# *Questions of Complexity and Scale in Explanations for Cultural Transitions in the Pleistocene: A Case Study from the Early Upper Paleolithic*

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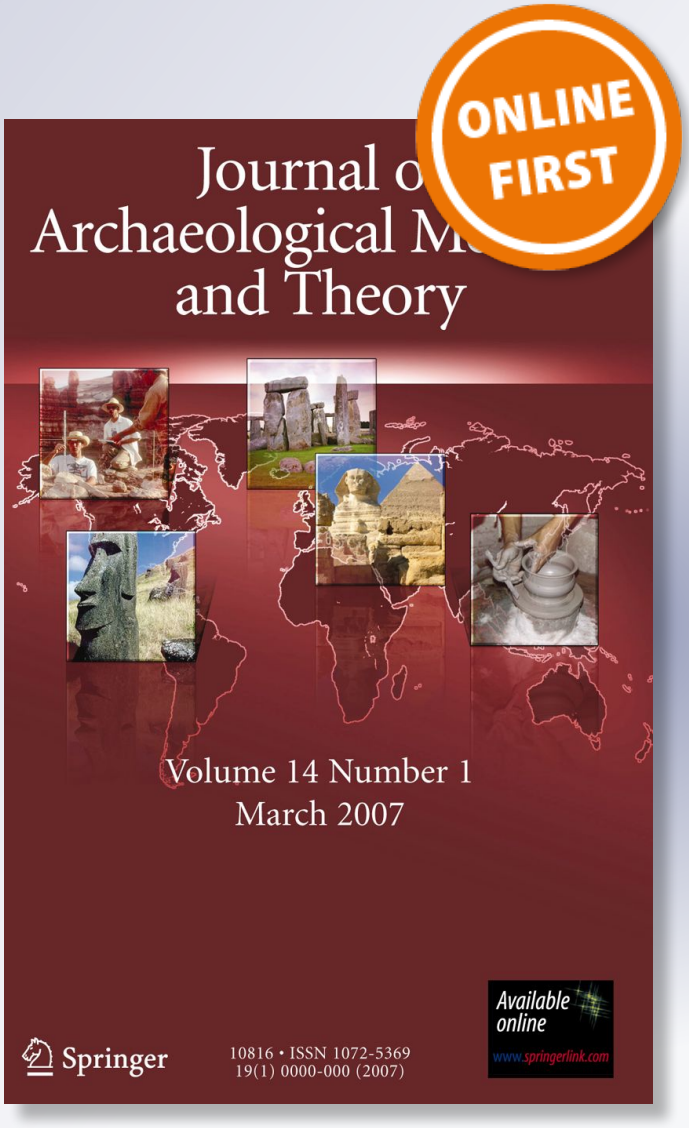


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# Questions of Complexity and Scale in Explanations for Cultural Transitions in the Pleistocene: A Case Study from the Early Upper Paleolithic

**Steven L. Kuhn**



**Abstract** Matching scales of observation and explanation is an essential challenge for archaeology, Paleolithic archaeology in particular. This paper presents a case study from the Early Upper Paleolithic (EUP) in the Eastern Mediterranean to illustrate some of the scalar issues in explaining transitions in the Pleistocene. The cultural sequence at Üçağızlı Cave I documents both continuity and change in a range of behaviors over approximately 12 ky. The sequence spans the transition from one EUP cultural unit, the Initial Upper Paleolithic (IUP) to another one, the Ahmarian. There is evidence for changes in lithic technology and retouched tool forms, human diets, and the role of the site within a regional land use system, but few if any of these changes are closely timed with the shift from one archaeological "culture" to another. In this particular case, local and regional transitions seem to be largely unconnected. However, considering the local situations allows a more precise focus on what the broader cultural transition represents and how it might be studied.

**Keywords** Upper Paleolithic · Complex systems · Emergent properties · Transitions · Scale

## Introduction

I take it as a given that there are many possible valid theoretical approaches to explaining cultural transitions in the deep (or the recent) human past. However, this does not mean that any given theory is equally applicable to any particular set of observations. As the organizers argued in the documents circulated before the

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workshop from which these papers come, it is important to match the spatial and temporal scales of theory and data. Although this may seem a commonsense notion, tension often emerges for archaeologists attempting to reconcile appropriate scales of explanation with familiar, culturally constrained forms of narrative. The field values certain kinds of explanations, and we find some kind of stories more compelling than others. This in turn may encourage us to seek causality for archaeological phenomena in dynamics that operate at inappropriate temporal or spatial scales. For example, Paleolithic archaeologists often frame accounts of Pleistocene sites at ethnographic, "lived" time scales, describing assemblages that took several generations to accumulate as representations of transitory phenomena such as base camps or hunting stations. Likewise, some advocate conceptualizing behavioral evidence "time averaged" over centuries, in terms of individual agency.

The temporal scale or scales at which we can productively view the archaeological record result in large part from the geological and human processes which created the record in the first place (*e.g.*, Holdaway and Wansnider 2006, 2008; Stern 2008; various papers in this volume). However, the scale of the record we study may be just as much a product of the units of analysis we impose on it. This is particularly apparent in attempts to explain the "big" transitions that attract so much attention. In Paleolithic research, chrono-stratigraphic and cultural units such as Acheulean, Levallois-Mousterian, Aurignacian, tend to be geographically extensive and to persist for very long periods of time. The "transitions" between them occurred across millions of square kilometers and took centuries to complete. Yet explanations of these phenomena often invoke comparatively short-term processes such as migration, diffusion, or social upheaval, that occur at the scale of lived experience.

In some respects prehistorians are handcuffed by our fascination with transitions among large-scale cultural units such as Middle and Upper Paleolithic or Aurignacian and Gravettian. There is no denying the fact that these units have long histories within the discipline, and therefore have weight and apparent consequence. However, they are also intellectual heritage. They were devised inductively by previous generations of prehistorians as cultural chrono-stratigraphic markers, and many of them are still useful as such: they were not created to help answer the questions we ask today. Understanding such large-scale phenomena is both interesting and challenging. At the same time, it remains an open question as to what sorts of cultural phenomena such widespread and persistent sets of cultural traits could represent, and how they might relate to the kinds of social, evolutionary, symbolic or adaptive dynamics that interest contemporary prehistorians. We must recognize that these analytical categories may not be particularly germane to any current theoretical program, and, conversely, that otherwise useful and exciting theory may not be helpful in understanding dynamics at this scale.

It is worth pointing out that archaeology is not alone in this quandary of shifting between different spatial and temporal scales. A seminal paper in ecology by S.A. Levin (1992) is entitled "The problem of pattern and scale in Ecology." In it, the author makes a strong case that "there is no single correct scale at which to view ecosystems…" (p. 1960), going on to show how matching explanatory (or predictive) theory to processes and phenomena studied is a central challenge of the discipline.

If we accept that we must match the scale of explanation to the phenomenon being explained, then it follows that the same phenomenon may require a different sort of explanation depending on the scale at which it is apprehended. Some of the most important issues faced by archeologists (and ecologists) concern aggregate behavior or emergent phenomena. How we understand the aggregate may have little to do with how we understand the individual. This applies to spatial as well as temporal scales. Just as Braudel (1969) argued that social changes occurring over radically different time spans must be understood as the result of fundamentally different kinds of dynamics, we must be prepared to seek very different kinds of causes for local, regional and global transitions. To cite just one example, a logically and empirically adequate account for the rapid global adoption of microlithic (bladelet—and microblade-based) lithic technology after the last Glacial Maximum may not be at all satisfactory in accounting for what happened in a particular region or a specific valley at that time (*e.g.*, papers in Elston and Kuhn 2002).

Insurance and actuarial statistics provide an apt illustration. The factors that may lead an individual to have an automobile accident in a particular time and place may be irreducibly complicated, such that it is impossible to predict where, when, or if a given person will crash their car. However, the emergent tendencies regarding frequencies of auto accidents in different places and among different groups can be predicted fairly well using a small number of variables. This after all is what enables insurance companies to make profits by betting on who will or will not have an accident in a given span of time. Sometimes they bet incorrectly, but in the aggregate they come out ahead.

Levin makes a parallel observation about ecological processes: "…if there are predictable patterns that may be observed in what we define as communities and ecosystems, they have arisen through the individualistic ecological and evolutionary responses of their components…" (1992, 1960). The emergent patterns that we call archaeological cultures in the Paleolithic are in some ways analogous. They are the result of countless decisions by individuals in the past, following agendas that may have been quite divergent, and that certainly had little to do with creating and maintaining what we perceive as the Mousterian, the Magdalenian or the Aurignacian. Yet the fact remains that we can identify and draw boundaries—sometimes fuzzy ones—in time and space around these entities.

This paper uses a case study from the Early Upper Paleolithic (EUP) in the Eastern Mediterranean to illustrate some of the scalar issues in explaining transitions in the Pleistocene. Üçağızlı Cave I preserves a long (though inevitably incomplete) sequence, which documents both continuity and change, stability and instability, over a period of roughly 12 ky. The sequence spans a significant, if fairly un-controversial technological transition from one EUP cultural unit, the Initial Upper Paleolithic (IUP) to another one, the Ahmarian. Within the sequence there is evidence for changes in lithic technology and retouched tool forms, human diets, and the role of the site within a regional land use system. Few of these changes seem to be closely coordinated or closely linked to the shift from one archaeological "culture" to another. There are *many* transitions at Üçağızlı, and in this particular case, small- (local) and larger-scale (regional) transitions seem to be largely unconnected. However, considering the local changes allows a more precise focus on what the regional cultural transition as commonly understood represents, and how it might be further investigated.

## Background to the Case Study

The IUP, variously called Emiran or "transitional" (Azoury 1986; Gilead 1991; Schyle 1992), or "*Paléolithique intermédiere*" (Ploux and Soriano 2003; Boëda and Bonilauri 2006) is the earliest known Upper Paleolithic complex in the Levant. There are few radiometric dates, but the estimated age range is roughly 50,000 to 40,000 (calendar) years BP. Characteristic methods of blade production include elements of Levallois technology (hard hammer percussion, platform preparation by faceting), but in some assemblages show a different kind of volumetric exploitation of the core. Two distinctive forms of shaped tool, the Emireh point and the *chanfrein,* are associated with IUP assemblages, but neither is ubiquitous. The former are found throughout the Mediterranean Levant and in the Negev, but have been found mainly if not exclusively in open-air sites (Copeland 2000). The latter, to this point, are mainly known from the northern Levant (coastal Lebanon and Turkey).

Some researchers describe IUP assemblages as transitional between Middle and Upper Paleolithic (Azoury 1986; Copeland 2000), mainly due to the presence of Levallois-like features in the blade technology. However, assemblages from sites with good organic preservation (Ksar 'Akil and Üçağızlı) are associated with bone tools and abundant ornaments. This, combined with the long IUP sequences at sites such as Ksar 'Akil, as well as the range of radiocarbon dates available from different sites, suggests that it is an EUP entity in its own right and not a brief period of instability or rapid transition between Middle and Upper Paleolithic (Kuhn 2003; Kuhn *et al*. 2009). There are no absolutely diagnostic hominin remains associated with IUP industries, although isolated teeth from IUP layers at Üçağızlı show predominantly *Homo sapiens* characters (Baykara 2010).

The Ahmarian follows the IUP in the Levant. Ahmarian assemblages are both more widespread and more numerous. Again, radiometric dates are scarce, but the estimated age range from the early Ahmarian is between 42,000 and perhaps 34,000 (calendar) years ago. Ahmarian assemblages are characterized by a heavy emphasis on production of narrow, regular blades using soft hammer or perhaps indirect percussion. Characteristic tool forms include retouched pointed blades (el Wad or Ksar 'Akil points), as well as endscrapers and scarce burins. Ahmarian assemblages from the arid southern Levant are also characterized by a kind of very fine marginal retouch (Ouchtata), whereas heavier direct scalar retouch is more typical in the northern Levant. In sites with organic preservation, Ahmarian assemblages include both abundant ornaments and simple bone artifacts. The small number of hominin remains associated with Ahmarian industries appear to represent anatomically modern *H. sapiens.* These include the partial skeleton of a juvenile *H. sapiens* individual which was probably recovered from Ahmarian level XVII at Ksar 'Akil (Bergman and Stringer 1989) and fragmentary crania from later levels at Qafzeh (Bar Yosef 2000, p. 113). A series of isolated teeth from the Ahmarian layers at Üçağızlı appear to represent modern humans as well (Baykara 2010).

The transition from IUP to Ahmarian is of particular interest because of possible links between the proceeding Levantine Mousterian and the IUP. Results from Ksar 'Akil, Üçağızlı cave and possibly other sites as well (Fox and Coinman 2001), suggest that the Ahmarian developed in place from the IUP. However, while there is fairly broad consensus that the Ahmarian is ultimately derived from the IUP, the

nature of the transition, its speed and the kinds of cultural evolutionary and cultural processes represented, have not been fully explored. Moreover, some researchers (Gilead 1991; Marks 1990, 1992) believe that the IUP developed directly out of the late Middle Levantine Paleolithic, although others argue that the source of the Levantine IUP may ultimately be northeastern Africa (Bar-Yosef 2000, pp. 141–142). *If* the IUP indeed has roots in the local late Mousterian, which is known to be associated with Neanderthals (Bar Yosef 2000, Fig. 2), and *if* it developed into the Ahmarian, apparently produced by modern humans, this would have significant implications for biological and cultural evolution in the region.

The cultural sequence at Üçağızlı cave, which preserves a wide range of evidence in addition to lithic artifacts, provides an excellent opportunity to explore this IUP/Ahmarian transition in more depth. Üçağızlı cave is located on the Mediterranean coast of the Hatay region of south-central Turkey. The site is situated on a very rugged stretch of coastline a few km south of the mouth of the Asi (Orontes) river (Fig. 1). The site today is only a part of what was once a much larger karstic chamber. A large part of the occupied surface, and as much as two meters of Upper and Epi-Paleolithic deposits, were lost to erosion after the cave's vault collapsed, probably during the late Pleistocene or Holocene. Nonetheless, the site preserves a sequence of Upper Paleolithic layers up to 3 m deep (Fig. 2), as well as smaller, localized deposits of Epipaleolithic-aged sediments. Moreover, conditions for organic preservation are by and large excellent so a range of evidence is preserved.

Understanding the geological matrix in which assemblages occur is crucial to studying transitions in any cultural sequence. The primary geogenic component in all layers at Üçağızlı cave is reddish clay or silty clay (*terra rossa*) typical of karstic landscapes in the Mediterranean. Since the lithology of the sediments is comparatively homogeneous, stratigraphic units were defined in the field primarily based on the quantity and nature of anthropogenic content, such as hearths, accumulations of ash, and varying quantities of artifacts, shells and bone. Thus, stratigraphic distinctions between layers track the ebb and flow of human presence in the cave more closely than they track geological or climatic events. Major stratigraphic units are designated by capital letters (B, C, etc.) whereas more localized lenses or especially dense deposits of cultural material are marked by numbers or lowercase letters (B1-3, Fa). Layers I though F contain IUP assemblages. Layers C, B1-B3 and B are clearly

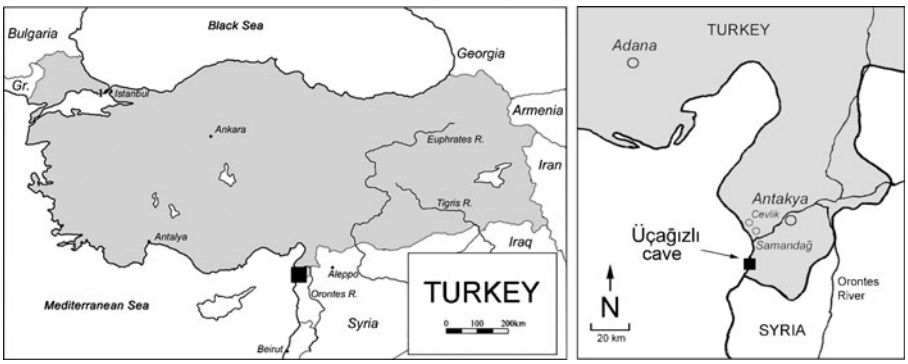


**Fig. 1** Map showing location of Üçağızlı Cave

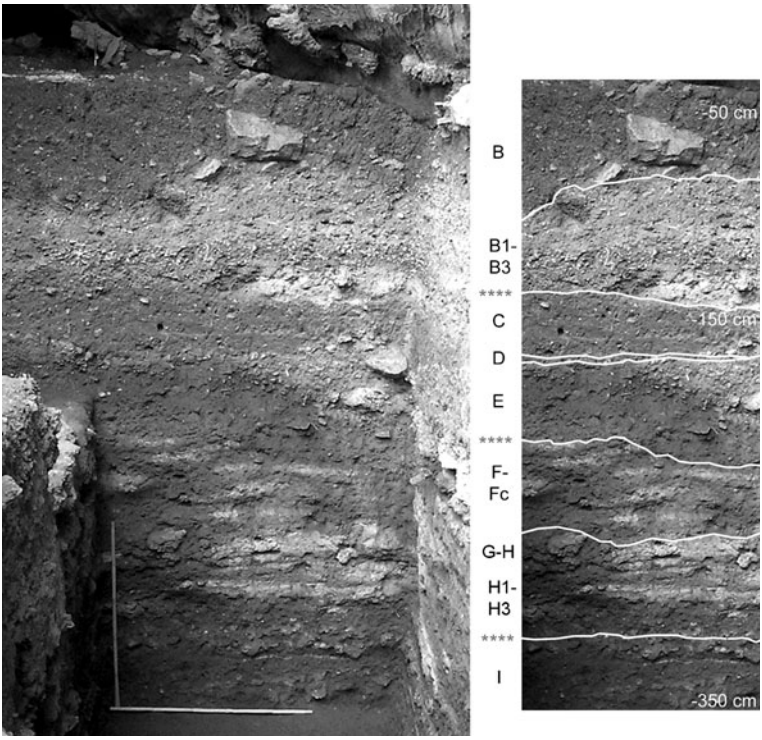


**Fig. 2** Üçağızlı Cave stratigraphy (north end of excavation trench). *Asterisks* mark gaps or hiatuses

Ahmarian. The assemblages from layers E and D are comparatively small and contain few diagnostic artifacts. However on the whole they resemble the Ahmarian more closely than the IUP.

Like all Paleolithic stratigraphies, the Üçağızlı cave sequence is incomplete. There are three major unconformities in the intervals between layers I/H3, F/E, and C/B1-3: these represent either complete hiatuses in deposition, or, more likely, episodes of erosion. The F/E hiatus also marks the transition from IUP to Ahmarian. Sediments at the site have also been subject to disturbance by non-human forces. Small scale reworking by burrowing insects and perhaps other invertebrates is common throughout the sequence. This result in thorough mixing of sediments over scales of up to 10 cm, erasing some evidence of very small-scale depositional events but leaving the macroscopic features such as hearths recognizable. There is also evidence of alluvial/colluvial displacement of materials horizontally across the site over scales of a few meters in some layers. Again, while this process would have mixed materials across the exposed surface of the site it did not impact stratigraphic integrity at the scale discussed in this paper (Mentzer 2011).

## Change and Continuity in the Üçağızlı Sequence

Depending on what aspect of the record one examines, the cultural sequence at Üçağızlı Cave I documents both stability and change. Some changes appear to have occurred abruptly, some unfolded more gradually. Some of these results discussed

below have been reported elsewhere and are only summarized here. Temporal trends in various indicators are summarized in Figs. 3, 4, 5, and 6.

Except for layer I (the earliest), the lithic assemblages at Üçağızlı cave are all dominated by blades as blanks for retouched tools. However, there is an important shift in principal methods of blade production at Üçağızlı. In terms of attributes, the change is marked by a (1) decline in platform faceting and increase in platform preparation by abrasion, (2) a decline in large faceted buts and an increase in punctiform and linear platforms, and (3) a significant increase in evidence for bidirectional exploitation of cores (Fig. 3). These technological changes are the most consistent indicators of the transition from IUP to Ahmarian. They mark a shift from a method of blade manufacture utilizing hard hammer percussion and unipolar cores in the IUP to one utilizing soft hammer or indirect (punch) percussion and bipolar cores in the Ahmarian. The interval of apparently rapid technological change spans the erosional or depositional hiatus between layers F and E. Consequently, the actual speed with which one method of blade production replaced another is unknown. It is worth noting that there is evidence for more subtle changes in technologies of blade production within the IUP, but that these are independent of the major shift from hard hammer to soft hammer/punch technique and from unipolar to bipolar cores.

There are a number of trends in the frequencies of different retouched tool forms, some of which are thought to be temporally significant (Fig. 4). *Chanfreins*, typical of the IUP in the northern Levant, are present in quantity only in layer I, at the base of the Upper Paleolithic sequence at Üçağızlı. As occurs also at Kar 'Akil, these distinctive artifacts disappear before the shift in the technology of blade production.

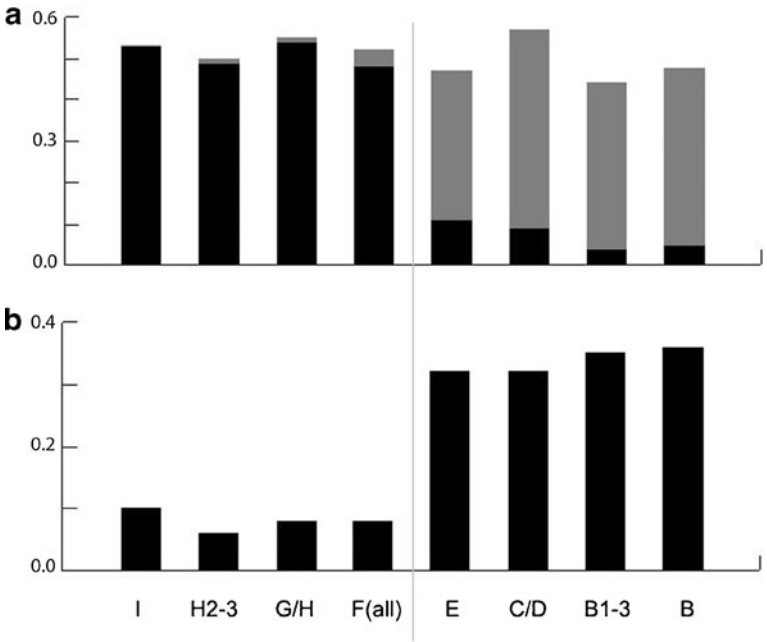


**Fig. 3** Trends in blade production: **a** platform preparation—*black bars* proportion platform faceting and *gray bars* proportion platform grinding; **b** proportion blades with bidirectional dorsal scar patterns. *Vertical gray line* indicates interval of shift from IUP to Ahmarian

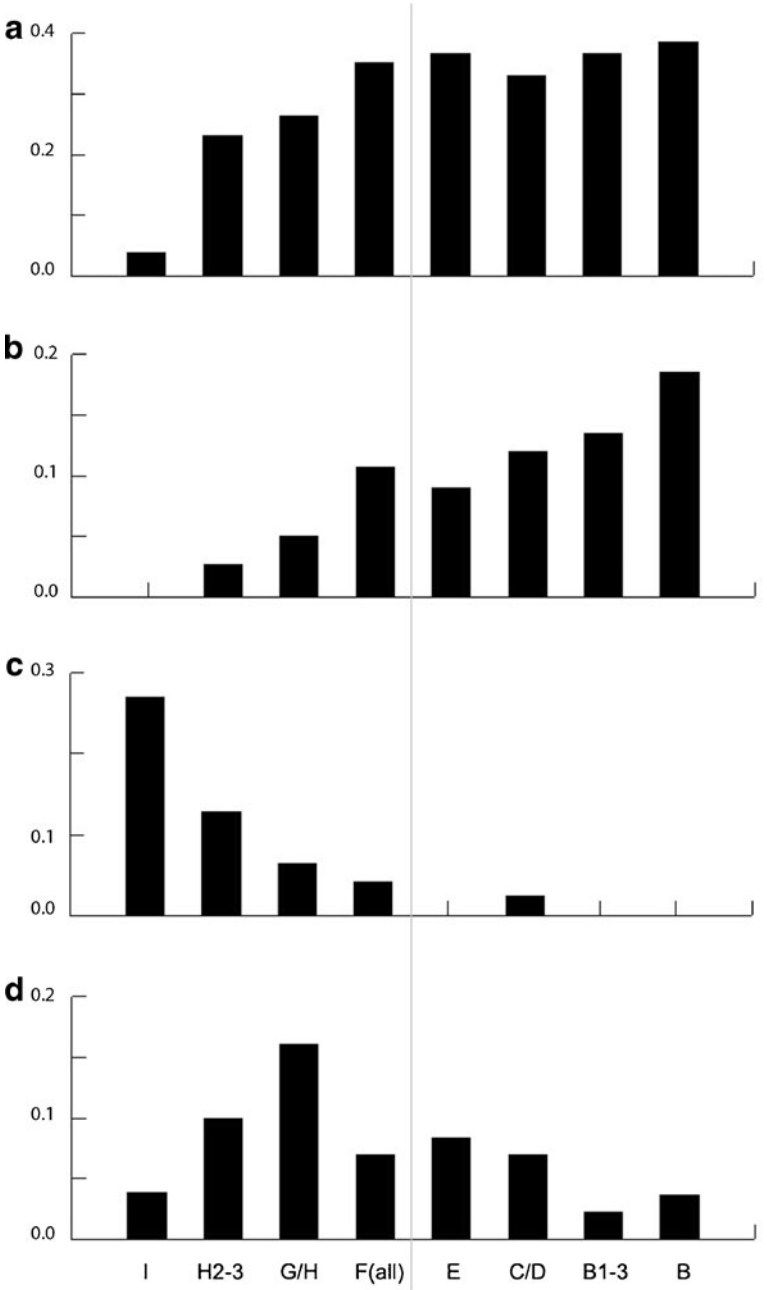


**Fig. 4** Trends in retouched tool forms. **a** endscrapers, **b** pointed blades, **c** Levallois flakes blades and points, and **d** burins. *Vertical gray line* indicates interval of shift from IUP to Ahmarian

Typologically Levallois pieces decline gradually in abundance within the IUP as well, one indicator of changes within the IUP in technologies of blank production. Burins, especially burins on oblique truncations, another indicator of the IUP in the northern coastal Levant, are on the decline before the technological transition. In

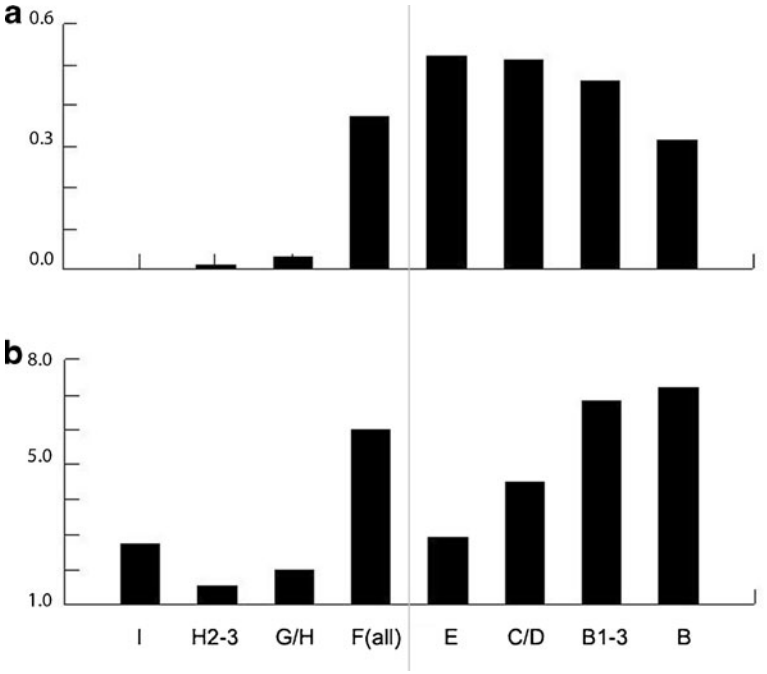


**Fig. 5** Trends in ornament species. **a** proportion of *Columbella rustica* in ornament assemblage and **b** diversity of mollusks taxa used for ornaments. *Vertical gray line* indicates interval of shift from IUP to Ahmarian

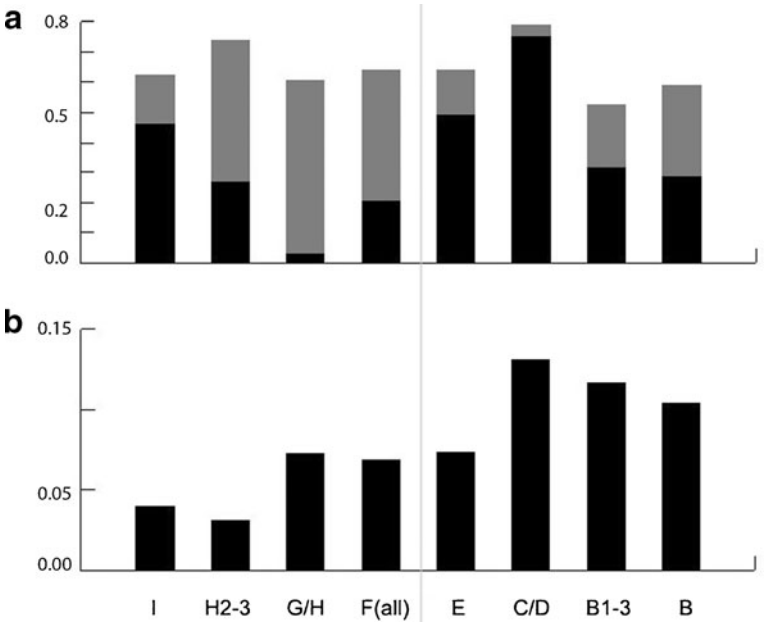


**Fig. 6** Trends in game use: **a** proportions of major large game species—*black bars D. mesopotamica* and *gray bars C. aegagrus*; **b** proportion of all small game within faunal assemblages (by NISP). *Vertical gray line* indicates interval of shift from IUP to Ahmarian

compensation, pointed blades or el Wad points—typical of the Ahmarian—increase gradually in frequency beginning in the earliest levels. Endscrapers however remain the most common tool form throughout the sequence (except for Layer I).

The Üçağızlı sequence has yielded nearly 1,000 beads and bead blanks (unmodified, beach-worn marine shells purposefully carried to the site), almost all of mollusk shells. There is considerable continuity in the use of mollusk species for ornaments. The frequencies of the two main taxa, *Nassarius* and *Columbella,* fluctuate, but the fluctuations to not match the transition in blade production (Fig. 5). *Nassarius* dominates the early levels but *Columbella* increases fairly abruptly toward the end of the IUP series, reaching a peak in layers F and E before declining slightly. There is also a gradual increase in the diversity of marine taxa used for the manufacture of ornaments over the course of the sequence. This appears to be a largely local signal—Ksar 'Akil, the only other site in the region with a long Upper Paleolithic sequence and good recovery of organic remains, shows less directional change in ornament types (Kuhn *et al*. 2001).

There is remarkable continuity in economic focus throughout the Upper Paleolithic at Üçağızlı cave. Despite its proximity to the sea, Upper Paleolithic groups using the site were strongly oriented toward hunting large terrestrial game. Small terrestrial animals, marine foods and other resources seem to have played fairly limited, though gradually expanding, dietary roles prior to the Epipaleolithic. This focus on large game may be tied to the site's geographic situation. The cave is located along a very rugged stretch of coastline, between two very steep, blind valleys. An extensive, low-lying coastal plain created by the delta at the mouth of the Orontes river begins just 2 km to the north. This topographic situation would have provided both good grazing for ungulates and features (the blind valleys) suitable for trapping herds or individual animals. The high frequencies of endscrapers throughout the sequence, as well as limited use-wear evidence (Martinez Molina 2005) indicate that hide preparation was another important technological activity throughout the occupation, again consistent with the emphasis on large terrestrial herbivore prey.

As noted above, large terrestrial ungulates dominate the faunal assemblages throughout the Üçağızlı sequence, accounting for 94 % or more of estimated meat biomass. The large ungulate faunas are also fairly diverse, with four to six species present in each layer. The two principal large prey animals are *Capra aegagrus* and *Dama mesopotamica.* Abundances of these two species show complementary patterns of cyclical variation over time (Fig. 6). These trends probably reflect fluctuations in moisture and density of vegetation, with *Capra* indicating drier conditions and open slopes and *Dama* indicating moister climate and denser vegetation. Although the great majority of the meat diet came from large terrestrial game, the Üçağızlı sequence shows a gradual increase in the use of small game as well as in the diversity (evenness) of types of small game resources exploited. This tendency is part of a pan-Mediterranean trend in the Upper and Epi-Paleolithic (*e.g.*, Starkovich 2009; Stiner 2001, 2009). Shellfish remains are essentially absent from the IUP except in layer I at the bottom of the sequence. They increase in abundance again beginning in layer C, a trend which continues with the Epipaleolithic.

A range of evidence document an apparently abrupt change in the way the site was used and very likely in its place within a regional settlement system. For most of the Upper Paleolithic sequence, occupations at Üçağızlı cave appear to have been

comparatively short in duration and separated by periods of geological but not cultural deposition. In these layers, the density of cultural remains reflects the frequency of sequential visits more than the duration of occupations or the sizes of groups using the site. However, in the two uppermost Upper Paleolithic layers (B and B1-B3), occupations appear to have been much more prolonged, and/or to have involved larger numbers of people. The changes in the nature of the occupation are indicated by shifts in the kinds of features present, the density of archaeological finds, and the provisioning of lithic raw materials (Kuhn 2004; Kuhn *et al*. 2009), and perhaps in strategies for processing and preserving meat. In a very broad sense, the evidence suggests a localized shift from high levels of residential mobility to a more staged, logistically organized pattern of land use. This shift in scale or duration of occupation corresponds with another gap in sedimentation, between layers C and B1-B3. Thus, it occurs *within* the Ahmarian sequence, and not at the interface between IUP and Ahmarian. In fact, with a comparatively low density of finds and high frequencies of tools made on non-local raw materials, Layer C, the earliest clearly Ahmarian layer, actually suggests the highest level residential mobility and most ephemeral local occupation of any assemblage in the site. Layer B1-B3, the next Ahmarian layer, is in many respects its polar opposite, with a high density of cultural remains, evidence for stockpiling materials at the site, and construction of a range of features.

## Transitions Large and Small

The stratigraphic relationships between the various transitions, gradual and abrupt, at Üçağızlı cave help clarify the nature of the transition from IUP to Ahmarian as it is manifest locally. Methods of blade production, the strongest marker of this cultural transition, apparently changed rapidly between layers F and E. Although it corresponds with a probable erosional hiatus in the cultural sequence, this seemingly abrupt shift occurs with little interruption in trends in artifact forms and in the selection of marine shell species for use as ornaments. Consequently, there is no reason to think that the temporal gap is very large.

The adoption of novel methods of blade production at Üçağızlı cave cannot easily be explained as a response to *local* economic or ecological conditions. Although the Üçağızlı sequence documents significant changes in foraging, resource selection and mobility/land use, none of these correlate clearly with the IUP/Ahmarian transition. The abundances of different large game species oscillate, probably in response to environmental changes. Use of small game shows a gradual, directional trend following regional tendencies. The major shift in the mode and intensity of occupation at the site occurs between layers C and B1-3, *after* the major technological transition. Continuity in selection of shells for ornament and gradual changes in abundances of different tool forms also suggest that the change in blade production is not accompanied by wholesale replacement of one cultural tradition by another.

It is important that many indicators of technological and cultural continuity across the IUP/Ahmarian boundary involve long-term, directional or cyclical changes in artifact forms, ornaments, and prey choices. Frequencies of different tool forms or bead types are not static but changed gradually across the sequence. However, changes in these aspects of behavior were not closely linked to methods of blade

manufacture: they seem to have responded to dynamic factors (whether social or environmental) that operated at different temporal scales than the processes that influenced changes in blade production. Continuity in fairly static characteristics, such as the persistent large game focus, is less significant, as it reflects the influence of equally static variables, in this case the site's topographic situation.

The Üçağızlı cave sequence has been presented as a case study. The diverse data available from the site permits us to explore a variety of possible factors contributing to changes in EUP material culture. However, this is a relatively unique site, and like any case study it embodies both local and regional evolutionary trajectories. In other words, the transition from IUP to Ahmarian at Üçağızlı cave is certainly a part of the regional transition, but it is not a proxy for the processes occurring at a larger spatial scale.

From the perspective of the Üçağızlı cave sequence the transition from IUP to Ahmarian does not appear to be a particularly momentous event. In this locality it seems to distil mainly to a widespread shift in methods for making blades, replacement of hard hammer percussion and single platform cores with soft hammer or indirect percussion and cores with two opposed striking platforms (see also Demidenko and Usik 1993). This technological change occurred over a large region—stretching from the Negev to southern Turkey, and from the Mediterranean coast of Israel and Lebanon to inland central Syria. From the perspective afforded by the Üçağızlı cave sequence at least, the reorganization in blade manufacture occurred in the context of much more gradual and non-synchronous shifts in foraging, mobility, and in the production of distinctive tool forms. Other aspects of economic and social life, including selection of marine shells for ornamentation, seem to have been largely unaffected.

Is Üçağızlı cave unique? Do other sites show a much more profound set of behavioral shifts in association with the appearance of the Ahmarian? Unfortunately, very few other localities in the region contain both IUP and Ahmarian assemblages in good stratigraphic context, and even fewer preserve anything besides lithic remains. One exception is Ksar 'Akil (Lebanon), the "reference sequence" for the Upper Paleolithic in the northern Levant. The Üçağızlı sequence appears to match Ksar 'Akil, XXII to XVI very closely, except that there is no obvious hiatus in the latter site. Ksar 'Akil shows an even more gradual technological and typological shift between the two industries. Chanfreins disappeared from the assemblages before hard-hammer blade manufacture from cores with faceted platforms was abandoned, whereas pointed blades begin to increase in abundance before the technological shift. The Ksar 'Akil ornament assemblage is even more homogeneous that that of Üçağızlı, with even greater continuity between the Ahmarian and IUP layers (Kuhn *et al*. 2001: table 3). Little information about fauna is currently available for the EUP of Ksar 'Akil beyond basic species lists (Hooijer 1961), and we can say little about mobility or site use. Nonetheless, this second case seems to support the conclusion that the transition from IUP to Ahmarian was marked mainly by re-organization of blade production, and that changes in ornaments and even retouched tool forms were not synchronous.

How then could we explain this technological transition? One hypothesis is that the various methods of blade production represent essentially arbitrary technological choices. It is important to emphasize that, in so far as the Ksar 'Akil and Üçağızlı

sequences are representative, it appears that changes in blade technology are not linked to wider changes in other more clearly stylistic features such as ornaments. This shows at least that new forms of lithic technology were not carried along as part of a larger complex of culture traits: the transition from IUP to Ahmarian does not appear to have involved wholesale replacement of culture or population (summarized in Fig. 7). Rather, if alternative methods of blade production are truly equivalent, without material consequence, the changes marking the transition from IUP to Ahmarian would reflect the operation of neutral processes originating in the replicator dynamics of cultural transmission among and within established populations. A hypothesis of neutral diffusion begs the question of why one replaced the other so rapidly and so completely. With neutral variation we expect to see more gradual and perhaps fluctuating changes in the frequencies of alternative variants. In contrast to Üçağızlı, Ksar 'Akil does seem to show more gradual transition between methods of blade production, although this may also be a function of excavation methods used in the 1930s and 1940s producing mixing within coarse-grained stratigraphic levels.

Fluctuations in the abundance of artifact forms such as *chanfreins* or pointed blades are more ambiguous, in large part because we do not know how the artifacts were used. *Chanfreins* are a well-defined form, and they are confined in the main to a particular time period and area. They could be a neutral stylistic marker. The form also suggests a particular function or set of functions, but unfortunately there is no use-wear evidence. Increasing frequencies of pointed blades through the IUP and Ahmarian may relate to changes in the design of weapons, but again there little direct evidence. Although they are the correct size to be projectile tips (Shea 2006), impact fractures are rare on these artifacts in the assemblages from Üçağızlı. However, the simple fact that the frequencies of different artifact forms are independent of, or at least not synchronized with, changes in technologies of blade production is important. Even if they too reflect neutral processes, they are different neutral processes than the ones that influenced other aspects of technology.

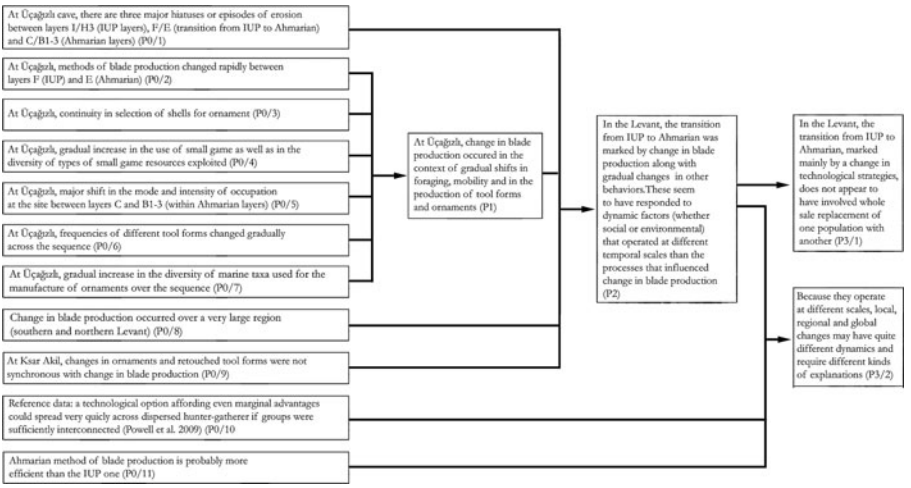


**Fig. 7** Synoptic view of the scientific construct presented in this paper ("logicist diagram"). *IUP* Initial Upper Paleolithic

An alternative hypothesis is that Ahmarian technology offered some *generalized* advantage over IUP blade production, an advantage that was not specific to a particular strategy of land use or economic structure. A technological option affording even marginal advantages could spread very quickly across dispersed hunter-gatherer communities if groups were sufficiently interconnected (Powell *et al*. 2009). In principle, the use of soft hammer or indirect percussion results in finer, thinner, and more regular blades than hard hammer percussion (Bar-Yosef and Kuhn 1999). This would make for more efficient conversion of raw material into edges or usable blanks. Efficiency in use of raw material in reduces procurement and transport costs, regardless of the abundance of flint, and so would be advantageous in a range of contexts. Exploitation of cores with two opposed platforms can also facilitate the production of naturally pointed blanks which would be ideal for conversion into el Wad points: aceramic Neolithic naviform blade technology (Wilke and Quintero 1995) is the best illustration of this principle. However, bipolar production is not typical of the early Ahmarian across its entire range.

It may seem inconsistent to hypothesize that the spread of Ahmarian blade technology was the result of some economic or functional advantage while at the same time claiming that its appearance in the Üçağızlı did not coincide with significant changes in land use or foraging economy. However, the global replacement of IUP blade production with Ahmarian blade production and the technological choices made by the people using Üçağızlı cave are entirely different scales of phenomena and we should not expect them to yield to similar explanations. While increased efficiency might explain the spread of Ahmarian-style blade production across the Levant, it does not necessarily explain why a specific local population chose to make this particular choice. The people occupying Üçağızlı cave may not have made conscious economic decisions in deciding how to make their blades: those particular individuals may simply have been copying their neighbors, or emulating a few well respected artisans within the group. Such social learning may be more advantageous than direct experimentation under a range of circumstances (Laland 2004; Boyd and Richerson 2005). Likewise, arguing that the larger regional pattern can be attributed to drift-like stylistic change does not preclude the possibility that some individuals or groups made calculated, cost-benefit decisions in deciding how to produce artifacts. Because they operate at different scales, local and global may have quite different dynamics, and require quite different kinds of explanations.

This sort of contrast between local and global scales of analysis is particularly apparent within Paleolithic studies. The transitions of greatest interest to Paleolithic studies concern large scale archaeological "cultures" such as the Mousterian, Aurignacian, Ahmarian, or Gravettian, consisting of co-occurring sets of material culture traits. Some researchers—explicitly or implicitly—equate archaeological cultures such as Aurignacian or Ahmarian to contemporary ethno-linguistic groups, and seek to explain their expansion, geographic structure, and dissolution in terms of familiar dynamics of ethnic interaction (*e.g.*, d'Errico *et al*. 1998; Mellars 2005). Such analogies are strained at best. For one thing, these archaeological units are usually defined based on a limited number of features of material culture and/or technological procedures, mostly (but not entirely) expressed in stone artifacts. For another, they occupy truly vast expanses of space and time. In terms of geographic scale, the distribution of cultural phenomena such as the Aurignacian or Acheulean is on par with the distributions of "people who eat with knives and forks" or

"people who eat with chopsticks." It is an empirical fact that people in different parts of the of the contemporary world prefer different kinds of eating utensils—but these enormous, meta-regional groupings are not ethonolinguistic units that most anthropologists would recognize, and their dynamics are likely to respond to a different range of influences.

I would argue that these large scale cultural entities might best be understood as complex systems (though not necessarily as complex *adaptive* systems) (see Holland 1999). Their persistence does not reflect active adherence to a shared set of norms, and their geographic coherence does not reflect maintenance of boundaries. Rather, they are emergent properties, aggregate characteristics of a great many individuals following more-or-less simple, and more-or-less independent agendas. Such large scale distributions could for example be a function of simple transmission rules (*e.g.*, Boyd and Richerson 1985, 2005) operating on bounded social networks. The distribution of chopsticks as the preferred eating utensil probably coincides with the edges of a vast, loosely connected set of social networks, roughly corresponding with certain language groups. Likewise, the distribution of the Levallois Mousterian or the Gravettian likely corresponds to the boundaries of a certain group of Pleistocene populations in sufficiently regular contact to exchange ideas about how to produce artifacts. The coherence of these vast systems is a function of intensity of contacts and habitual ways of sharing information but does not imply any sense of shared identity.

This brings us to another theme of this workshop, that of complexity versus simplicity (reductionism) in the explanation of transitions. We should not assume that the scale of archaeological phenomena is correlated with intricacy in structures of causality—just the opposite in fact. Explaining variation or change in emergent phenomena may be fairly simple. The forces which hold large-scale emergent "systems" together, the forces that render them stable and coherent enough to be mapped and described by archaeologists, may be relatively simple. By that same token, the factors which caused a system to disaggregate or collapse could be equally simple, a minor change in network structures, or in some key environmental variable. Explaining local transitions may be much more *complicated* than explaining global ones. Because of differences in scale, what is a sufficient and satisfying explanation for the transition between Aurignacian and Gravettian in Western Europe, or from IUP to Ahmarian in the Levant, may not apply to a particular region or sites. The rise in cell phone use and distracted driving in the USA may explain an increase in auto accidents (NHTSA 2010), but it would not necessarily explain why I drive my car into a parking barrier next week (I do not carry a cell phone). In the same way, the history of a specific valley or a specific site could have been much more complicated and more deeply contingent than the processes that allowed a particular set of material culture traits to spread across most of Europe and persist for several thousand years.

Integration of regional analyses and case studies (global and local phenomena) is crucial to recognizing complex systems in archaeological contexts. Causal congruence or discordance between phenomena operating at different scales may help show when we are dealing with emergent phenomena. A situation where all case studies seem to behave similarly, where local transitions show evidence for similar patterns of causality everywhere, would suggest that the aggregate behavior is not emergent, but is a consequence of homogeneous conditions or behavior. On the other hand, where plausible models for causality at a large scale frequently break down locally, or vice versa, we can infer that the global patterns are partly or wholly emergent, and that very

different scales of phenomena are behind local and global trajectories. I suspect that the second hypothetical situation is by far the most common one, particularly in Paleolithic studies.

Meanwhile, we should also be attentive not to be shackled by the discipline's fascination with large-scale, emergent phenomena in the deep past. To return to the specific case, there are many other trends and transitions at Üçağızlı cave—and in almost any other temporal sequence—which are more immediately relevant to contemporary questions. Two examples are the abrupt changes in how the site was used, and the more gradual fluctuations in molluscan taxa used to manufacture ornaments at the site. Evidence for raw material provisioning, density of cultural materials deposits, and the nature of features suggest a reorganization of the local settlement system, and perhaps changes in the sizes of social groups as well, between layers C and B1-3 (Kuhn 2004; Kuhn *et al*. 2009). Reorganization of mobility and land use might be a response to environmental shifts, demographic processes, or a combination of both. From the limited perspective afforded by large game taxa, it does not seem to be correlated in a deterministic way with environmental change. The more gradual dietary expansion seen in the Üçağızlı sequence, particularly the increasing diversity of small animals exploited, is part of a pan-Mediterranean trend that has been attributed to gradual demographic growth (Stiner 2001, 2009). It is more interesting to consider, and more difficult to predict, how these two factors—cyclical environmental fluctuations and gradually increasing regional populations—might have interacted, although testing such hypotheses requires data from other localities.

Changes in the exploitation of different molluscan taxa for the manufacture of ornaments pose another set of questions, and demand another theoretical stance. The rise and fall of certain species (*Theodoxus*, for example) could be a simple outcome of neutral processes of cultural transmission. It could also reflect changes in littoral ecology. The increasing taxonomic diversity of the ornament shells, which is paralleled by an expansion in the range of techniques for modifying them, may again be an effect of environmental conditions along the coast. However, it could also indicate a broadening of the social messages being conveyed by personal ornamentation, linked perhaps to scales of social interaction or the compositions of social groups. If so, is this simply a matter of social scale, or is it tied to a reorganization of social roles and ways of signaling them? And how might it relate to the changes in mobility and organization of activities that occurs toward the end of the UP sequence? These are topics for future research. The point is simply that there are many interestingly and theoretically germane phenomena in sequences like this that have little or nothing to do with the pan-regional cultural transitions, and that the latter require a different order of explanation.

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