

Variability in Later Mesolithic Microliths of Northern England

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Introduction

Aside from a few notable exceptions where organic remains have been preserved in significant quantities, such as Star Carr, North Yorkshire (Clark 1954, 1972; Legge and Rowly-Conwy 1988, 1989) and Thatcham III, Berkshire (Wymer 1962), the majority of our understanding of the Mesolithic in England comes from the interpretation of lithic assemblages. Geographical distributions of lithic scatters and the diversity and morphology of stone tools have long formed the backbone of regional syntheses for both England in general (Clark 1932; Mellars 1976b; Wymer 1991) and Northern England in particular (Jacobi 1978; Myers 1986; Petch 1924: 12-33; Radley 1969; Raistrick 1963). This focus on lithics is due largely to poor organic preservation, but also stems from historical factors, where past collecting strategies and a large database of previous research have made lithic studies a fruitful avenue for furthering our understanding of Mesolithic behavior. Because they are associated mainly with early Holocene assemblages and are found in similar shapes and sizes over most of Europe, microliths have been a popular topic within this line of investigation. In England this research has included (but is not limited to), stylistic analysis (eg. Reynier 1994), microwear studies (i.e. Dumont 1987, 1989; Levi-Sala 1986, 1992; see also Findlayson 1990 for a study in Scotland), blood residue analysis (Richards 1989), and examinations of variability for purely typological (eg. Clark 1934; Palmer 1977: 16-20; Saville 1981), geographical (eg. Clark 1955; Jacobi 1976), and chronological (eg. Jacobi 1973; Mellars 1976a; Myers 1987; Switsur and Jacobi 1979) purposes.

Much of this research has focused on documenting and interpreting formal variability within microlith assemblages in the Early Mesolithic. The present study continues this trajectory, but focuses instead on the Later Mesolithic. Archaeologists have long noted that there is a marked increase in the number of microlith shapes and sizes from the Early to the Later Mesolithic. Many theories have been put forward to explain this increase in variability, from a degeneracy of style (Radley and Marshall 1963: 96), to migration or diffusion (Clark 1932, 1955; Radley 1969), to experimentation with new forms (Mithen 1990: 190), to an increase in the need to demarcate social boundaries (Wymer 1991). Other factors which may potentially cause an increase in morphological variability include changes in raw material use (i.e. some materials may be more difficult to work than others causing increased variability), an increase in functional diversity (i.e. different shapes may have been used for different purposes), and an increase in the number of flintknappers (i.e. more people and their errors during production could lead to an increase in the number of different shapes). Through an analysis of variance, this paper seeks to come to a better understanding of the source of variability in Later Mesolithic microliths of Northern England.

Database

Data for this study were drawn from several Later Mesolithic collections curated in museums across England. Assemblages from Northern England (Figure 1) were

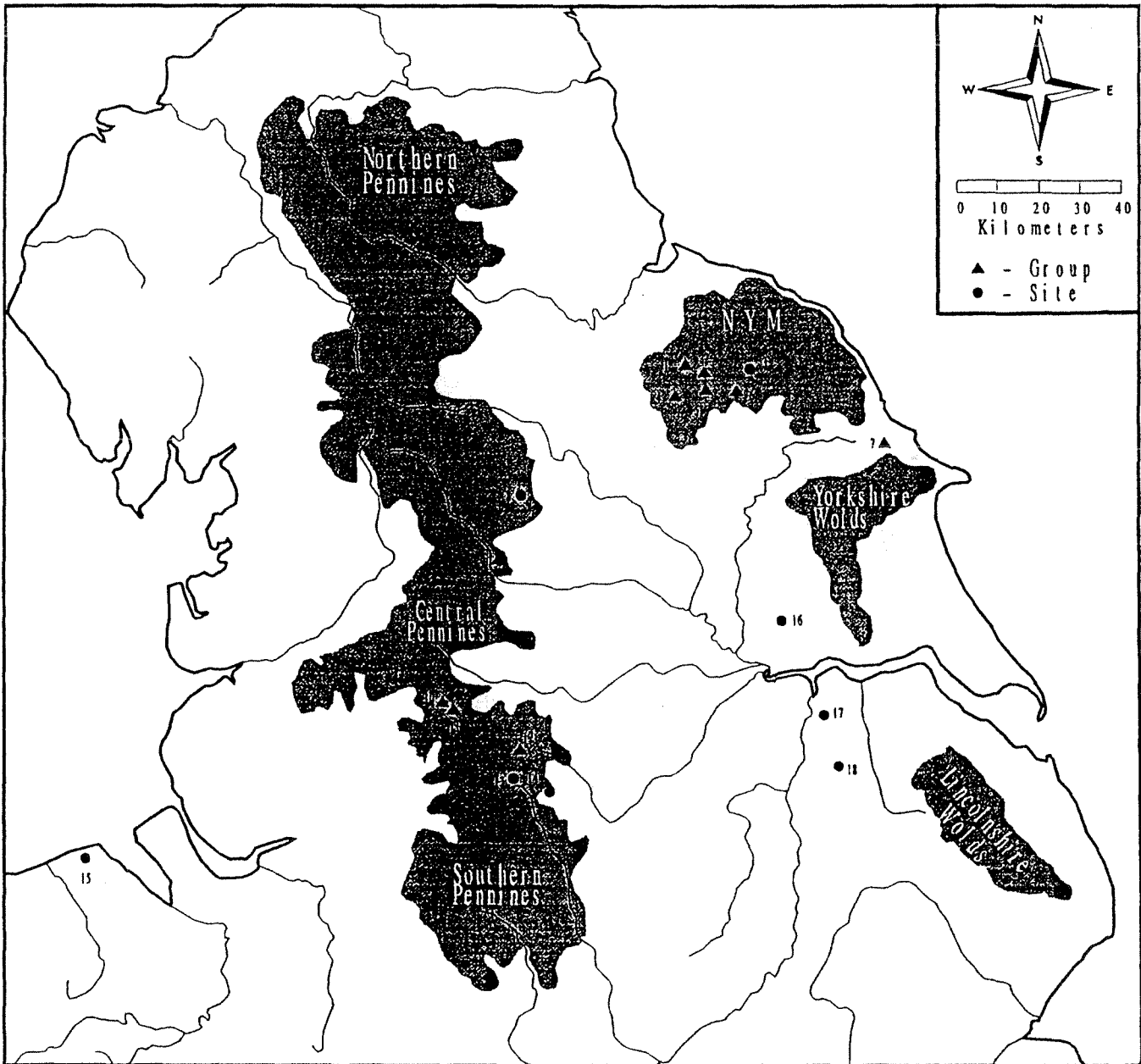


Figure 1. Distribution of sites studied (and number of assemblages at each location if more than one). Locational information from Wymer (1977). 1=Money Howe. 2=Urra Moor (3). 3=Glaisdale Moor (3). 4=Cow Ridge. 5=East Bilsdale Moor. 6=Rosedale. 7=Seamer Carr. 8=Kettlestang. 9=Blubberhouses Moor (2). 10=Windy Hill. 11=March Hill (2). 12=Heathfield Moor (2). 13=Dunford A. 14=Broomhead 5. 15=Prestatyn. 16=Howe Hill. 17=Roxby-cum-Risby. 18=Manton Common.

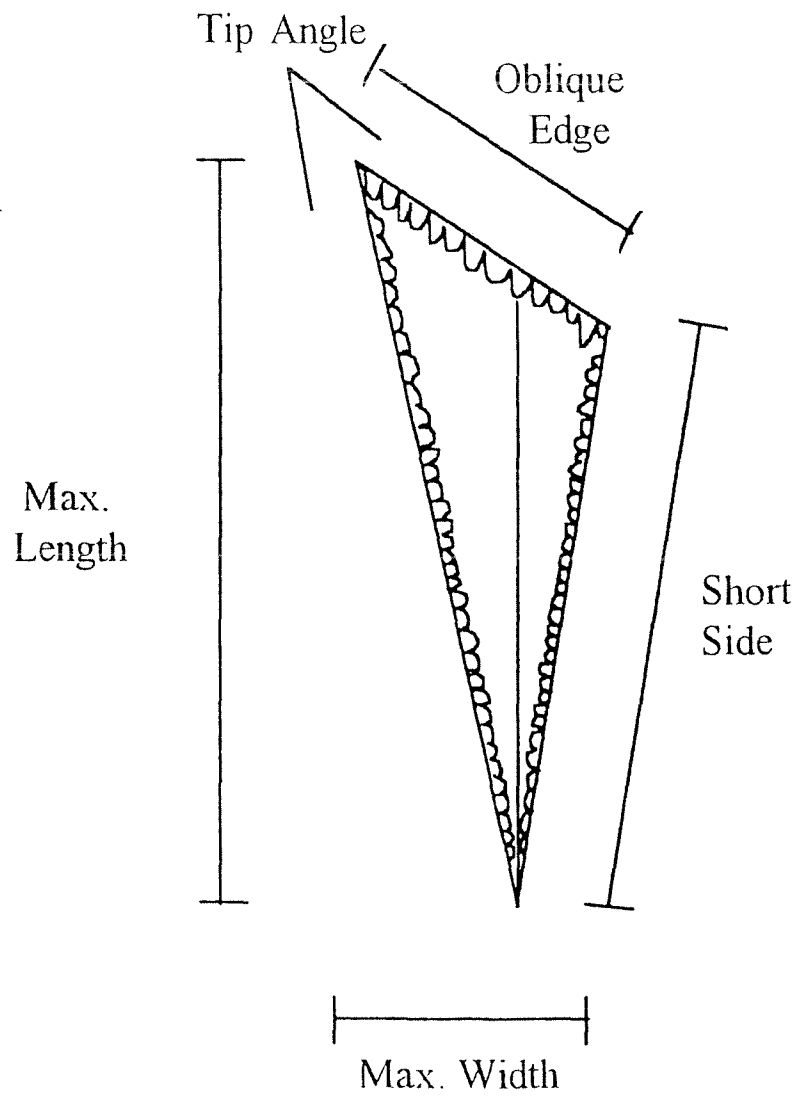
selected, representing different social and spatial scales, including microlith "groups", likely representing the work of a single individual over a relatively short period of time, and excavated and surface collected sites or localities, likely representing the work of more than one flintknapper over a longer period of time. To avoid confusion, the word "group" is used exclusively to refer to microlith assemblages clearly removed from all other flaking debris (eg. Barton *et al.* 1995; Myers 1989), and not groups of people.

From these collections geometric microliths were selected for study, pieces that consistently date to the Later Mesolithic, that is, from 6800 to 3500 B.C. (Mellars 1976a; Switsur and Jacobi 1979). This study focuses only on scalene triangular and rhomboidal pieces; rods were omitted due to their incompatibility with the attributes listed below. Each microlith was measured for length, width, thickness, oblique side, short side, tip angle, lateralization, and direction of striking surface or bulb of percussion (see figure 2). Measurements were made using hand-held digital calipers and were rounded to the nearest tenth of a millimeter (i.e., error = +/- .05mm). Microliths were then agglomerated at different spatial scales to facilitate comparisons between lowland and upland regions, and the North Yorkshire Moors and Pennine Dales regions. Finally, triangular microliths from northern England, northwest continental Europe (data from Gendel 1984), and Scandinavia (data from Blankholm 1990) were compared. Although triangular microliths probably do not occupy exactly the same intervals in these large regions (our understanding of chronology and technological change is incomplete), radiocarbon evidence shows that they do overlap in time: they are dated to 8800-5500 B.P. in northern England (Mellars 1976a; Switsur and Jacobi 1979); to 8800-8000 B.P. in northwest Europe (Rozoy 1978), and to the later part of the Maglemosian, roughly 8800-7950 B.P., in Scandinavia (Blankholm 1990).

In general, it is expected that variance within a set of artifacts will increase as more people contribute items to that set. Thus, as we include microliths from broader social, temporal, and spatial scales, variance is expected to increase. Variance at the individual and short temporal, or microlith group, level should be smallest, while variance at large social or regional scales, covering extended periods of time, should be largest.

Results

Table 1 gives the average coefficient of variation (C/V, or standard deviation divided by mean) for six attributes (1-6), and average index of qualitative variation (IQV) for two attributes (7-8), of the microliths measured in this study. The C/V and IQV, though not comparable to one another, facilitate comparisons of variance among different continuous and categorical attributes respectively. In this manner we can compare variance between, for example, length and width, which is not possible using simple standard deviations alone.



Microlith is right lateralized

Figure 2. Measurements taken.

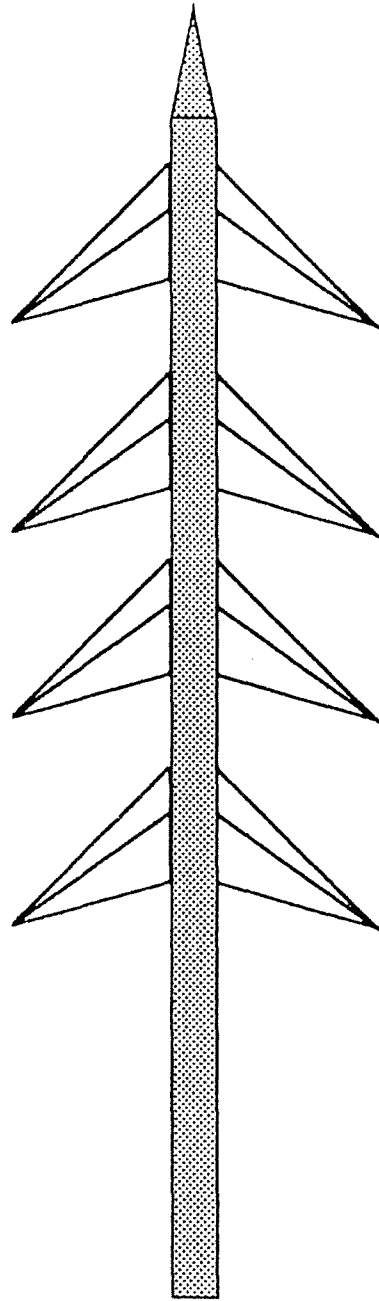


Figure 3. Examples of microliths hafted into foreshaft.

Comparing Different Attributes

Table 1 shows differences in variance between different attributes, demonstrating that some are consistently less variable than others. Maximum width, maximum length, and oblique edge, for example, seem to be among the least variable measurements, not only in England, but among mainland north-west European and Scandinavian microliths as well. If microliths were used as barbs hafted onto the sides and tips of hunting projectile, as has frequently been assumed (though see Clarke 1976 for an alternative perspective), the former two attributes most likely relate to the ability of microliths to penetrate and cause damage to intended prey (eg. Barton and Bergman 1982; Fischer 1989; Fischer *et al.* 1984; Rozoy 1989). If so, then barbs too wide or too long may fail to penetrate deep enough to kill an animal (i.e. to hit internal organs), while barbs too narrow to too short may not do enough damage to bring an animal down. In other words, these attributes would seem to be strongly affected by functional constraints, and for this reason display minimal variability among microlith assemblages.

Oblique edge is probably less related to function in this manner, and for this reason it may seem odd that there is little variability within these measurements. However, it is most likely the side that was inserted into a bone, wood, or antler foreshaft (as in figure 3). Later Mesolithic tools seem to have been made with maintainability in mind, where the overall tool was more valuable than the easily replaced and redundant (i.e. many barbs per tool) microlith (eg. Barton *et al.* 1995; Clarke 1976; Myers 1986, 1989). If this interpretation is correct, it explains the low variance within the attribute oblique edge, especially among group assemblages. Rather than custom-making every piece for a different sized inset slot, the use of standardized insets on the foreshaft, and standardized oblique edges, would have made replacement of broken microliths a more efficient process.

Because retouch on microliths is limited to flake margins only, thickness is not alterable once a flake has been struck. In other words, it is a measurement directly related to initial flake morphology and, thus, flaking technology. For this reason, and the additional reason that thickness is probably less related to the overall function of a barb than length or width (i.e. relative to its size there is more room for error in this attribute), it is expected to be highly variable. Table 1. shows that among metrical attributes (i.e. continuous variables, or items 1-6 in Table 1.) this is indeed the case, where thickness is among the most variable attributes in all columns. Thus, relative to other attributes, standardization of microlith thickness does not seem to have been a major concern among Later Mesolithic flintknappers.

Measurement	Northern English Groups	Northern English Sites	Northwest European Sites	Scandinavian Hut Floors
1. Maximum Length	.16	.23	.17	.24
2. Maximum Width	.12	.21	.18	.17
3. Max. Thickness	.24	.26	.20	.27
4. Oblique Edge	.15	.23	.18	.25
5. Short Side	.20	.22	.18	.29
6. Primary Angle	.16	.25	.21	N/A
7. Lateralization	.10	.45	.83	.33
8. Bulbar Position	.84	.83	.89	.29

Table 1: Measurements for Average Variation by Assemblage Type and Attribute.

Measurements for Maximum Length through Primary Angle represent the average Coefficient of Variation, while Lateralization and Bulbar Position represent average values of the Index of Qualitative Variation (IQV). Because they are measured on different scales, the former 6 values cannot be directly compared to the latter 2.

Comparing Social Scales

Examining the magnitude of change when we cross social scales, that is, when we compare variance in groups against variance in sites and regions also gives interesting results. As expected, the study demonstrates that variation within microlith groups is, in general, less than that found within assemblages from sites and regions, suggesting that the microliths composing a single tool or made by a single manufacturer are highly standardized relative to those found within the context of a single site or within a region, and presumably, larger numbers of people. More interesting, however, is when we compare relative changes in different attributes across social scales. For example, there are large differences in the attributes of maximum length, maximum width, and oblique edge, where, on average, variance within groups is much less than within sites. For these attributes groups seem to encompass a relatively small fraction of the total variation that exists within microliths in a site, suggesting that inter-individual differences are high. On the other hand, thickness, short-side, and bulbar position show minimal differences between scales, suggesting that the variation produced by a single person is, in general, equal to the variation produced by the many people occupying a site. This implies that inter-individual differences are small. Standard Analysis of Variance (ANOVA) tests bear out these results as well, where differences in the means for length, width, and oblique edge are more pronounced and significant than those for thickness, and to some extent short side (although larger variance in these measurements makes comparison difficult). Since bulbar position is a binomial variable, this test could not be performed on this attribute.

Tables 1 and 2, as well as ANOVA tests, demonstrate that there are few differences spatially and socially, in means and variance, in thickness measurements for Northern English microliths. Since thickness is primarily a product of the technique used to remove blanks from a core (i.e. microlithic technology does not modify blank thickness), this implies all Later Mesolithic flintknappers were using a similar technique to produce microliths, an argument that would account for the apparent homogeneity among Later Mesolithic debitage assemblages as well (see Pitts and Jacobi 1979). In addition, the high IQV value, indicating near homogeneity, for bulbar position among microlith groups demonstrates that manufacturers were relatively unconcerned with flake orientation prior to retouch, that is, whether the bulb of percussion was towards the proximal or distal end was immaterial to the end product. That this value is equally large for groups, sites, and regions indicates, again, that a similar technology was used among all Later Mesolithic knappers. This situation also holds for microliths from north-west mainland Europe. However, flintknappers from Scandinavia seem to be more concerned with flake orientation, preferring to fashion the oblique edge from the proximal end of the microlith blank (Blankholm 1990), as is shown in Figure 2 with the bulb towards the top of the page. On the other hand, lateralization is much more standardized among Northern English microliths. This is particularly true among English groups, where assemblages seem to be almost all left or all right lateralized (i.e. IQV near 0). That sites are more heterogeneous suggests they represent the accumulation and mixing of several microlith groups. Scandinavian assemblages are similar in this regard, with near homogeneity at the hut-floor level and relative heterogeneity at the site level. North-west European assemblages, on the other hand, contain almost even numbers of right and left lateralized pieces and appear to be more mixed in this regard than English or Scandinavian pieces.

Table 2 gives mean and C/V values for microlith assemblages when they are agglomerated into broader social and spatial categories (i.e. combining groups and sites), as well as data from north-west mainland Europe (data from Gendel 1984), and Scandinavia (Blankholm 1990). Interestingly, when we begin to merge sites and groups in this fashion, variance in length, width, and oblique edge begin to equal, and occasionally exceed that of thickness. This, in association with ANOVA tests discussed earlier, confirms that, relative to thickness, there are large inter-site and inter-microlith-group differences in these attributes. At the same time, like thickness, primary angle and, to a lesser extent, width show only modest gains in variance from the site (table 1, column 2) to the regional (table 2, columns 1-3) level. In other words, sites encompass most of the variability that exists at the regional scale in thickness, primary angle, and width. This suggests that flintknappers are conforming to norms that reside at a local band (i.e. site) level for these attributes, rather than individual (i.e. microlith group) or regional standards.

Attribute	Pennine Dales	North Yorkshire Moors	Northern English Lowlands	North-west mainland Europe	Scandinavia
Maximum Length	14.8 .26 (69)	15.1 .34 (88)	18.0 .28 (50)	20.9 .24 (257)	25.7 .28 (766)
Maximum Width	4.7 .20 (109)	4.4 .28 (136)	5.3 .30 (83)	7.5 .24 (552)	5.8 .29 (766)
Thickness	2.0 .28 (112)	2.0 .28 (139)	2.0 .29 (88)	2.5 .23 (532)	1.8 .37 (766)
Oblique Edge	6.2 .30 (89)	5.7 .30 (114)	6.8 .29 (62)	9.5 .24 (455)	8.9 .39 (766)
Short Side	10.4 .31 (75)	10.9 .39 (99)	14.2 .35 (43)	16.3 .27 (285)	19.3 .34 (766)
Primary Angle	42.0 .27 (99)	43.8 .27 (124)	39.5 .30 (71)	44.2 .26 (550)	N/A
Lateralization	Left 0.08 (93)	Left 0.22 (119)	Left 0.96 (75)	Left 0.99 (692)	Left .73 (718)
Bulbar Position	Proximal 0.98 (53)	Proximal 0.99 (59)	Proximal 0.96 (35)	Distal 0.99 (465)	Distal .37 (682)

Table 2: Mean or mode (categorical variables), C/V or IQV (categorical variables), and sample size (in parentheses) for agglomerated scalene micro-triangular microliths.

Spatial Patterns in Variance

Table 2 reveals that there is little morphological difference between the Pennine Dales and North Yorkshire Moors upland regions, a notion supported by z-statistics (large sample), which are all insignificant for comparing means at the .01 level. Thus, it appears that the same 'type' of microlith is found in both the Pennines and North Yorkshire Moors. On the other hand, variance seems to be consistently lower within the Pennines, in spite of the fact that the sites included are spread over a wider area and include a smaller number of microlith groups (5 versus 7 in the North Yorkshire Moors). This suggests that either there is a bias in the sample selected, though the number of microliths measured is approximately equal in each region, that the sample from the Pennines represents a smaller number of people, or that hunters were, for some reason, more concerned with conforming to a standardized shape in this region.

Raw material quality and access may have played a role here. Regular access to high quality toolstone may have allowed flintknappers to replace their tools more frequently with workable material, generating less variance, rather than having to resharpen tools and/ or make do with poor quality and difficult to control material, leading to higher variance. However, given the nature of upland chert and flint resources, relatively poor in both regions (Myers 1989; Raistrick 1963), this explanation does not seem likely.

Differences between uplands and lowlands are more pronounced. On the whole, lowland microliths seem to be larger than their upland counterparts. Z-statistics comparing means from the Pennines and North Yorkshire Moors against those from the lowlands are significant at the .01 level or better for all attributes except thickness and primary angle. In addition, lowland microliths seem to be fairly variable, in most cases more so than upland assemblages, and more evenly split between left and right lateralized pieces. Where lateralization could be determined, 40% (n=75) of the lowland pieces are right lateralized, while only 4% (n=212) of upland microliths are the same, ratios that are reflected in the IQV values in table 2.

Distinctions between upland and lowland locations are particularly intriguing given past discussions concerning Mesolithic activities, mobility patterns, and social territories (i.e. Jacobi 1978; Mellars 1976b; Schadla-Hall 1988). The differences noted here hint that microliths may be playing a slightly different role in lowland versus upland contexts. For example, the high variability in lowland contexts may reflect a greater diversity in hunting strategies and/ or intended prey. Alternatively, it could represent a greater diversity in the number of flintknappers responsible for the microliths measured. These latter hypotheses support the arguments made by Mellars (1976b), who found that lowland sites, in general, were larger in size and had more diverse stone tool assemblages, although he did not differentiate between Early and Later Mesolithic sites (Myers 1987). In this respect, perhaps lowland sites represent locations where multiple bands, utilizing microliths lateralized both left and right, nucleated and camped together, hence accounting for the larger site size and lateralization mixing, while upland sites represent the splitting apart of bands into smaller nuclear families travelling together and using a similar style of lateralization (i.e. all left or all right). It could also simply reflect a larger number of individuals living and travelling together year-round in the more bio-productive lowlands (e.g. Schadla-Hall 1988), producing left and right lateralized pieces, while uplands were permanently, but also more sparsely, populated by knappers making mostly left-lateralized items. Interestingly, other studies (Gendel 1984) have found that lateralization seems to be the only attribute that reflects emblematic stylistic differences between large regions. The fact that upland microliths are smaller and less variable than those found in the lowlands is consistent with the notion that hunters attempted to maximize the utility of their stone tools in areas with poor quality raw materials. In such a situation, one would expect that raw material would be carefully managed, hence be more standardized, and the use-life of tools maximized through resharpening, and on average be shorter than tools in areas with more plentiful and better quality materials.

Despite all the variation at the group, site, and regional levels already discussed, there are still even larger differences within Mesolithic triangular microliths. Table 2. shows that when English microliths are compared against similarly shaped mainland European

items from the same "techno-complex" (Clark 1932, 1936; Jacobi 1976), some of these differences are quite pronounced. Here, there are even marked differences in thickness measurements, an attribute that was quite stable among northern English assemblages, hinting that Mesolithic flintknappers may have been using a different technology to produce flakes and blades across the English Channel. For example, not only are microliths significantly larger and thicker in northwest Europe, but they are more standardized as well. On the other hand, although they are also larger than British pieces, Scandinavian assemblages as a whole seem to be thinner and highly variable. Even when adjusted for the larger sample size, the differences between northwest mainland Europe, Scandinavia, and northern England are much higher than regions *within* northern England (i.e. between the Pennine Dales, North Yorkshire Moors, and lowland areas). These differences surely reflect divergent traditions passed down over multiple generations and perhaps the different functions microliths performed in each region.

Discussion and Conclusions

This paper began by seeking to understand the source of variability within Later Mesolithic microliths in northern England. Although these microliths have been described as homogenous and standardized (Myers 1989: 84; Wymer 1991: 22), it should be clear by now that there is quite a bit of diversity, reaching across both social and spatial scales, to be studied. Variance is smallest at the smallest social scale, that of the microlith group or individual. As we add individuals and move to the site level, variance increases accordingly, and as we agglomerate sites into regional databases, variance increases yet again. However, the magnitude of change is not equal among all attributes. Some show dramatic increases when we cross social scales, while others are more conservative, suggesting that attributes conform to norms that reside at different social scales. Some, such as thickness and bulbar position, show greatest variance and difference in means at the microlith group level with little additional difference at the site and regional levels. These attributes, then, appear to comply with regional norms, though differences between mainland Europe and England suggest that the commonalities stop short of a pan-European standard. In the case of thickness, the similarities probably relate to a common technique of flake and blade production.

For other attributes, such as primary angle, there is a large jump in average variance from the group to site level, but only small changes from the site to regional level. This indicates that there are large inter-microlith group or between-individual differences with only minimal inter-site differences. That is, norms for this attribute probably reside at an individual level, which is where the majority of variation is seen. On the other hand, attributes such as short side display minimal change from the group to site level, while gains in variation from sites to regions are large. This attribute appears to be conforming to standards that lie at the site or band (i.e. multiple persons) level. In other words, inter-individual differences are small relative to inter-site differences. For still other attributes, such as length and oblique edge, changes in variance are large across all social scales, suggesting not only significant inter-individual, but significant inter-site and occasionally inter-regional differences as well.

All of this implies that different attributes are varying according to different functional and social constraints, hinting that there is no single cause of increased microlith variation in the Later Mesolithic. Some attributes, such as thickness and bulbar

position, are governed more by technology. Others, such as primary angle, are probably dictated by assertive choices individuals make at the site level, leading to increased variance there, but must still conform to general rules regarding functionality, accounting for less variance at a regional level. Short side and lateralization appear to be following emblematic rules, where individuals within a site conform to a common size or style, but between site differences suggest different band norms. Moreover, the increased variance and mixing of styles in conjunction with larger site size and higher tool diversity in lowland locations suggests these areas were places where several families camped together. Finally, length and oblique edge appear to be constrained by few norms, varying widely between all social and spatial categories. These variables may be shaped largely by experimentation with new microlith shapes due to high competition among hunters, akin to what Mithen (1990: 190-191) has argued.

Surely this paper has only scratched the surface in documenting and making sense of the variability seen in Mesolithic stone tools, and further research will undoubtedly modify the results obtained here. However, it is only through such comparative studies that we will further our knowledge of Mesolithic behavior. It is my belief that a thorough understanding of patterns in variance, and how this measurement changes across different social, spatial, and temporal scales, an arena that has remained largely unstudied, is crucial to this goal.

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