6

New Quantitative Perspectives on the Middle–Upper Paleolithic Transition: The View from the Northern Mediterranean

Julien Riel-Salvatore
Arizona State University

C. Michael Barton
Arizona State University

Abstract

In this paper, we present a method to analyze lithic assemblages that can yield detailed information about Paleolithic technological organization patterns and land-use strategies. Applying it to series of Late Pleistocene assemblages from sites distributed along the northern Mediterranean (i.e., Gibraltar, eastern Spain and southeastern Italy) and spanning the Middle–Upper Paleolithic Transition, we show how this approach can be used to track diachronic behavioral change for Paleolithic hunter-gatherers. We demonstrate that the approach has wide applicability, that it can be used to reconstruct prehistoric land-use practices provided sedimentation rates can be accounted for, and that it provides a better explanation for diachronic lithic variability than schemes that simply classify assemblages in poorly defined "archaic" to "evolved" sequences. This analysis strongly suggests that no marked shift in the flexibility of technological organization or land-use strategies coincides with the Middle–Upper Paleolithic Transition. The implications of these findings and the apparent disjunction of behavioral and biological change known to have taken place during that interval lead us to outline new kinds of research questions which may better enable researchers to comprehend the mechanisms of the Transition process.

The Middle–Upper Paleolithic transition (hereafter, the Transition) continues to generate considerable popular and scientific interest. As the interval that saw the disappearance of Neanderthals as a discrete population and the putative widespread diffusion of 'modern behavior' outside of Africa, the Transition provides continued impetus for research across an ever-widening array of disciplines, including most prominently archaeology, human paleontology, ecology, geology, and genetics. Despite the number of studies centered on this topic, resolution of the fundamental questions associated with the Transition still eludes us, as the lively debates fueled by its empirical record demonstrate (see papers in Bar-Yosef & Pilbeam 2000, Hays & Thacker 2001, Zilhão & d'Errico 2003, Brantingham et al. 2004a, Straus 2005). In part, this situation is due to a generalized lack of interest in formulating widely accepted theoretical scaffoldings to frame the debate and explicitly define the expectations of researchers on both sides of the issue (see Clark & Riel-Salvatore 2006, Riel-Salvatore & Clark 2001).

To a degree, this is inevitable in a field of research as discovery driven as paleoanthropology (but see Brantingham et al. 2004b for a welcome exception). Perhaps more problematic, however, is the lack of appropriate methodologies to effectively capture and coherently present the dynamics of the Transition empirical record from an empirical record whose most abundant and best preserved components are lithic assemblages. As we have argued elsewhere (e.g., Riel-Salvatore & Barton 2004), this is in part due to the influence of typological approaches, so formative to our understanding of the Pleistocene archaeological record, that have imposed an *a priori* distinction between the Middle and Upper Paleolithic records (Simek and Price 1990, Grayson and Cole 1998, Marks et al. 2001). Theses systematics require that assemblages first be classified as either Middle *or* Upper Paleolithic. They are subsequently classified in typologies that differ fundamentally with regards to the types that make up each system. Furthermore, this makes these typologies inherently inadequate tools to classify and study the *transition* in lithic assemblages that span the two periods (Grayson & Cole 1998).

This paper is an effort to draw together the results of several past studies in order to demonstrate the broad usefulness of an approach to lithic analysis (originally proposed by Barton [1998]) that can be applied equally to Middle and Upper Paleolithic assemblages and its potential for revealing changing behavioral dimensions of the Transition. Here, we summarize the results of three studies that have employed this methodology to analyze Late Pleistocene assemblages from Gibraltar, eastern Spain and southeastern Italy. We use these results as a basis for comparing the flexibility of Mousterian and early Upper Paleolithic technocomplexes and the ways in which the makers of these artifacts exploited their landscapes. Our results, drawn from a dozen geographically dispersed sites, situated across a variety of ecological contexts, provide compelling evidence that the Transition does not coincide with a dramatic shift in landscape use. We conclude by considering the implications of our findings for clarifying our understanding of fitness-enhancing mechanisms that may have been at play during that crucial interval of recent human evolution, linking our behavioral observations to some of the biological dimensions of the Transition.

Methodology

The method used in this paper was originally proposed by Barton (1998) and subsequently developed in greater detail by the authors (Riel-Salvatore & Barton 2004). We present a brief overview of it here and refer the reader to the earlier publications for a more detailed discussion.

Our approach begins with plotting the frequency of retouched tools in an assemblage against its total lithic artifact volumetric density, defined as the quantity of chipped stone per cubic meter of sediment from which the assemblage was derived under conditions of similar depositional rates and archaeological recovery methods. The resulting relationship is predicted to be negative; assemblages with high frequencies of retouched pieces will tend to have comparatively low densities of artifacts while, in contrast, assemblages with low amounts of retouch will have higher densities. This pattern, we argue, reflects accumulated artifacts deriving from primarily curated to primarily expedient artifact use respectively. These differences are best distinguished when all the assemblages from a site or a series of sites are plotted on the same graph, and both axes are expressed as log scales (see figure 1). It is important to emphasize that we are not here arguing that the terms "expedient" and "curated" reflect individual site-occupation events. Rather, in an archaeological context, these labels refer to time-averaged suites of strategies resulting from a palimpsest of occupations, the predominant character of which will dominate the signature of a given archaeological assemblage.

Expedient assemblages often accumulate at intensively occupied sites, where raw material was *effectively abundant* as a result of any combination of natural availability, stockpiling and/or other behavioral mechanisms. Curated assemblages, in contrast, more commonly derive from relatively short occupations of a site under conditions of raw material *effective scarcity,* due either to natural unavailability or to behavioral mechanisms, such as high mobility, that restrict raw material use.

These characteristics of assemblages also can be linked to the prevalent land-use strategy employed by the hunter-gatherer groups responsible for their manufacture, use, maintenance and deposition as originally defined by Binford (1979, 1980; see also Nelson 1991). Expedient assemblages are often a consequence of logistical mobility, whereby a central site is occupied for prolonged periods of time while task-groups come and go from it to procure various non-local resources. In contrast, curated assemblages are by and large expected in cases of residential mobility whereby a group of hunter-gatherers moved their home base camp frequently to go from resource patch to resource patch and artifact portability is important.

Thus, it becomes possible to link lithic assemblages to generalized patterns of land-use and landscape exploitation. Importantly, since this analytical method does not depend on typologies specific to either Middle or Upper Paleolithic assemblages, it enables the comparison of behavioral modalities across time and space. In the context of Transition research, it therefore provides a powerful methodological tool to assess whether the makers of different industries appear to have exploited their landscapes differently, or whether they display comparable ranges of behavioral flexibility. As will be discussed below, the dominance of one or the other mode in given technocomplexes may also have significant implications about how 'behavioral modernity' may be defined as based on lithic assemblages.

This method addresses questions related to the use-life of lithic assemblages and to landscape-use; it provides no information about the typological or technological make-up of given assemblages. Our approach is not designed to answer all the questions pertaining to lithics in the context of the Transition. What it does allow, however, is the direct comparison of assemblages argued on technotypological grounds to be different. This therefore enables researchers to address questions which traditional typotechnological systematics simply are not suited to tackle, such as the potential behavioral connotations of technotypological differences.

As we have previously noted (i.e., Barton 1998, Riel-Salvatore & Barton 2004), sedimentation rates and diagenesis can influence the results obtained through this approach. Fine-grained chronological data can provide estimates of deposition rates for given assemblages, while sedimentary analysis can indicate the effects of postdepositional forces on artifact counts and sediment volume. Such information significantly helps to clarify the original depositional regime under which an assemblage entered the archaeological record (Karkanas et al. 2001, Weiner et al. 2002). In the absence of such information, the inferences drawn from our method can be admittedly tentative in cases where non-cultural depositional processes appear to have varied across assemblages. This further emphasizes the need for careful geoarcheological studies in contemporary prehistoric research of all sorts. However, deviation from expected patterning can equally serve to identify contexts of variable depositional and postdepositional processes.

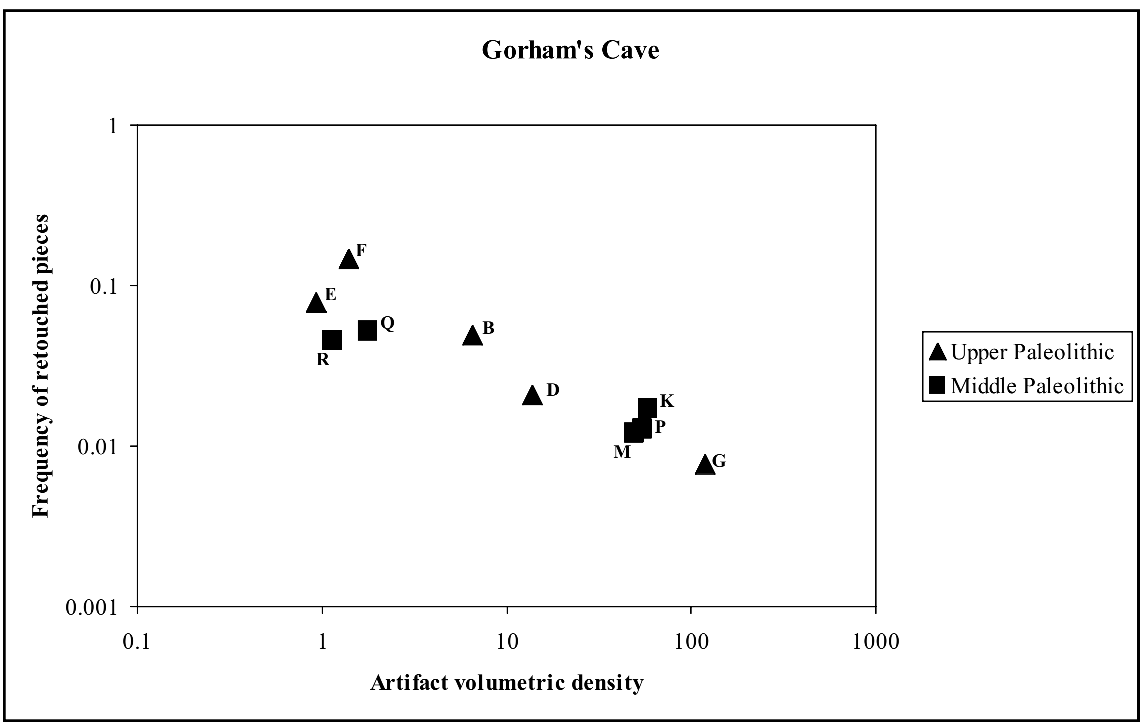
Case Studies

The case studies used in this paper extend around the western and northern margins of the Mediterranean Sea: Gibraltar, eastern Spain, and southeastern Italy. Because these sites are distributed over a wide area, they permit us to test this method beyond the influence of local conditions on Late Pleistocene technological behavior. As well, each of the three regions contains several techno-complexes, including the Mousterian, the Aurignacian, and the Uluzzian in the case of southeastern Italy. This offers the potential to take an interregional view of the process of the Middle–Upper Paleolithic Transition and to highlight its common aspects as well as its regional peculiarities.

1. Gibraltar

The site of Gorham's Cave is located on the Gibraltar peninsula and has a long history of research. The results of our analysis are based on a sample of the material from Waechter's original excavations at the site between 1948 and 1954, reported in detail by Barton (1988). Our model was applied first to the Gorham's Cave assemblages and they closely match its expectations (figure 1). The data suggest that Mousterian occupations at Gorham's Cave did not conform to a single land-use modality. Rather they show that site-use varied, suggesting possible shifts in overall land-use strategy, with the site alternating between a ephemeral residential site and a 'home base' from which logistical forays were conducted to procure other resources. Layers G, K, M and P appear to represent a prolonged use of the site as a 'home base' reflected by higher densities of artifacts and lower frequencies of retouched pieces, indicating that the site likely was provisioned with

Fig. 6.1. Graphical depiction of patterns for Paleolithic assemblages form Gorham's Cave, predicting a negative relationship (r = -.924, p = 0.000, N = 10) between artifact volumetric density and frequency of retouched pieces, along with associated technological strategies (after Barton 1998).

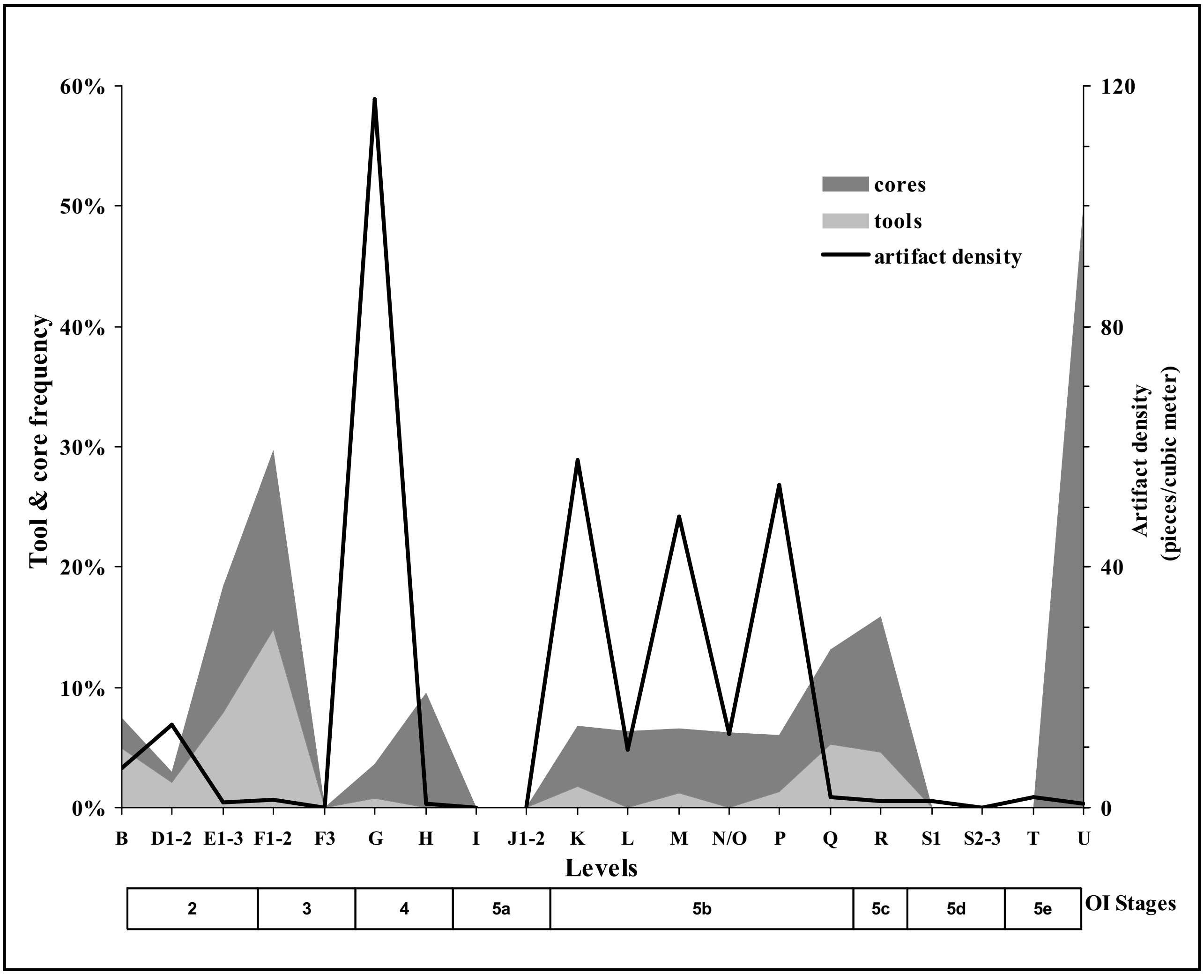


raw material and that expedient lithic production was the dominant strategy at the site. In contrast, layers Q and R document more intensive use of lithic resources, resulting in lower artifact densities and higher frequency of retouch. These assemblages probably reflect the use of Gorham's Cave as short-term residential sites by highly mobile foragers who discarded exhausted (i.e., highly retouched) components of their lithic assemblages. Based on currently available data, it is difficult to assess whether layers Q and R could reflect repeated use of the site as specialized activity area (cf. Riel-Salvatore & Barton 2004:259).

In light of a replacement model which often predicts large-scale discontinuities in land-use patterns between the Middle and Early Upper Paleolithic (e.g., Bar-Yosef 2002, Mellars 1996), it is striking that the upper levels of Gorham's Cave provide clear evidence of the continuation of this alternation in site occupation modality during the Upper Paleolithic. For this time period, layers B and D appear to document more prolonged use of the site with a concomitant increased reliance on expedient lithic technology while layers E and F document short-term site occupations with discard of more curated material. Also of interest is that there appears to be no unilineal trend in the adoption of one or the other strategy during the Upper Paleolithic. Again, currently available data make it hard to assess whether layers E and F reflect specialized activity or short-term residential occupations.

Thus, it cannot be excluded that curated Upper Paleolithic assemblages represent special activity occupations by logistical task groups in contrast to Mousterian short-term residential occupations (or vice-versa). An examination of paleoclimatic data, however, indicates a potential common thread linking Middle and Upper Paleolithic curated assemblages from Gorham's Cave. Figure 2 shows that expedient assemblages for both periods correspond to

Fig. 6.2. The correlation between OIS-scale climatic fluctuations and the density of lithic artifacts and incidence of cores and retouched tools in the Gorham's Cave assemblages (after Barton 1998).



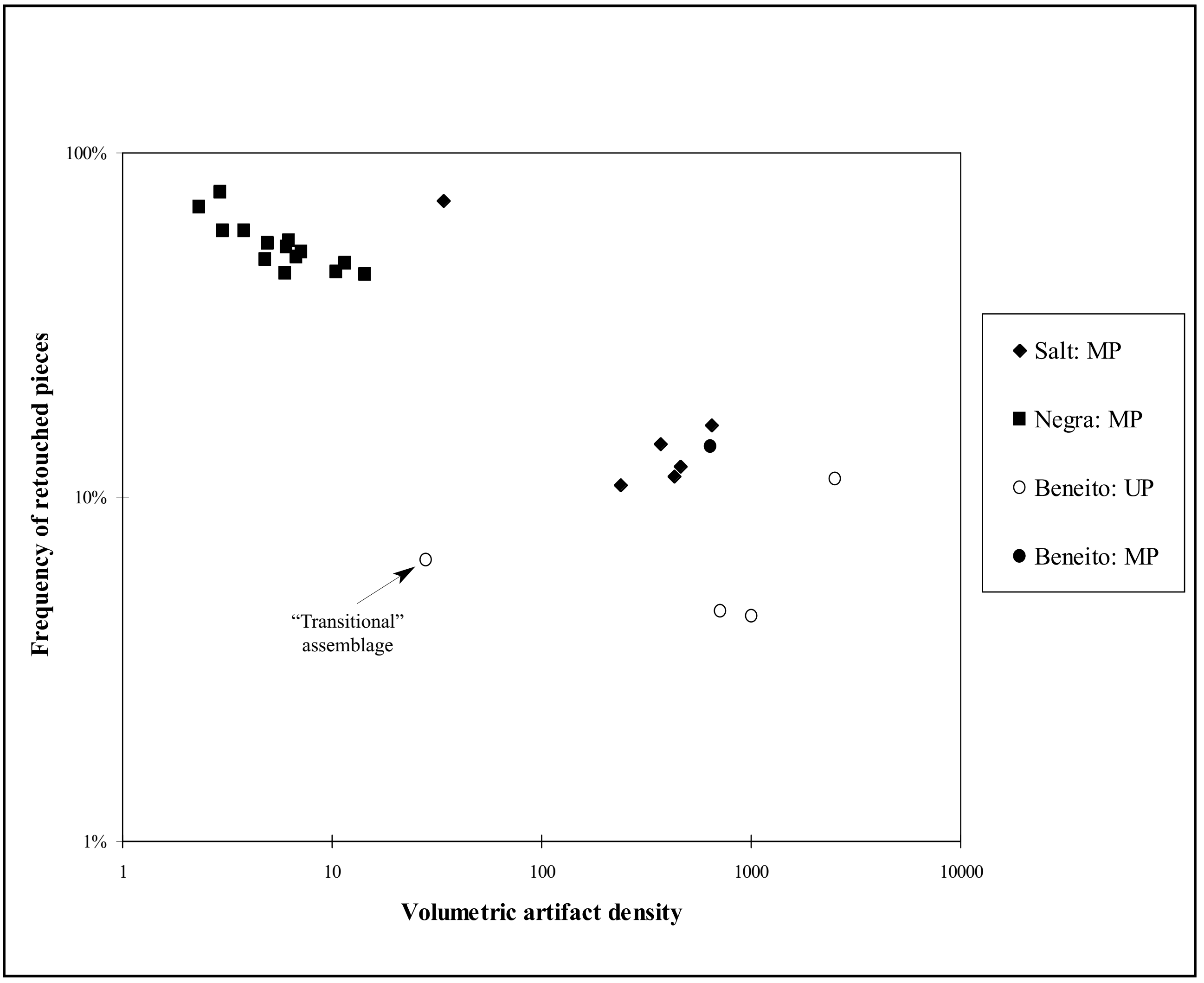
phases of climatic deterioration, while curated assemblages indicate milder climatic conditions. This suggests that, in both periods, the cave's human occupants had very similar land-use patterns which emphasized use of the site as a home-base from which logistical forays could be organized during colder periods, while warmer periods saw an increase in mobility reflected by the use of the site as an ephemeral (and probably repeatedly used) residential site.

It would be quite interesting to see whether these conclusions, based on material from the original excavations at Gorham's Cave (Waechter 1951, 1964), find support in the data resulting from the recent, multidisciplinary reexcavation of the site (see papers in Stringer et al. 2000), but the complementary and self-reinforcing conclusions drawn from lithic technology and paleoenvironmental reconstruction do suggest that we are dealing with robust, meaningful patterns at Gorham's Cave.

2. Valencia, eastern Spain

Northwest of Gibraltar along the Mediterranean coast are three Late Pleistocene sites in the region of Valencia, in southeastern Spain: the Mousterian sites of Cova Negra and Cova del Salt, and the Middle–Upper Paleolithic site of Cova Beneito (figure 3). The Mousterian of Cova Negra adheres closely to the theoretical expectations of our model (r = -.851), with low volumetric artifact densities (2–14 artifacts/m^3) and high retouch frequencies (44–77%). While these patterns have previously been interpreted as reflecting increased artifact curation due to exhaustion of local lithic resources over the course of long occupations (e.g., Barton 1988, 1990; Villaverde 1984), the methodology used here suggests rather that, during the Mousterian, the site was used for short periods during which mainly exhausted lithics were discarded (Villaverde et al. 1998:146). The interpretation of the Cova Negra

Fig. 6.3. The relationship between absolute artifact density and frequency of retouched pieces for Paleolithic assemblages from eastern Spain (after Villaverde et al. 1998).



Mousterian layers as the results of short-lived occupations is further supported by the site's faunal assemblages. Microfauna indicate that the site was occupied by bats and raptors that accumulated lagomorphs bearing no traces of human processing (Villaverde et al. 1996) while most gnaw marks on the remains of medium-sized ungulates (mainly ibex and thar) suggest that wolves and dholes were responsible for their accumulation at the site (Villaverde 1984). Humans appear to be mainly responsible for the accumulation of large herbivore remains found at the site, however, indicating alternating use of the site by human and non-human carnivores, which strengthens the interpretation of the site as being ephemerally occupied by Mousterian toolmakers. While it is difficult at present to establish whether the Cova Negra assemblages represent residential as opposed to specific-activity occupations, studies of artifact assemblage richness combined with microwear studies would likely yield useful information in that regard (see Kuhn 1989).

Overall, the Cova Negra material also indicates a consistent use of the site in Mousterian times, which differs from the shifting land-use pattern identified at Gorham's Cave. This is all the more striking in light of the patterns documented by the material from Cova Beneito and Cova del Salt (figure 3). In stark opposition to the Cova Negra pattern, the chipped stone assemblages from the Mousterian levels of those two sites (with the exception of one layer from Cova del Salt) attest mainly to an expedient technological strategy that can be referred to a use of those sites as home bases in Mousterian times. While it is impossible to determine whether the single Mousterian assemblage from Cova Beneito fits our model's theoretical expectations, the material from Cova del Salt agrees with them closely (r = -.893).

Studies of the sedimentary history at Cova del Salt and Cova Negra (i.e., Barton 1988, Barton & Clark 1993) indicate that the significant difference in artifact densities at the two sites is not merely the result of differences in sedimentation rates and depositional environments. This warrants the possible interpretation that the sites served different functions within a broader regional land-use system used by Neanderthals in the region, especially in light of their probable contemporaneity (Barton 1988). Barton (1990) has proposed that altitudinal differences between the two sites might be a significant dimension to explain the variability displayed in their lithic assemblages: While Cova del Salt and Cova Beneito are upland sites, Cova Negra lies under 150 m asl. in a coastal setting *sensu lato.* Cova del Salt and Cova Beneito are also located at ecotones at the edge of the valleys onto which they open, endowing them with strategic positions from which to coordinate activities such as the tracking and logistical exploitation of migrating herds of animals in the valley below and the procurement of other resources in the neighboring highlands. Given this, it is tempting to hypothesize that these sites might have formed a single socio-ecosystem in which Cova Negra—located slightly over 30 km away—could be interpreted as a site visited during targeted resource exploitation forays. The sedimentary studies mentioned above suggest the possibility of comparing retouch frequencies and artifact densities for the assemblages of all on a single graph (figure. 3). The resulting pattern conforms almost perfectly to the model's expectation (r = -.937) while nonetheless clearly distinguishing between the ephemeral and long-term occupations. This reinforces the impression that these sites might well have articulated together within a single land-use system that can be defined as broadly logistical.

Shifting our attention to the Upper Paleolithic sequence of Cova Beneito, all the pertinent assemblages show lower frequencies of retouch and higher artifact densities than the does the site's Mousterian assemblage (see also Iturbe et al. 1993). This suggests that the site was used for longer periods during the Upper Paleolithic, in agreement with a pattern of generalized forager mobility in Mediterranean Spain during that period (Villaverde et al. 1998). This interpretation is also corroborated by the faunal record, which is dominated by the remains of lagomorphs and locally available medium-sized ungulates (especially ibex), many of which bear traces of human modification (Villaverde et al. 1996). This depart from the Mousterian pattern at the site where human modification is concentrated on the bones of large-bodied ungulates (horse, aurochs) and infrequent on lagomorph remains (Iturbe et al. 1993). Thus, lithic data complement faunal data to indicate that the earliest Upper Paleolithic of the region witnessed a shift towards decreasing mobility and increased exploitation of more immediately available resources than was the case during the preceding Mousterian (Villaverde et al. 1998). However, Cova Beneito is only one site and there are no other excavated sites of the same age in its vicinity. It is possible that additional Upper Paleolithic sites might show a similar range of occupational patterns seen in the Middle Paleolithic assemblages of Cova del Salt and Cova Negra. The site from southern Italy, discussed below, provide such data.

The alleged "transitional" assemblage at Beneito reported by Iturbe et al. (1993) is also interesting in the context of using a whole assemblage analysis approach to investigate the Transition. This assemblage was originally argued to document the transition between Middle and Upper Paleolithic but has recently been shown to be the result of mixing of the Mousterian and Aurignacian assemblages that sandwich it (Domenèch Faus 2004). For this reason, it has been omitted from this study (in terms of deriving r-values for the site as a whole), although it was discussed in an earlier publication that used the method presented here to interpret it as representing only "sporadic occupation of the site" (i.e., Villaverde et al. 1998:148). Interestingly, that study also unambiguously showed that assemblage as departing from the expected pattern based on overall sedimentation rates at the site (see Villaverde et al. 1998: figure 5). That this problematic assemblage is reported by Domenèch Faus (2004) to be the result of post-depositional taphonomic processes demonstrates our methodology's potential usefulness as a tool to investigate site formation processes (see Riel-Salvatore & Barton 2004), since it had clearly highlighted that this assemblage as a depositional "odd man out" in the earlier study.

3. Salento, southeastern Italy

In order to further test the applicability of our methodology and to stress its usefulness in highlighting behavioral patterns that can help clarify our understanding of the Transition, we also applied it to a series of eight cave and rockshelter sites located on the western coast of the Salento peninsula in southeastern Italy (for a full discussion, see Riel-Salvatore & Barton 2004). An important criterion for site selection was the presence of a well-implanted 'transitional' industry in the region—the Uluzzian—along with Mousterian, proto-Aurignacian and Epigravettian levels, as well as the close geographical clustering of the sites and their comparable depositional settings that, despite the absence of detailed sedimentary studies, nonetheless allows for more or less direct comparisons of their deposits.

Figure 4 presents the results of this effort. Broadly speaking, most sites display a general adherence to the expectations of the model, although the *r*-values tend to be low. While this may be in part the result of the problems inherent in estimating excavated volumes from published reports, it is interesting to note that in most cases this rather appears to be due to the presence of one or a few anomalous assemblages within a site's sequence. As suggested by Barton (1998) in the case of Gorham's Cave, the position of these assemblages may reflect sedimentary vagaries rather than the result of long-term patterned human behavior, though the available published data does not allow us to satisfactorily resolve the question at this time.

Another factor likely to be of greater importance in explaining these patterns in the specific case of these assemblages from the coastal Salento is raw material availability. Milliken (1998, 2000) has argued that the Salento does not contain sources of fine-grained siliceous material, although Bietti and Negrino (this volume; see also Richetti & Pieri 1999: figs 10 & 11) use geological reports to suggest that the region likely contains some outcrops of good-quality cryptocrystalline rock. Nonetheless, while there may be some outcrops of usable lithotypes in the Salento, none are currently known in the immediate vicinity of the cluster of eight sites. Cryptocrystalline raw material therefore probably should not be considered "local" in the sense usually attributed to it in most studies of lithic procurement (e.g., Féblot-Augustins 1997). As such, the pattern of raw material utilization is quite striking, in that non-local (and perhaps even exotic, according to Milliken) lithotypes appear to have been systematically targeted for retouch and resharpening (Palma di Cesnola 1996).

Multiple scenarios can be invoked to explain the presence of distinct types of raw materials within archaeological lithic assemblages, most of which suggest that non-local stone was procured and maintained differentially from local lithotypes (see Riel-Salvatore & Barton 2004:265). For this reason, it may be useful to separate given assemblages into their local and non-local components to better reconstruct patterns of prehistoric technological behavior. Doing so for the four sites for which the published information is adequate results in their assemblages displaying a very strong adherence to the predicted negative relationship between retouch frequency and lithic artifact volumetric density predicted by our model (figure 5). These results suggest two main observations. First, and unsurprisingly, it is important to account for raw material variability in whole assemblage analyses of prehistoric assemblages. Second, it appears that the Mousterian and Uluzzian display equally flexible technoeconomic strategies involving both residential and logistical land-use patterns. It is, however, important to note that fine-grained, non-local material represents a commodity embedded in the context of time-specific procurement systems and that it was not necessarily always heavily curated simply *because* it is non-local. For instance, in the Epigravettian assemblages from our sample, flint is the dominant—and some times the only—exploited lithotype. Despite this, these assemblages show expedient management strategies, suggesting that non-local material had become effectively abundant after the LGM (see also Milliken 1998).

It is also possible to make somewhat more subjective observations about some of the sites for which information about raw material was insufficient to subdivide the assemblages into distinct components. For instance, at Serra Cicora A, where a full "transitional" sequence is found, studying the Uluzzian and proto-Aurignacian assemblages separately reveals an extremely strong adherence to the pattern predicted by the model, even in the absence of raw material differentiation ($r = -.991$, $p = .009$, N = 4). Spennato (1981) reports that limestone is abundant throughout the sequence, but that it only dominates in the lowermost Uluzzian assemblage from layer D. Despite this, that assemblage is tightly clustered with the proto-Aurignacian ones from layers A and B, all of which are more curated than the upper Uluzzian from layer C which documents a more expedient strategy. The Salento assemblages demonstrate that, over the course of the Early Upper Paleolithic in southern Italy, we cannot speak of a simple unidirectional switch from expedient to curated technoeconomic

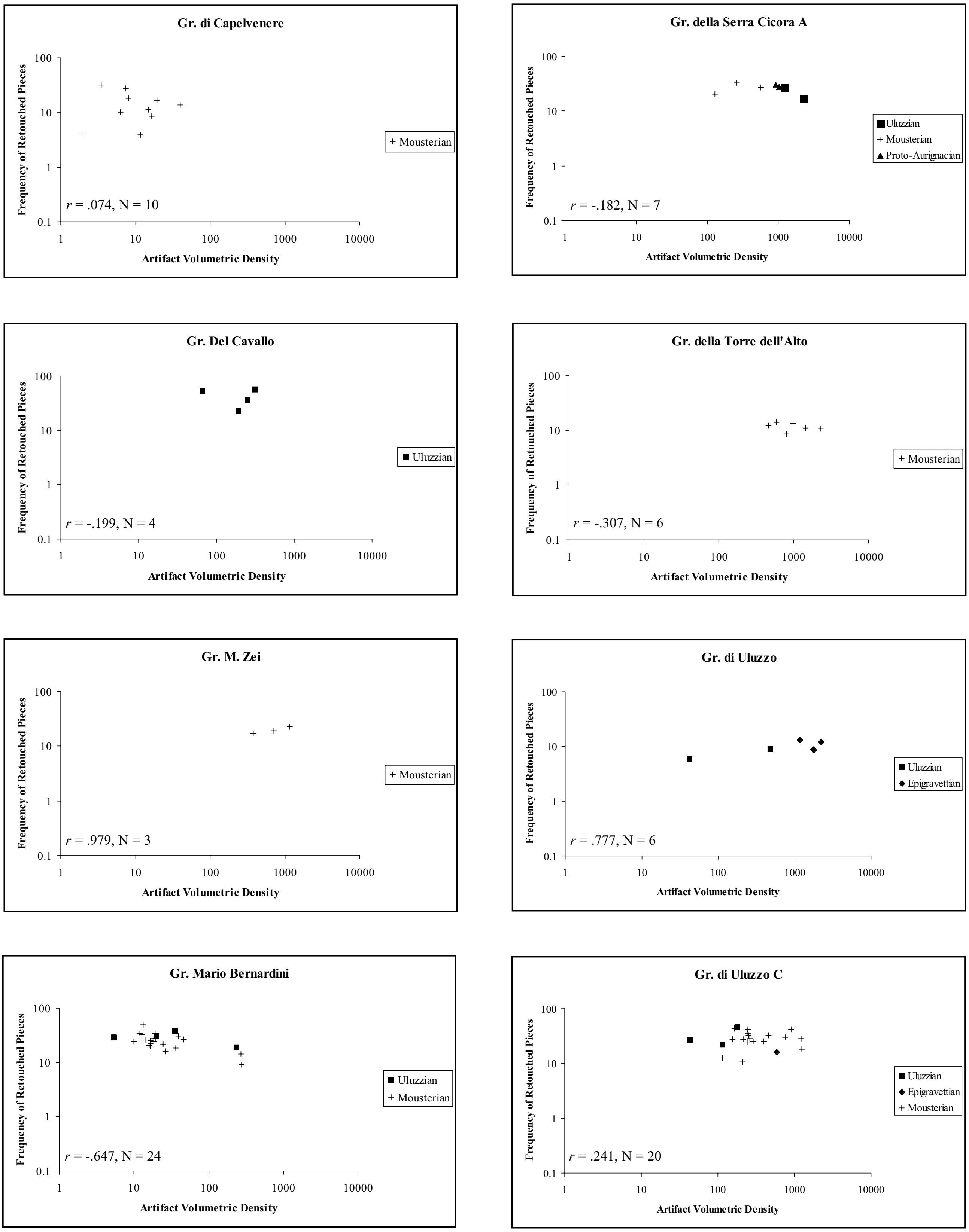


Fig. 6.4. The relationship between absolute artifact density and frequency of retouched pieces for the eight sites from the Salento (after Riel-Salvatore and Barton 2004).

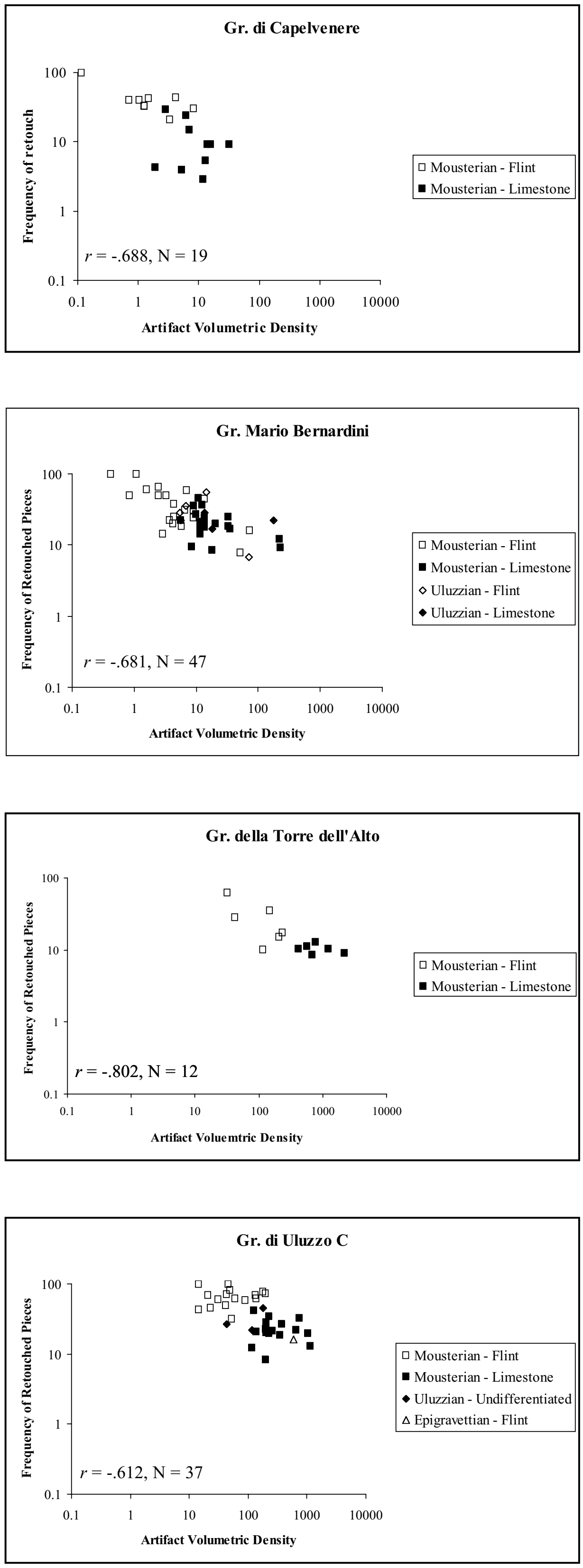


Fig. 6.5. The relationship between absolute artifact density and frequency of retouched pieces after differentiating between flint (i.e., high quality raw material) and limestone (i.e., low quality raw material) sub-assemblages, for the four sites from the Salento for which adequate information is available.

strategies. This analysis offers researchers a more nuanced perspective on the variability of behavioral systems at that time, one which must incorporate detailed discussions of the context for the adoption of alternative adaptive modes.

The linkages between assemblage composition and human ecology also provide the basis for a new interpretation of lithic variability within the transitional Uluzzian industry. Because of its relatively crude tools and reliance on large amounts of local siliceous limestone, the expedient Uluzzian assemblage of Grotta Mario Bernardini (i.e., layer A-IV) has been interpreted as representing an "archaic" phase of that technocomplex, as defined by Palma di Cesnola (1966, 1967, 1989, 1993). In contrast, the "evolved" and "final" phases of the Uluzzian are characterized by a lesser dependence on local lithotypes and by a more refined tool typology, something which Palma di Cesnola (1993) has interpreted as a gradual evolution of the Uluzzian through time marked by increasing technotypological "refinement." The whole assemblage analysis approach used here, however, interprets the site's "final" Uluzzian assemblage (i.e., layer A-I-II) as reflecting a comparatively curated technological organization. Here, we would argue that the various "phases" of the Uluzzian probably represent different land-use strategies used by its makers, imbuing Palma di Cesnola's keen observation of differences within the Uluzzian with behavioral as opposed to 'evolutionary' meaning. This perspective also has the advantage of accounting for disparities in the placement of various Uluzzian assemblages in an "evolutionary" framework, for instance as at Serra Cicora A where the most expedient Uluzzian assemblage is not the lowermost one (Spennato 1981, Palma di Cesnola 1989, 1993). It also provides an explanation for why Palma di Cesnola's evolutionary sequence does not seem to apply to stratified Uluzzian assemblages outside of the Salento, since little attention has been paid to the behavioral significance of varying retouch frequencies and of shifting modalities of raw material use. The whole assemblage analysis approach also allows the incorporation of assemblages with too few tools to permit a secure typological attribution (e.g., Grotta Mario Bernardini, layer A-II) into broader models of behavioral variability within the Uluzzian in this particular case, and prehistoric assemblages more generally.

Discussion and Conclusions

This overview of work conducted in three distinct regions of the northern Mediterranean offers new insights about the Transition. On a methodological level, the whole assemblage analysis approach used here and in other papers (i.e., Barton 1998; Riel-Salvatore & Barton 2004; Villaverde et al. 1998) permits us to directly compare assemblages assigned to different technocomplexes and otherwise analyzed using distinct typological systems. Doing so reveals that, across a broad geographic area, the Mousterian evidences a considerable range of technoeconomic flexibility and of concomitant land-use strategies. This is equivalent to the range of behavioral flexibility apparent in industries largely thought to have been manufactured by modern humans from Gibraltar, eastern Spain and the Salento. Perhaps most interesting in the context of a discussion of "transitional" behavioral dynamics is that the makers of a transitional industry (the Uluzzian) employ the range of land-use and associated lithic management strategies seen in the Middle and Upper Paleolithic but do not show trends toward any particular strategy. The ultimate impetus behind these shifts remain to be fully elucidated, but paleoenvironmental data from Gorham's Cave suggest that changes in ecological conditions or climatic regimes might have been major catalysts of behavioral dynamics throughout the Late Pleistocene (Barton 1998).

This study joins a growing body of work (e.g., Grayson & Cole 1998, Simek & Price 1990) in establishing that the use a single framework to study lithic assemblages across the Transition interval usually does not bear out the differences implicitly embedded in typological systematics. As a result, we would argue that a large part of the distinction between the Middle and Early Upper Paleolithic in Eurasia may itself be an artifact of different typologies traditionally having been used to characterize lithic variation across this analytical boundary (see also Barton et al. 1996; Riel-Salvatore & Clark 2001, this volume). As suggested by the results from the Salento and studies based on other lines of evidence (e.g., art [Barton et al. 1994]), the most significant changes in land-use strategies in Eurasia seem to coincide with the LGM, some 20–25,000 years *after* the Transition. There is no question that sometime between 45–25 kya, Neanderthals as a distinct morphological population disappeared from Eurasia (Trinkaus 2005, Wolpoff et al. 2004). However, the disjunction between this process and some of the fundamental ecological and economic adaptations that might best account for it forces us to recast the questions we should be asking about the Transitions itself. In fact, we would argue that before attempting to delineate the exact process by which 'modernity' spread across Eurasia, it might be more illuminating to figure out what were the precise selective forces that would have driven such a spread (Riel-Salvatore & Barton 2004:269). Only thus will we truly be able to tackle an evolutionary problem using appropriate conceptual frameworks that adequately direct inquiry rather than simply applying an evolutionary veneer to the inductive pattern searches that still characterize much paleoanthropological research (e.g., Mellars 2004, 2005).

In sum, the data presented in this paper suggests that, in terms of the organizational strategies employed to create lithic assemblages, the Neanderthals responsible for manufacturing Mousterian and Uluzzian assemblages were able to adapt their technological responses to changing local conditions to a degree comparable to that of the makers of the Upper Paleolithic, often assumed to be behaviorally and morphologically modern humans. Along with other lines of evidence for 'modern' Neanderthal behavior such as fully efficient large-game hunting (e.g., Marean & Kim 1998, Marean & Assefa 1999) and symbolic behavior (e.g., d'Errico 2003), this observation contradicts the widespread assumption that the two hominin populations were somehow behaviorally unequal (e.g., Bar-Yosef 2002, 2003; Mellars 2004, 2005). We certainly do not pretend that there was no behavioral change over the course of the Late Pleistocene or over the 50–30 kya interval, for that matter. However, while novel behaviors are certainly noteworthy topics of investigation, we advocate that they can only be fully understood when studied in the broader adaptive context within which they emerge. That this context, over the Transition interval, is largely unchanging is, to us, just as important to explain (if not more!) as is the nature of any behavioral changes that did manifest themselves at that time.

The methodology employed in this study offers the potential to directly and objectively compare Middle Paleolithic, "transitional" and Upper Paleolithic assemblages within a single, unified conceptual framework that sheds light on the behavior of the hominins responsible for their manufacture. Its simplicity makes it easily applicable across a large range of archaeological contexts, and we are heartened to see that others who have employed it (e.g., Sandgathe 2005) have found it a provocatively informative source of information on Paleolithic lifeways. As we have shown, this approach also has the advantage of helping to monitor depositional regimes and even offers an alternative explanation to putative pseudo-evolutionary trends within a single techno-complex, which are an integral part of most traditional typological classificatory schemes. The results of applying this common analytical framework to a dozen sites from the northern Mediterranean also strongly suggests a pronounced disconnect between the biological and behavioral aspects of the Transition, thus enabling us to redirect the attention of researchers away from painstaking description of the archaeological manifestations of the Transition and towards the nature of the link between the two kinds of change, behavioral and morphological. As such, this study offers new avenues to explore (and new ways to re-explore old ones) in the ongoing effort to better understand this fascinating segment of recent human evolution.

Acknowledgments

We would like to thank Geoff Clark and Frank Harrold for constructive comments on the version of this paper presented in the original SAA symposium from which this volume derives. Our understanding of the Uluzzian has greatly benefited from discussions with Amilcare Bietti, Paolo Gambassini and Fabio Negrino. Support for Riel-Salvatore during this research was provided in part by the Social Sciences and Humanities Research Council of Canada.

References

Barton, C. M.
1988 *Lithic variability and Middle Paleolithic behaviour. New evidence from the Iberian Peninsula.* BAR International Series, 408, Oxbow Press, Oxford.
1990 Stone tools and Paleolithic settlement in the Iberian peninsula. *Proceedings of the Prehistoric Society* 56: 15–32.
1998 Looking back from the world's end: Paleolithic settlement and mobility at Gibraltar. In *Las culturas del Pleistoceno superior en Andalucía* (J. L. Sanchidrián Torti & M. D. Simón Vallejo, eds.), pp. 13–22. Patronato de la Cueva de Nerja, Cordoba, Spain.

Barton, C. M., & G. A. Clark
1993 Cultural and natural formation processes in late Quaternary cave and rockshelter sites of western Europe and the Near East. In *Formation Processes in Archaeological Context,* (P. Goldberg, D. T. Nash, & M. D. Petraglia, eds.), pp. 33–52. Prehistory Press, Madison.

Barton, C. M., G. A. Clark, & A. E. Cohen
1994 Art as information: Upper Palaeolithic art in Western Europe. *World Archaeology* 26:185–207.

Bar-Yosef, O.
2002 The Upper Paleolithic revolution. *Annual Review of Anthropology* 31:363–393.
2003 Reflections on selected issues of the Upper Paleolithic. In *More than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East* (A. N. Goring-Morris & A. Belfer-Cohen, eds.), pp. 265–273. Oxbow Books, Oxford.

Bar-Yosef, O., & D. Pilbeam (editors)
2000 *The Geography of Neanderthals and Modern Humans in Europe and the Greater Mediterranean.* Peabody Museum Bulletins, Harvard University Press, Cambridge.

Binford, L. R.
1979 Organization and formation processes: looking at curated technologies. *Journal of Anthropological Research* 35:255–273.
1980 Willow's smoke and dogs' tails: hunter-gatherer settlement systems and archaeological site formation. *American Antiquity* 45:4–20.

Brantingham, P. J., S. L. Kuhn, & K. W. Kerry (eds.)
2004a *The Early Upper Paleolithic Beyond Western Europe.* University of California Press, Berkeley.
2004b The Early Upper Paleolithic and modern human behavior. In *The Early Upper Paleolithic Beyond Western Europe* (P. J. Brantingham, S. L. Kuhn, & K. W. Kerry, eds.), pp. 242–248. University of California Press, Berkeley.

Clark, G. A., & J. Riel-Salvatore
2006 Observations on systematics in paleolithic archaeology. In *Transitions Before the Transition: Evolution and Stability in the Middle Paleolithic and Middle Stone Age* (E. Hovers & S. Kuhn, eds.), pp. 29–56. Springer, New York.

d'Errico F.
2003 The invisible frontier: A multiple species model for the origin of behavioral modernity. *Evolutionary Anthropology* 12:188–202.

Domenèch Faus, E.
2004 Le Paléolithique moyen et supérieur dans le Levant espagnol: la séquence de La Cova Beneito (Muro, Alicante, Espagne). In *Acts of the XIVth UISPP Congress, University of Liège, Belgium, 2–8 September 2001, Section 6: Le Paléolithique Supérieur/The Upper Palaeolithic, General sessions and posters* (eds.), pp. British Archaeological Reports no. 1240. Archaeopress, Oxford.

Féblot-Augustins, J.
1997 *La circulation des matières premières au Paléolithique.* ERAUL 75, Liège.

Grayson, D. K., & S. C. Cole
1998 Stone tool assemblage richness during the Middle and Early Upper Palaeolithic in France.

Journal of Archaeological Science 25:927–938.

Hays, M. A., & P. T. Thacker (editors)
2001 *Questioning the Answers: Re-Solving Fundamental Problems of the Early Upper Paleolithic.* British Archaeological Reports 1005. Archaeopress, Oxford.

Iturbe, G., M.P. Fumanal, J.S. Carrion, E. Cortell, R. Martinez, R. M. Guillem, M. D. Garralda, & B. Vandermeersch
1993 Cova Beneito (Muro, Alicante): una perspective interdisciplinar. *Recerques del Museu d'Alcoi* 2: 23–88.

Karkanas, P., O. Bar-Yosef, P. Goldberg, & S. Weiner
2000 Diagenesis in prehistoric caves: the use of minerals that form in situ to assess the completeness of the archaeological record. *Journal of Archaeological Science* 27:915–929.

Kuhn, S. L.
1989 Hunter-gatherer foraging organization and strategies of artifact replacement and discard. In *Experiments in Lithic Technology* (D. S. Amick & R. P. Mauldin, eds.), pp. 33–48. British Archaeological Reports, 528. BAR International Series, Oxford.

Marean, C. W., & S. Y. Kim
1998 The Mousterian faunal remains from Kobeh Cave: Behavioral implications for Neanderthals and early modern humans. *Current Anthropology* 39:S79–S114.

Marean, C. W., & Z. Assefa
1999 Zooarchaeological evidence for Neandertal and Early Modern Human faunal exploitation. *Evolutionary Anthropology* 8:22–37.

Marks, A. E., H. J. Hietala, & J. K. Williams
2001 Tool standardization in the Middle and Upper Paleolithic: a closer look. *Cambridge Archaeological Journal* 11:17–44.

Mellars, P.
2004 Neanderthals and the modern human colonization of Europe. *Nature* 432:461–465.
2005 The impossible coincidence: a single-species model for the origins of modern human behavior in Europe. *Evolutionary Anthropology* 12: 12–27.

Milliken, S.
1998 Hunter-gatherer land use in Late Glacial southern Italy. *Oxford Journal of Archaeology* 17:269–286.
2000 The Neanderthals in Italy. *Accordia Research Papers* 8:11–82.

Nelson, M. C.
1991 The study of technological organization. *Archaeological Method and Theory* 3:57–100.

Palma di Cesnola, A.
1966 Il Paleolitico Superiore Arcaico (Facies Uluzziana) della Grotta del Cavallo, Lecce. *Rivista di Scienze Preistoriche* 20:33–62.
1967 Il Paleolitico Superiore Arcaico (Facies Uluzziana) della Grotta del Cavallo, Lecce. (Continuazione). *Rivista di Scienze Preistoriche* 21:3–59.
1989 L'Uluzzien—Facies Italien du Leptolithique Archaïque. *L'Anthropologie* 93:783–812.
1993 *Il Paleolitico Superiore in Italia: Introduzione allo Studio.* Garlatti e Razzai Editori, Florence.
1996 *Le Paléolithique Inférieur et Moyen en Italie.* Jérôme Million, Grenoble.

Richetti, , G., & P. Pieri (editors)
1999 *Guide GeologicheRegionali 9: Itinerari Puglia e Monte Vulture, Prima Parte.* BE-MA Editrice, Rome.

Riel-Salvatore, J., & G. A. Clark
2001 Grave markers: Middle and Early Upper Paleolithic burials and the use of chronotypology in contemporary Paleolithic research. *Current Anthropology* 42:449–481.

Riel-Salvatore, J., & C. M. Barton
2004 Late Pleistocene technology, economic behavior and land-use dynamics in southern Italy. *American Antiquity* 69:257–274.

Sandgathe, D. M.
2005 *An Analysis of the Levallois Reduction Strategy Using a Design Theory Framework.* Unpublished Ph.D. dissertation, Dept. of Archaeology, Simon Fraser University.

Simek, J. F., & H. A. Price
1990 Chronological change in Périgord lithic assemblages. In *The Emergence of Modern Humans: An Archaeological Perspective (*P. A. Mellars, ed.), pp. 243–261. Edinburgh University Press, Edinburgh.

Spennato, A. G.
1981 I livelli protoaurignaziani della Grotta di Serra Cicora (Nardò, Lecce). *Studi per l'Ecologia del Quaternario* 3:61–76.

Straus, L. G. (editor)
2005 *Armageddon or entente? The demise of the*

European Neandertals in Isotope Stage 3. Special issue of *Quaternary International* 137: 1–89.

Stringer, C. B., R. N. E. Barton, & J. C. Finlayson (editors)
2000 *Neanderthals on the Edge.* Oxbow Books, Oxford.

Trinkaus, E.
2005 Early modern humans. *Annual Review of Anthropology* 34:207–230.

Villaverde, V.
1984 *La Cova Negra de Xativa y el Musteriense de la Region Central del Mediterraneo Espanol.* Serie de Trabajos Varies, 79, Servicio de Investigaciones Prehistoricas, Valencia.

Villaverde, V., J. E. Aura, & C. M. Barton
1998 The Upper Paleolithic of Mediterranean Spain: a review of current evidence. *Journal of World Prehistory* 12:121–198.

Villaverde, V, R. Martinez-Valle, P. M. Guillem, & M. P. Fumanal
1996 Mobility and the role of small game in the Middle Paleolithic of the Central Region of the Spanish Mediterranean: A comparison of Cova Negra with other Paleolithic deposits. In *The Last Neandertals, the First Anatomically Modern Humans: A Tale About the Human Diversity. Cultural Change and Human Evolution: The Crisis at 40 KA BP* (E. Carbonell & M. Vaquero, eds.), pp. 267–288. Universitat Rovira i Virgili, Tarragona.

Waechter, J. d'A.,
1951 Excavations at Gorham's Cave, Gibraltar. *Proceedings of the Prehistoric Society* 17:83–92.

Waechter, J. d'A.
1964 The excavation of Gorham's Cave (Gibraltar): 1951–54. *Bulletin of the Institute of Archaeology* 4:189–222.

Weiner, S., P. Goldberg, & O. Bar-Yosef
2002 Three-dimensional distribution of minerals in the sediments of Hayonim Cave, Israel: diagenetic processes and archaeological implications. *Journal of Archaeological Science* 29:1289–1308.

Wolpoff, M.H., B. Mannheim, A. Mann, J. Hawks, R. Caspari, K. R. Rosenberg, D. W. Frayer, G. W. Gill, & G. A. Clark
2004 Why not the Neandertals? *World Archaeology* 36:527–546.

Zilhão, J., & F. d'Errico (editors)
2003 *The Chronology of the Aurignacian and the Transitional Technocomplexes: Dating, Stratigraphies, Cultural Implications.* Instituto Portugêse de Arqueologia, Lisbon.