1 have lower scores on Function 2 while Lady's Run Structure 2 ceramics have the highest. All other scores occur in the middle for Function 2. One tentative interpretation for this

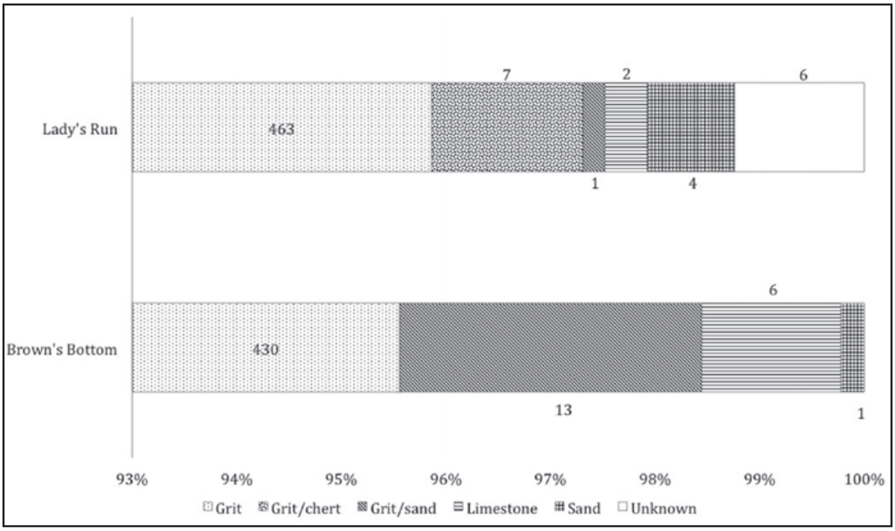

Figure 6. Ceramic temper type frequencies.

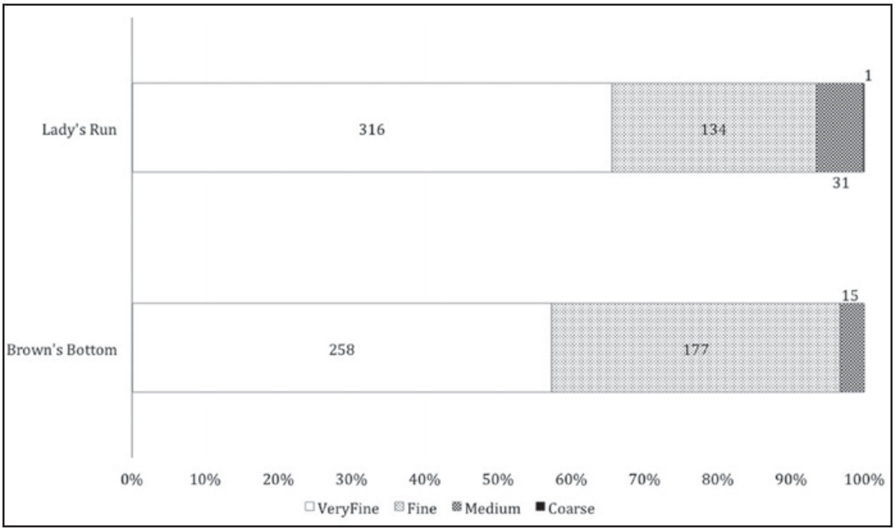

Figure 7. Ceramic temper size frequencies.

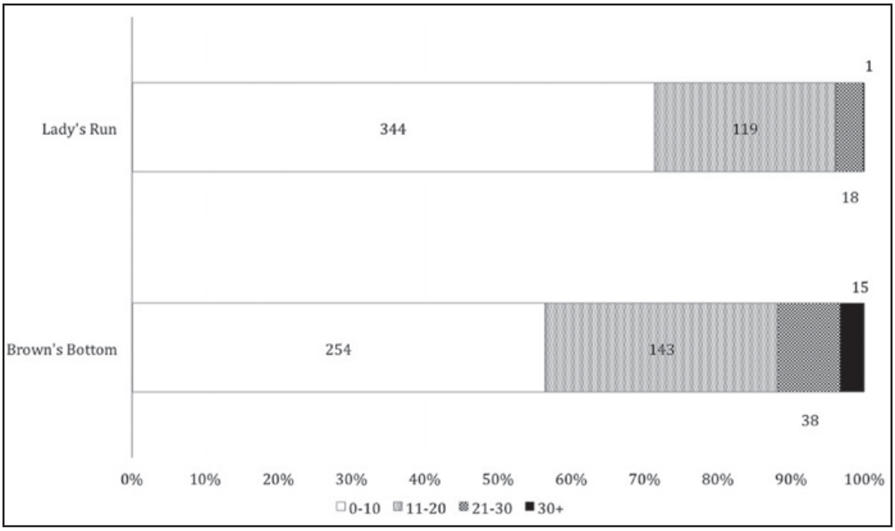

Figure 8. Ceramic temper density.

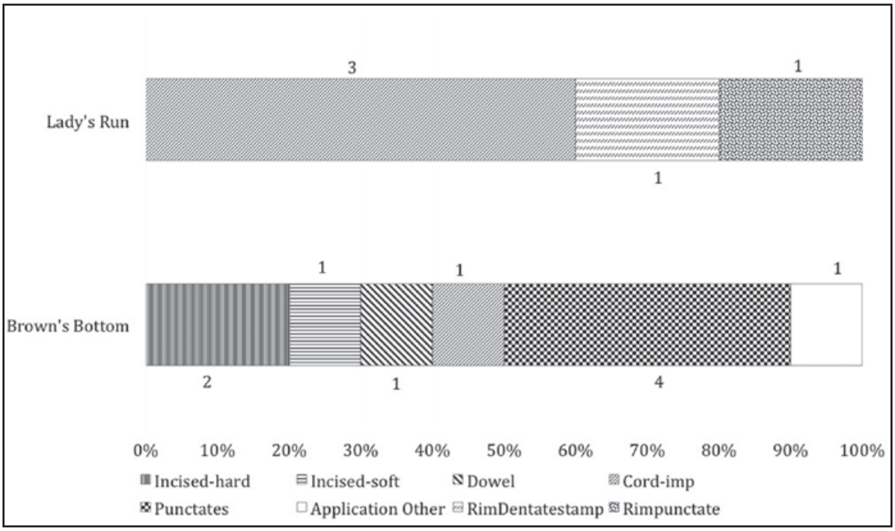

Figure 9. Frequencies of ceramic decorative elements.

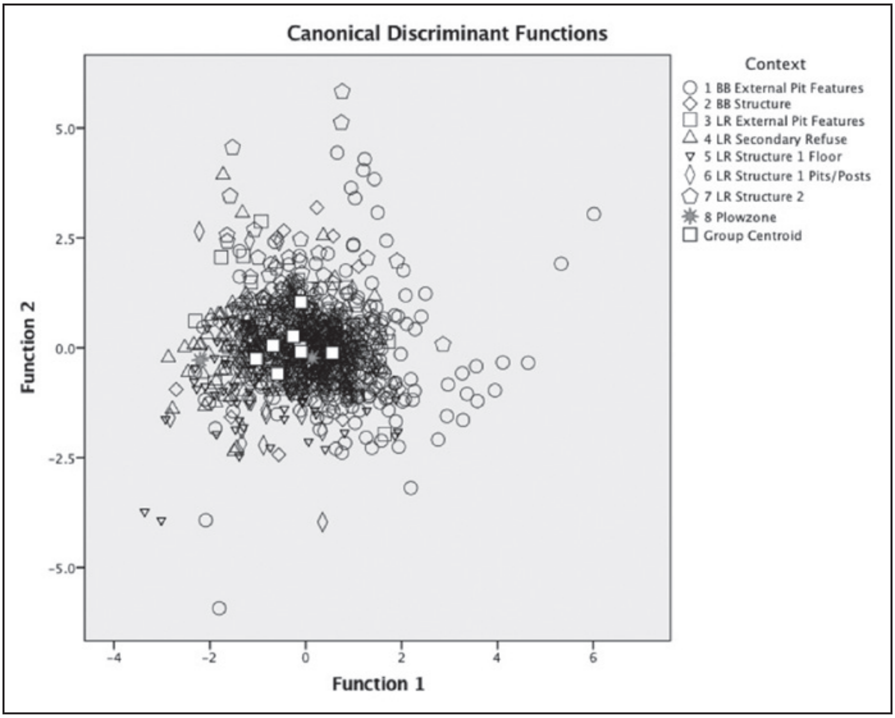

Figure 10. Discriminant function plot of Functions 1 and 2 of the elemental composition of ceramic sherd cores.

trend is that Function 2 represents time, with Lady's Run Structure 2 being early, Lady's Run Structure 1 Floor deposits being late, and everything else overlapping in the middle. This is consistent with the chronology proposed by Pacheco and colleagues (this volume).

Obscured by the overall similarities in traits and elemental composition, there are notable differences in ceramics between Lady's Run and Brown's Bottom #1. These differences are particularly apparent when comparing that material culture by feature and depositional context. Examining each site in more detail best illustrates these differences.

LADY'S RUN

Temper. A higher variety of temper types and temper characteristics are found within the Secondary Refuse context than at any other context at Lady's Run. Temper types in Secondary Refuse include grit, grit/chert, limestone, grit/sand,

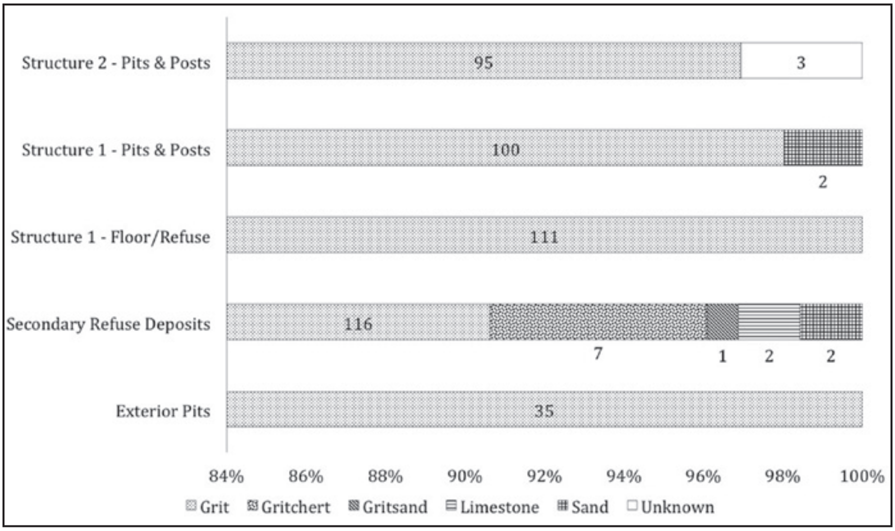

Figure 11. Lady's Run ceramic temper frequencies by provenience.

and unknown. As it is believed that this feature represents a mixed deposit, this high diversity of traits is not unexpected. The grit/chert temper type, found at Lady's Run but not at Brown's Bottom #1, is *only* present in the secondary refuse deposits while grit/sand temper, common at Brown's Bottom #1, is only represented by a single sherd found in Structure 1 Floor Refuse, as is limestone temper represented by two sherds (Figure 11).

Surface Treatment. As mentioned previously, cordmarked and plain surfaces were well represented at both sites, but burnished sherds were more common at Lady's Run. However, these burnished sherds are largely found within the Lady's Run structures, and are relatively uncommon in exterior pit and midden contexts. Brushed and stamped sherds are found *only* in Structure 1 and in exterior contexts. Exterior contexts also show a higher frequency of plain sherds than is found within either of the structures (Figure 12).

Twist. While both sites featured predominantly S-twist cord impressions with small frequencies of Z-twist, at Lady's Run the Z- twist cord impressions are only found in Structure 1. All other contexts are exclusively S-twist cordage (Figure 13).

Exterior colors. Ceramic colors reflect the composition of the clays, the temperature at which vessels were fired, differential use of those vessels, and possibly the amount of time broken sherds were exposed to sunlight prior to burial. The distribu-

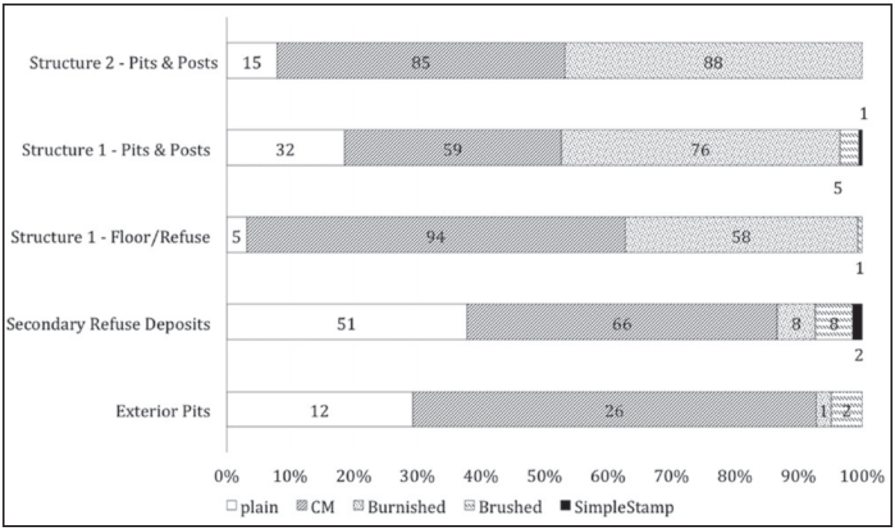

Figure 12. Ceramic surface treatments at Lady's Run by depositional context.

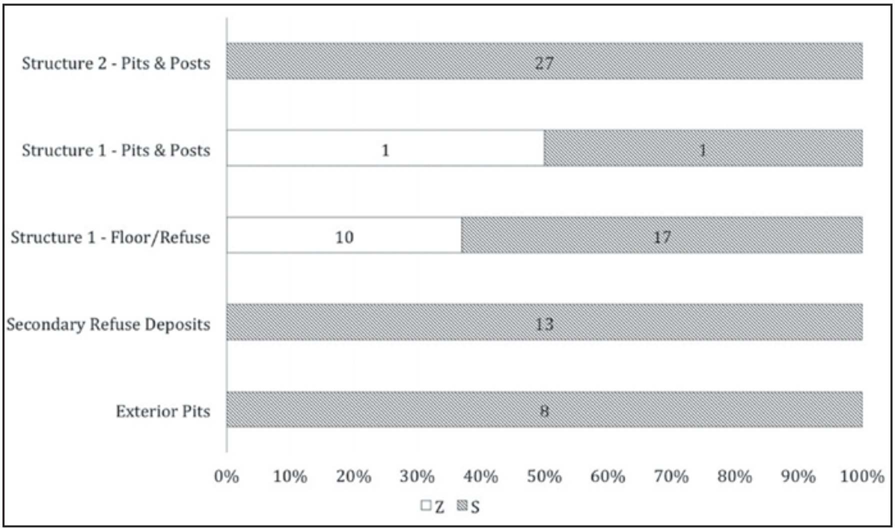

Figure 13. Cordage twist on Lady's Run ceramics by depositional context.

tion of colors therefore reflects differences in ceramic manufacturing and use, and differences in site formation processes across the variety of contexts at Lady's Run. We note that there are more deep red hues (7.5YR or lower) in Structure 1 pits and posts at Lady's Run, though the reddest hues were recovered from the floor of Structure 1 (2.5YR). However, Structure 1 floor also has sherds that represent very yellow hues (majority 2.5Y or 10YR). The lightest colored exteriors are in Structure 1 floor (Value 7+), and the darkest sherds are in Structure 2 pits and posts (Value 1–3). Structure 1 floor has the most saturated (washed out) colors (chroma 1–3), while Structure 1 and 2 pits and posts are least saturated (chroma in 1–3 range). The non-structure depositional contexts show a mix of saturated and unsaturated chromas.

Core Colors: The cores of ceramic sherds vary in color between depositional contexts at Lady's Run. The cores of sherds recovered from the Structure 1 floor are very yellow (2.5Y and 10YR are majority). Structure 1 pits and posts and the secondary refuse deposits contain more red cores. Structure 1 has more of the lightest sherds (values 7+), and the exterior pits have more of the darkest sherds (values 1–3). Secondary refuse deposits have the most washed out colors, Structures 1 and 2 are more saturated (chromas less than 3), and exterior pits are the most saturated.

Interior Colors. Most of the sherd interiors from Structure 1 floor were yellow (2.5Y or 10YR), but only the secondary refuse and Structure 1 floor had 2.5YR reds. The hues are mostly 7.5YR and 10YR in all contexts save the floor of Structure 1. Structure 1 floor was the lightest, while Structure 2 pits and posts were the darkest sherds. Structure 1 floor was the most washed out sherds (high chroma values), while Structure 1 and 2 pits and posts were most saturated. Secondary refuse sherds are also mostly saturated (chroma 1–3).

It is possible that Structure 1 floor/refuse context sherds were generally dirtier. Though short of prehistoric behaviors, an explanation for such a consistent yellowing throughout the sherds in just this one context is difficult to articulate.

Diagnostic Lithics. As above, the assemblage of diagnostic lithics at Lady's Run is dominated by Flint Ridge and Upper Mercer cherts. However, while Flint Ridge is present in all depositional contexts, Upper Mercer is only found in Structure 1, secondary refuse, and exterior pits while it is absent from Structure 2 pits and posts (Figure 14). As expected for a mixed deposit, secondary refuse also has the widest range of materials represented, and all of the Wyandotte and Burlington diagnostic lithics discussed previously were found in this midden deposit. The lack of Burlington and Wyandotte diagnostics in the structural contexts and their restriction to the secondary refuse midden is particularly noteworthy.

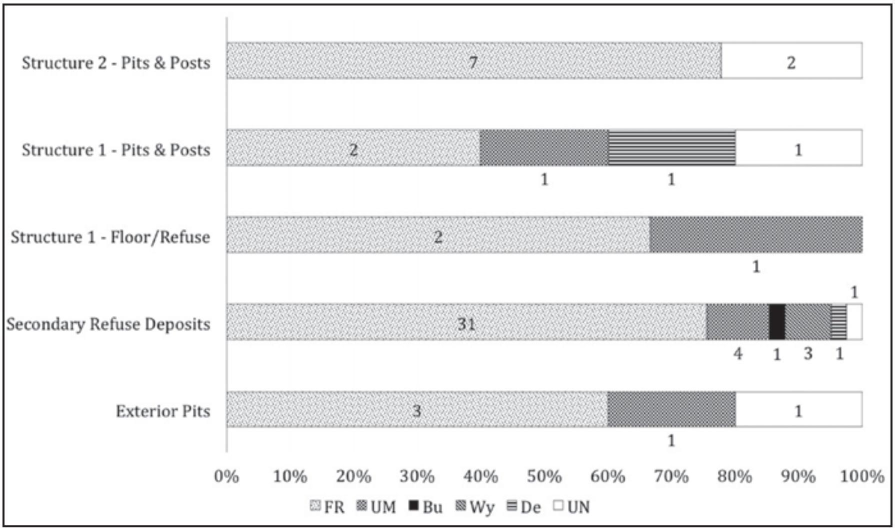

Figure 14. Lady's Run diagnostic lithics by depositional context.

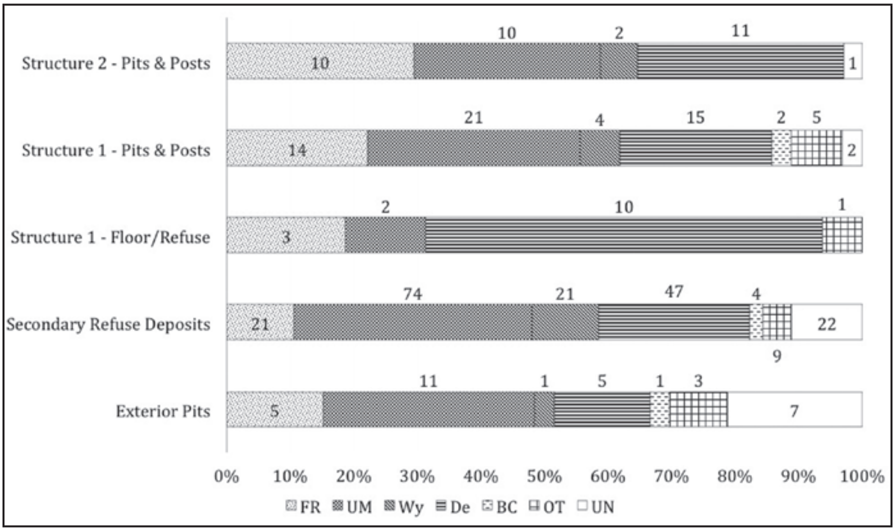

Figure 15. Non-diagnostic lithics from Lady's Run by depositional context.

Non-Diagnostic Lithics. Unlike the diagnostic lithic assemblage, the non-diagnostic assemblage features high frequencies of Delaware chert (Figure 15). Delaware chert non-diagnostics are common in all contexts, but are most common in Structure 1 floor/refuse. Interestingly, non-diagnostic Wyandotte lithics are more widespread than diagnostics, with these materials found in all contexts except Structure 1 floor/refuse.

BROWN'S BOTTOM #1

Temper. While grit, grit/sand, limestone, and sand were all used as ceramic temper at Brown's Bottom #1, there is a differential distribution of these tempers across the site (Figure 16). Grit temper is distributed across both interior and exterior contexts, while limestone temper is only found in the structure pits and posts. This is the opposite of the pattern seen at Lady's Run, where limestone temper was not in the structures but only in the secondary refuse contexts. Also at Brown's Bottom #1, grit/sand and sand tempers are only represented in the exterior pits.

Twist. Again, as at Lady's Run, S-twist cordage is significantly more common at Brown's Bottom #1 than is Z-twist. However, unlike Lady's Run where all the Z-twist was found within Structure 1, all of the Z-twist at Brown's Bottom #1 is found *outside* the structure in exterior pits (Figure 17).

Surface Treatment. Little differentiates the ceramic surface treatments between contexts at Brown's Bottom #1. Most of the ceramics are cordmarked, with a lesser number of plain, and there is a much smaller frequency of burnishing than at Lady's Run (Figure 18).

Exterior Colors. Exterior pits have more 7.5YR and less 5YR, but proportions of 2.5YR and 10YR are approximately equally small in either context. Exterior pits are more washed out than structure pits and posts (higher chroma values). The structure pits and posts have more dark sherds (low values) than exterior pits.

Core Colors. Exterior pits have 2.5YR hues, and slightly more 10YR hues, while the structure has no 2.5YR and fewer 10YR. Core colors are more washed out than structure colors (more chromas 4–6 and 7+). There are significantly more light sherds (Value 7+) in exterior pits than in the structure.

Interior Colors. Exterior pits are largely 2.5YR but the structure has no 2.5YR colors, instead featuring more 5YR and 10YR hues than the exterior pits. Exterior pits are more washed out than the structure by a significant margin and have significantly more light values than the structure, which has darker values between.

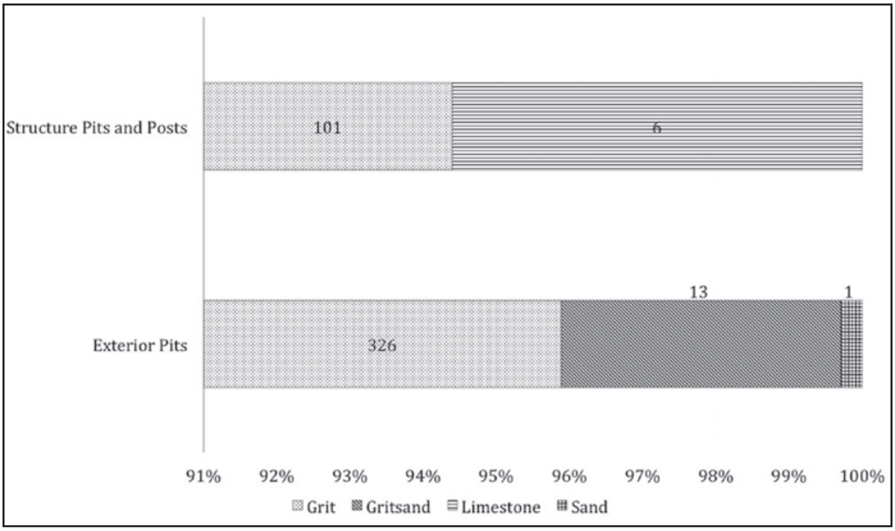

Figure 16. Ceramic temper types by context at Brown's Bottom #1.

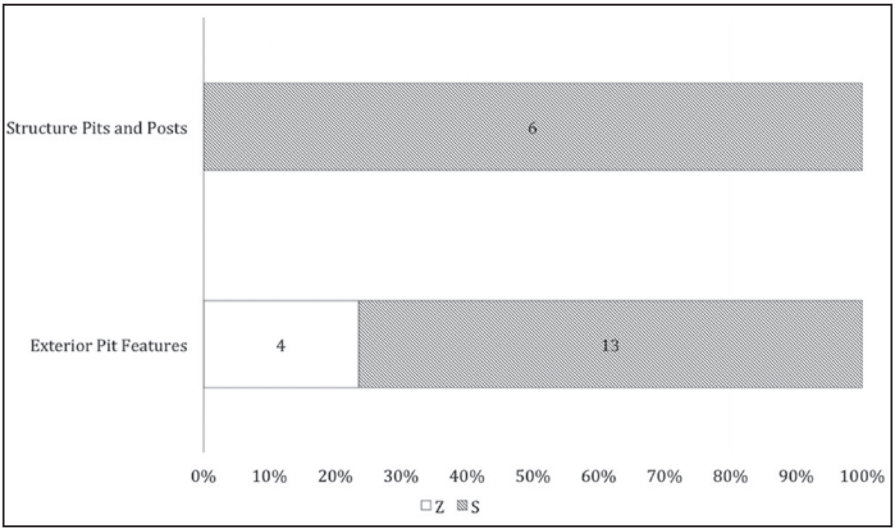

Figure 17. Distribution of cordage twist across depositional contexts at Brown's Bottom #1.

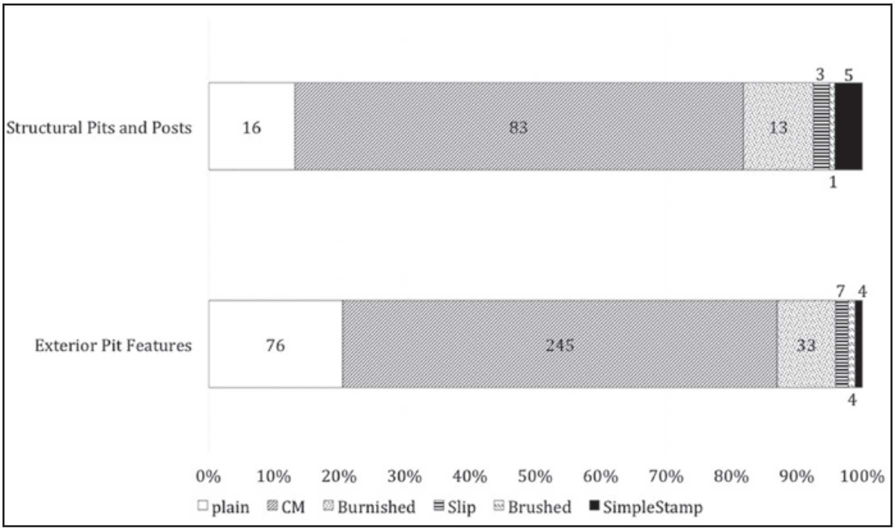

Figure 18. Brown's Bottom #1 ceramic surface treatments by depositional context.

This color pattern seems to be inverse of Lady's Run ceramics, where the lighter, more washed out, and variable hued sherds occurred within the structures.

Diagnostic Lithics. Diagnostics lithics are largely made from Flint Ridge at Brown's Bottom #1, with much lower frequencies of Upper Mercer chert. Counts of diagnostics are low within the structure (n=8), though the only instance of a Wyandotte diagnostic occurs there unlike Lady's Run where all Wyandotte diagnostics were found in exterior contexts (Figure 19).

Non-Diagnostic Lithics. Delaware chert again dominates the non-diagnostic lithics both in structure and non-structure contexts (Figure 20). No Wyandotte chert non-diagnostic lithics are present in any context, and Burlington chert is only found in the exterior pits context. Non-diagnostic Burlington chert is only found at Brown's Bottom #1, not at Lady's Run—an opposite pattern to that displayed by Wyandotte chert.

SUMMARY

A number of attributes are found to be present in all depositional contexts at Browns' Bottom #1 and Lady's Run (Table 3). These include grit-tempered ceramics with plain, cordmarked and burnished surface treatments, S-twist cordage, diagnostic lithics of Flint Ridge chert, and non-diagnostic lithics of Delaware, Flint Ridge, and Upper Mercer cherts. These common materials and attributes are

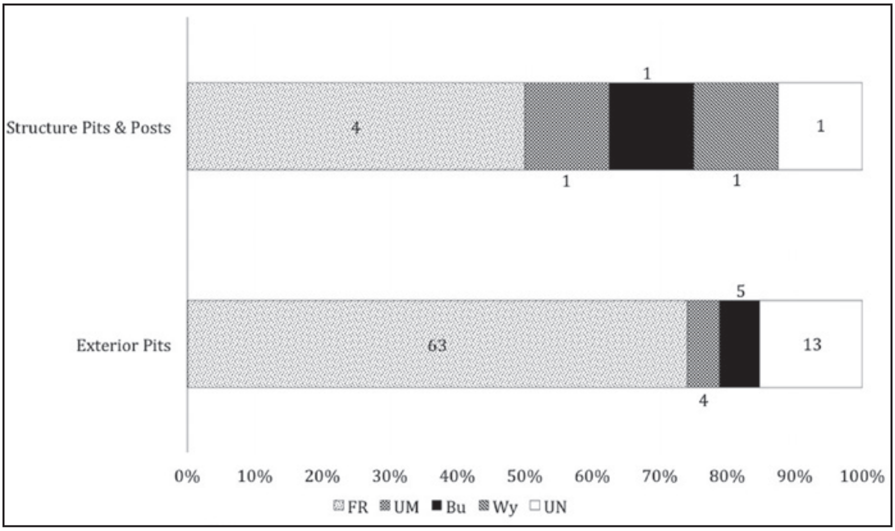

Figure 19. Diagnostic lithics (count) by depositional context at Brown's Bottom #1.

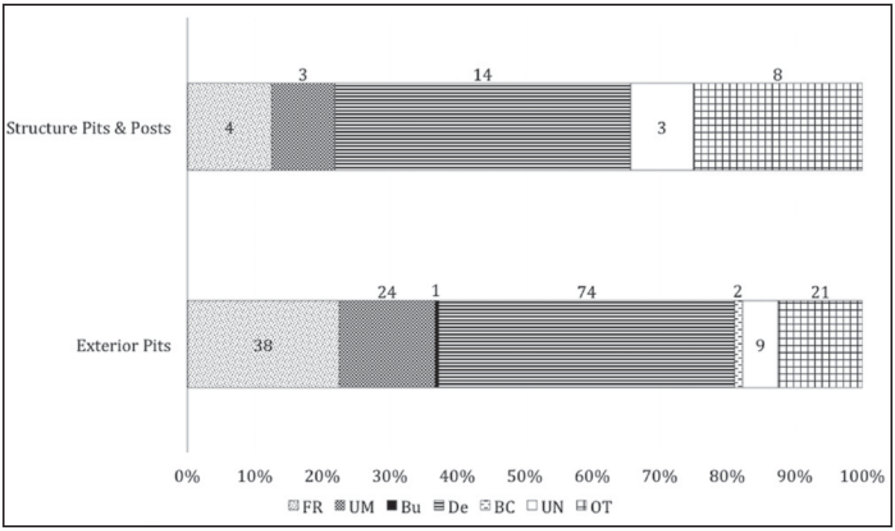

Figure 20. Non-diagnostic lithics (count) at Brown's Bottom #1 by depositional context.

found within all three structures and in exterior middens and exterior pit features. Ceramic elemental composition is likewise indicative of similarities in clay sources, production methods, and use practices. In many ways, Brown's Bottom #1 and Lady's Run are remarkably similar, and the two sites are often found to be most similar to one another across our larger database of Scioto Valley Hopewell sites (see Nolan et al., this volume).

Table 3. Attributes Common Across Interior and Exterior Depositional Contexts at Brown's Bottom #1 and Lady's Run.

		INTERIOR			EXTERIOR		
Attribute	**Attribute Type**	**BB**	**LR 1**	**LR 2**	**BB**	**LR**	**Comments**
Ceramic Temper	Grit	Present	Present	Present	Present	Present	All contexts
Ceramic Surface Treatment	Plain	Present	Present	Present	Present	Present	All contexts
	Cord-marked	Present	Present	Present	Present	Present	All contexts
	Burnished	Present	Present	Present	Present	Present	All contexts
Cordage Twist	S-Twist	Present	Present	Present	Present	Present	All contexts
Diagnostic Lithic Raw Material	Flint Ridge	Present	Present	Present	Present	Present	All contexts
Non-diagnostic Lithic Raw Material	Flint Ridge	Present	Present	Present	Present	Present	All contexts
	Upper Mercer	Present	Present	Present	Present	Present	All contexts
	Delaware	Present	Present	Present	Present	Present	All contexts

However, while these similarities within the ceramic and lithic assemblages are present, subtle differences appear between these two sites (Table 4). In particular, depositional contexts seem to have an inverse relationship between the two sites in which attributes found in exterior contexts in one site are matched by the same attributes found only in interior contexts at the other. Some attributes, including grit/chert and sand tempers, diagnostic lithics of Delaware chert, and non-diagnostic lithics of Burlington and Wyandotte chert, are restricted to one site or the other.

Table 4. Attributes That Vary Across Interior and Exterior Depositional Contexts at Lady's Run and Brown's Bottom.

		INTERIOR			EXTERIOR		
Attribute	**Attribute Type**	**BB**	**LR 1**	**LR 2**	**BB**	**LR**	**Comments**
Ceramic Temper	Grit/Chert Temper	Absent	Absent	Absent	Absent	Present	LR Exterior, absent BB
	Grit/Sand Temper	Absent	Absent	Absent	Present	Present	Exterior contexts only LR and BB
	Sand Temper	Absent	Present	Absent	Absent	Present	Present LR, Absent BB
	Limestone	Present	Absent	Absent	Absent	Present	LR Exterior only, BB Interior only
Ceramic Surface Treatment	Brushing	Present	Present	Absent	Present	Present	Brushed ceramics absent from LR 2
	Simple Stamped	Present	Present	Absent	Present	Present	Simple Stamped ceramics absent from LR 2
	Slipped	Present	Absent	Absent	Present	Absent	Slipped ceramics absent from LR Sample

		INTERIOR			EXTERIOR		
Attribute	**Attribute Type**	**BB**	**LR 1**	**LR 2**	**BB**	**LR**	**Comments**
Cordage Twist	Z-Twist	Absent	Present	Absent	Present	Absent	Z-twist found interior only at LR, Exterior only at BB
Diagnostic Lithic Raw Material	Upper Mercer	Present	Present	Absent	Present	Present	Upper Mercer absent from LR 2 structure
	Burlington	Present	Absent	Absent	Present	Present	Burlington only found exterior at LR, interior and exterior BB
	Wyandotte	Present	Absent	Absent	Absent	Present	Wyandotte interior at BB, Exterior at LR
	Delaware	Absent	Present	Absent	Absent	Present	Delaware Absent from BB and LR 2
Non-diagnostic Lithic Raw Material	Burlington	Absent	Absent	Absent	Present	Absent	Present only in BB exterior
	Wyandotte	Absent	Present	Present	Absent	Present	Present only at LR interior and exterior, absent from BB
	Brush Creek	Absent	Present	Absent	Present	Present	Present only in LR 1 interior and BB/LR exterior contexts

These results suggest that the three households represented at these two sites are highly similar across common attributes. However, the variability found in this study further suggests that Lady's Run and Brown's Bottom #1 represent similarly scaled and structured households differentially participating in shared patterns of ceramic and lithic production and use.

These differences appear to support the idea that households are the basic unit of organization with respect to lithic and ceramic production and use. The households represented at Lady's Run and Brown's Bottom #1, while nearly contemporary or contemporary, are not engaged in identical production and exchange networks.

These differences between households are either structured by time—in this case quite a short period of time, perhaps as little as a generation or two—or differences in external networks or relationships structured through marriage and external ritual obligations manifested at the household level. This subtle differential participation in production and exchange networks lends support to the observations of Nolan and colleagues (this volume) that household level interaction and management of exchange relationships around (and not just through) the earthworks is a major driver of "Hopewell." This may further reflect a risk reduction strategy of diversification of external networks that would increase the opportunities for resource procurement in times of local shortages.

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