INFERRING GESTURES FROM ARTIFACTS

(Working paper)

Paul Bouissac

University of Toronto, Victoria College.

1. The cognitive continuum.

Artifacts are prefigured by the selection of natural objects whose physical and morphological characteristics are appropriate for solving a problem to which an organism is confronted. For instance, hermit crabs chose empty shells as permanent shelters that are commensurate with their own size and move to bigger shells when their first shelter becomes too small as they grow up. Bower birds pick up shells, stones and other objects whose accumulation and composition display an attractive indicator of their fitness to entice females to visit their bower and mate with them. The use of projectiles and branches by primates is well documented in the context of defensive actions or intimidation of rivals. Artifacts proper appear when natural objects are modified in view of the functions they are meant to serve, such as the nests constructed in trees by chimpanzees or their preparation of fishing sticks designed to catch termites. These behaviors have been shown to vary in their particular techniques and to be learned from the mother. They have been construed by primatologists as prefigurements of culture.

The manufacturing of a fishing stick requires manual dexterity as does its efficient manipulation to probe termite mounds. Films showing the awkward first attempts by young individuals as opposed to the skill of adults demonstrate that observation and practice is a necessary part of the acquisition process of the gestures required to achieve success in obtaining nutritious termites. But this skill demands more than a mere motor capacity for stripping the twigs and driving the stick with the right speed and precision into the termite mound's holes. It presupposes a cognitive competence that covers a set of successive evaluations from the assessment of the situation, the selection of a twig that will fit into the holes once it is stripped of its leafs, the decision that the tool is ready for use and the anticipation of the results which must have been present from the very inception of the whole process. The skill of a human fisherman may involve more complex behavior and artifacts but is essentially based upon the same capacity for a cognitive representation of the whole process including the adaptation of the means to the ends, and the anticipation of the results that can be inferred from termite fishing among some chimpanzee populations.

Moreover, the dynamic process that chimpanzees and humans initiate and complete in these two instances have in common that they are oriented toward preys that are assumed to exist in particular locations without actually been seen, and the behavior of these preys are accurately predicted. This is why observed or inferred gestures that produce and use artifacts also provide an invaluable point of entry into cognition since they imply memory, representation and anticipation.

2. Reconstructing gesture patterns.

We constantly engage in gesture reconstruction when we assess the intentionality of an action, or more formally when we investigate an accident or a crime. We try to represent virtually whether the initial move was spontaneous or deliberately planned, what was the path of the limbs through space, how it was aimed and what was the force and effect of the impact. Naturally, symbolic interactive gestures cannot be reconstructed by forensic methods as they leave no trace in the space in which they are displayed. Furthermore, variations occurring and mistakes made while performing ritualistic gesture have no consequences in spite of claims to the contrary. But any gesture involving a contact with something material, let it be another body, a natural object or an artifact, necessarily transforms this object, albeit sometimes only imperceptibly for an unaided observer. Variations and mistakes in technical gestures have material consequences on the style or, more importantly, the adaptiveness of the artifacts. Since Francis Galton (1822-1911), modern technology has been put in the service of identifying the microscopic marks, such as fingerprints, left by gestures and refining the range of inferences that can be confidently elaborated from such evidence or, at least, significantly reduce uncertainty. The transformation of raw material into a standardized functional artifact is a patent case of the power of gesture but the successive steps which achieved this result must be inferred from incidental features that only specialists can observe and process. The same is true of the marks that result from the ways in which an artifact has been used and which must be distinguished from the physical and chemical transformations that are caused by the passing of time and the action of the environment as taphonomy demonstrates.

In the most abstract terms, reconstructing object-oriented gesture can be conceptualized as the representation of a geometrical and dynamic figure that is bounded by three sets of constraints. The first set is formed by the laws of physics and chemistry which apply both to the object and to the body that originates the movements; the second one is determined by the kinetic potential of the skeletal and neuromuscular apparatus that has evolved in a particular environment; and the third one comes from the properties of the object itself which can be heuristically considered as a kind of negative of the gestures. This applies to both the manufacturing and using of artifacts.

Further principles that may guide the reconstruction of technical gestures include the economy of efforts or reduction of energetic costs, the plausibility of cooperation in achieving desired results, and the serendipitous discoveries of shortcuts toward a set goal. The reconstruction of gestures is indeed a moving target as the theoretical object of the inquiry is actually a sort of genealogy, a series of transmissions and changes that never comes to a resting stage.

3. The social dimension of gestures.

Indeed, the reconstruction of gesture cannot ignore the set of constraints which comes from the social environment. The particular forms of symbolic and technical gestures are learned in the process of socialization. Although the possibility of individual innovation is real, it is very limited and it usually involves slight modifications of existing patterns rather than radical changes, except in the case of sudden outside interferences such as those caused by invasions, capture or trade. Techniques are carried forward from generation to generation with strong conservative drives.

Cultural diversity among humans as well as primates shows that there usually is more than one method to achieve a goal. For example, nuts are not cracked exactly in the same manner in populations of chimpanzees which are separated by geographical barriers such as rivers. Palaeolithic stone tools can be obtained by knapping or by heating flints or other minerals, and both processes have many variants. It can be assumed that pyrotechnologies require a higher level of cooperation because of the high degree of heat which must be obtained and the short window of optimality that produces the desired results. It is also obvious that technological memory has to be reliably preserved and transmitted with precision since the necessity of constant reinvention would be definitely maladaptive.

Although modern gesture studies, in their search for functional units, have tended to conceptualize gestures as originating from a single agent and in isolation from their context and from each other, a more appropriate approach should be to consider instead ecologies of gestures. A hafted axe is a reasonable ground for inferring a whole series of actions that goes beyond the concatenation of the technical gestures that produced such a complex stone artifact from a coarse block of mineral, a piece of wood or bone, and some binding agent from animal or vegetal origin: collecting and processing the raw materials; selecting or preparing a working platform; keeping the maker safe from outside interferences while the work is in progress; testing, storing, protecting and maintaining the finished artifact, possibly endowing it with magic power; acquiring it through trading, stealing or inheritance; learning the skill to use it efficiently and, perhaps, to display both the artifact and the skill outside their utilitarian contexts. All these requirements form a conservative list of virtual gestures which are constrained by the physical properties of both the raw materials and the completed object such as weight, balance, resistance, aerodynamic, optimal percussive angle, and the like.

Both symbolic and technical patterned movements usually involve dyadic, triadic or multi-polar cooperation. Constructing artifacts requires synergies, complementary movements that are as much synchronized as they are in hunting and warfare. Play, dominance and mating rituals, group integration and collective decisions, defensive and offensive strategies, transformative works, and other forms of interaction and industry, involve the correlated gestures of multiple agents. The cognitive and social complexity which is implied by such behaviors is often so exclusively associated with "culturally", rather than "anatomically" modern humans that they are implicitly downgraded to a state of assumed "primitiveness" that hardly would match the sophistication of ape societies as they are now described by contemporary primatologists.

4. Fallacies of the "primitive".

The very expression "anatomically modern humans" is reductive in as much as it implicitly denies cultural sophistication by separating anatomic evidence from cognitive and social competences. Religious and philosophical dualism probably lurks behind this terminological gesture. There is still a powerful image of the primitive that prevails in the standard interpretations of prehistoric data. Dualism is rescued by a notion of evolution that tends to forget that evolving foremost means surviving to reproduce rather than ascending a discontinuous ontological ladder toward an optimal stage (i.e., modern humans as we ideologically fancy them rather than as we experience them). In the same manner, technologies tend to be assessed from primitive to modern with the assumption that the scale goes from simple to complex. The consequences of such a frame of mind for the reconstruction of gestures are quite dramatic. What is indeed a "primitive" technology? Is this a technology defined by the nature of the material being transformed? Or a technology supported by "primitive" technological gestures? Does the latter mean rough and awkward? Lacking precision? Showing ignorance? Relying on chance rather than careful planning?

There may be degrees of competences and varieties of skills in the way raw materials are transformed into artifacts, but the touchstone of any artifact is its adaptiveness, that is, whether or not it fulfills a desired function, how efficiently it does so and how easily it can be reproduced. However, efficiency alone is not an absolute value because the energetic cost involved in producing an artifact is a crucial factor for evaluating its adaptiveness. Time, energy, and skill are precious commodities that cannot be invested without limit in the producing of artifacts as well as in their use. At any given time, contexts may select rougher artifacts simply because they are cost-efficient. It is not possible to infer from their rougher feature a necessary lack of skill. Other factors than technical knowledge as it is expressed by transformative gestures can account for our assessment of degrees of technological advances. These factors may include demography, population dynamic, climate, availability of resources, competition pressures, modes of transmission and memory preservation.

Another fallacious assumption is the idea that technological complexification is indicative of cultural "progress", which, on the contrary, is often indicated by simplifications in the production processes. Making highly functional tools from raw flints and combining them with softer materials like wood and bones requires more complex skills than implementing the mass production of metal objects once the principles of metallurgy have been mastered. Moving from the former to the latter reduces the richness and sophistication of the gesture repertory involved in stone tools production. We should be therefore cautious when we spontaneously equate technological advances with cognitive progress and skill since energetic cost and adaptiveness are crucial factors for the evaluation of gesture and their cognitive ground.

5. The pluri-disciplinary imperative.

Although it is tempting to think that gestures can be reconstructed intuitively, at least as far as this attempt concerns anatomically modern humans, there is a serious danger of overlooking the cultural and historical nature of symbolic as well as technical gestures and thus to inadvertently interpret the past through our knowledge of the present. The reconstruction of gestures can only be achieved through the mediation of a method.

Gestures can be inferred by exploring the virtual paths between the dynamic of a body and the properties of the artifacts it generated. Both ends of the virtual paths can be abstractly considered as sets of constraints. These constraints are knowable whereas the gestures themselves can only be inferred. Actually, these constraints are not knowable in the sense that they could be directly and completely observed and measured but the basis for inferring their properties can be confidently derived from the reliable knowledge which has been acquired in several disciplines in the biological and physical sciences. Archaeologists of gestures cannot use approximate and impressionistic evaluations of the two sets of constraints but must rely on the data and models provided by these sciences.

Only once both sets of constraints have been explicitly formulated, can some potential paths and their properties be modeled. Ideally, the knowledge of the constraints should be so precise that the paths of the gestures and their dynamic properties would restrict the possibility of variations to a minimum. But, in fact, it is probably impossible to acquire absolute certainty by following this purely formal approach which can only determine a range of potential paths. It is through replication of the gestures that can be performed within this range that a fairly high degree of plausibility can be reached. However, when dealing with others than anatomically modern humans, the knowledge we can acquire can only result from reasoning and artificial simulations.

The list of disciplines that can be usefully tapped is practically without limits, and it is often surprising how much knowledge can be reliably inferred from scant archaeological evidence with the help of other disciplines. The case of palaeontology provides interesting examples. For long, this discipline has exclusively focused its interest on establishing catalogues of skeletal features organized into cladograms or along hypothetical genealogical trees. The ways in which these organisms behaved, that is, their habits and adaptations, when they where alive many millions years ago was considered absolutely out of reach. It has now become possible to infer fairly detailed knowledge regarding their body mass and energetic needs, their modes of locomotion and the energetic cost of their movements, what their usual diet was, their rate of growth, the age at which they were weaned, how fast they matured, reproduced and died. Such elements of life stories can be synthesized from information provided by precise comparative morphometric assessments of the fossilized bones and from the micro-analysis of the teeth which reveals specific dental development and wear patterns. Of particular significance for locomotor studies are anatomic details such as the semicircular canals of the inner ear that sometimes fossilize and whose radii of curvature is proportionate to the need for maintaining balance and orientation, thus giving cues as to whether the organism was a slow mover or a fast swinging brachiator. Such bio-mechanic data coupled with fossilized environmental data make it possible to reconstruct very plausible "life histories" patterns that owe little to creative imagination.

How this does relate to the reconstruction of gestures in early *Homo* and in anatomically modern humans? All gestures are necessarily sustained by the bio-mechanical resources and the visuo-motor system that have evolved under the evolutionary pressures of particular environments and modes of subsistence. No successful gesture can be understood in isolation from its complete dynamic and cognitive context. All gestures presupposes a posture that secures its efficient completion. All the senses are involved in addition to proprioceptive feedback, balance and orientation. Ergonomics and kinesiology have achieved fine grained knowledge concerning the range of possibility of anatomically modern humans and the energetic costs required for each type of movements from locomotion at various gaits to precision grip and percussion.

For others than anatomically modern humans, fossilized skeletal remains have provided data from which bio-mechanical properties can be confidently inferred. The features of some bones can lead to a fair estimation of the corresponding body mass and muscular structure, and consequently to the amount of calories needed to sustain it, whence to the modes of subsistence of these individuals. Entering in a single system all the constraints that have been inferred separately with the help of a host of disciplines can allow at least some broad gesture reconstructions.

6. Conclusion: Gestures, cognition and culture.

If the existence of prehistoric languages can be inferred from indirect evidence such as inner skull casts or the assumed necessity of communicating symbolically during coordinated hunting or in other form of elementary social organization, it seems impossible to reconstruct what such languages could have been. This is nevertheless attempted by those who contend that all languages derive from a hypothetical mother tongue which could theoretically be reconstructed through comparative linguistic methods. Performative gestures, that is, gestures which accomplish some symbolic action or communicate some contents through their being performed in space without any material impact on the environment, do not even offer a similar opportunity of being plausibly reconstructed. Only gestures that can be demonstrated to be hardwired in *Homo* could be assumed to have been a part of prehistoric behaviour. But transformative gestures such as those which produce artifacts necessarily leave traces that provide a ground for reconstruction.

The efforts toward reconstructing such gestures are all the more important as they offer the only opportunity to gain access to the cognition and culture of prehistoric populations. It is symptomatic that in the latest two attempts at synthesizing our current understanding of human evolution, gestures form a recurring theme. Both Walker and Shipman (2005) and Mithen (2005) devote many pages to this topic. The latter goes as far as approvingly quoting Rudolph Laban, the author of a landmark book entitled *The Mastery of Movement* (1950): "Each phase of movement, every small transference of weight, every single gesture of any part of the body reveals some feature of our inner life." It also opens a window on our understanding of the properties of our environment, our capacity to model and manipulate it, and to anticipate the results of our actions towards specific goals. It also bears witness to how much we owe to our predecessors who have transmitted to us the kind of knowledge that can be acquired only through painful trial and error processes.

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