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Perception, cognition, and the semiotic affordance of patterns

Paul Bouissac

Abstract. This paper advocates a reconsideration of rock art focusing on the numerous geometric signs that appear in great number in Palaeoart. It elaborates an evolutionary perspective on the adaptive perceptual and cognitive processing of natural patterns that provide a plausible semiotic affordance for the emergence of symbolic communication. The type-tokens relationship and the functionality of consistent differences form a potentially robust ground for encoding vital information when the need for this arises. AI technology can now parse large quantities of data and demonstrate whether clusters of signs within some bounded cultural areas display mere randomness or show significant degrees of systematic organization. The latter case would be a first necessary step toward a tentative decoding of the potential messages these graphic signs may convey and make an important contribution to the archaeology of writing.

Introduction

One of the main enigmas of the prehistoric archaeological record is the presence of geometric signs engraved and painted on the surface of cave walls, boulders, stones, pebbles, and bones. Early recordings of palaeolithic parietal art have focused on easily recognizable animal representations and have given rise to a variety of interpretations regarding their meaning for the humans who carved or painted them. Geometric signs which greatly outnumber "figurative" signs, have attracted less attention and have usually been explained as representations of artifacts (traps, weapons, ornaments) or sexual symbols (schematic vulvae, pubic triangles, erect penises) which are assumed to relate to fertility rituals or erotic visual stimulations. Until recently, there has been precious little attempts to study their mutual positions and combinations beyond the early observation that they are usually collocated in a rather consistent manner with figurative drawings (e.g., Sauvet & Sauvet 1988; Leroi-Gourhan 1992). A few inconclusive attempts have construed some geometric sign clusters as entoptic (hallucinatory) phenomena (e.g., Lewis-Williams 2002), calendar notations (e.g., Marshack 1972, 1988, 1991), artificial memory systems (e.g., D'Errico 1994), ideogrammatic or magic symbols (e.g., Anati 1994). Mainstream prehistorians have discussed at length the artistic and symbolic aspects of figurative panels and their potential narratives and visionary values, but have, until recently, excluded a priori the possibility that both geometric signs and figurative representations could constitute early forms of scripts, that is, visual signs encoding the meanings articulated in spoken languages or otherwise formalized knowledge that needed to be preserved in a non-perishable form for the purpose of cross-generational transmission or for keeping records of events. If this was indeed the case, it can be assumed that vital information was preserved for the exclusive benefit of the group or some selected individuals rather than as messages to whom it may concern, and, consequently, was encrypted, by necessity or by design, along some rules privy to the relevant addressees.

The purpose of this paper is to review the assumptions behind this epistemological attitude, concerning both language and writing, and to outline a broader, albeit still tentative framework for the semiotic treatment of the visual, graphic data offered by the archaeological record. The following statement by Roy Harris can serve as an incentive to venture on a path that may lead to interesting discoveries: "What is needed – the goal –is […] clear enough. It must be a semiology which breaks with the old tradition of treating writing systems as indices of cultural progress or cognitive advancement, the tradition which judges writing systems by their 'accuracy' in transcribing the spoken word, the tradition which invariably treats the alphabet, either tacitly or overtly, as the ultimate human achievement in the history of forms of writing. For only then can we feel confident that we have an available semiology of writing which does not merely recycle the old prejudices" (Harris 2000:15).

An evolutionary framework: the cognitive emergence of visual patterns

The perception of differential patterns endowed with some meaning is a vital cognitive adaptation of organisms that have evolved vision. We find indications of the interest of primates for manipulable patterns in a social behavior that has been observed among chimpanzees. Dubbed "leaves grooming" by the researchers who documented and discussed this behavior, it consists of plucking particular leaves from trees and groom them with their mouth or fingers. Some observers have noticed that it is often associated with getting rid of ectoparasites but it has proved to be a more general social behavior in which individuals appear to show a leave to other chimpanzees as an object of particular interest (Wilke et al. 2022; Higgs 2022). All leaves have indeed specific geometric characteristics through both the curve of their contour and the nervure of their surface. Chimpanzees have also been documented to select for consumption some leaves that have therapeutic value, a behavior that is transmitted from mothers to offspring (Newton 1991; Huffman 2001) and is based on the recognition of significant distinct patterns. It can be reasonably assumed that the perception of distinct leaf patterns associated with relevant properties (nutritional or others) is a legacy of the tree-dwelling common ancestor of the primates.

Although comparisons across huge gaps of time and modalities are not scientifically sound, some probes distant from each other (both across species and cultures) may be legitimately considered to be indicative of similar evolutionary pressures, mainly when they point to the cognitive dynamics in a single-family branch such as the primates. The recognition of significant patterns in leaves is of this kind. In this respect and with all due caution, it might be worthy to note that in Romany, the Indo-European language spoken by nomads who originated in Northern India, the word that designates a leaf, *pateran*, also means *sign* (Borrow 1991 [1851]). This is, of course, more generally related to the root that gave the word "pattern" in modern English. These latter remarks are not meant to suggest a form of hypothetical continuum but are nevertheless indicative of the perceptive and cognitive dynamical constraints associated with the production of signs based on differential visual characteristics easily identifiable and manipulable, a step toward abstraction and generalization.

Another source of patterns, mainly when bipedalism became a defining feature of *Homo erectus* who could scan and observe the night sky, is the puzzling diversity of the

stars and constellations. Tree-dwellers such as the common ancestors of primates lived in a leafy environment in which attention given to the world above was probably limited to the live-saving detection of flying predators. In addition, like modern apes, they likely were diurnal animals. Once hunters-gatherers roamed the savannah and the steppes, stargazing led inevitably to the identification of patterns of a special kind that were more pregnant as the humans have inherited from their arboreal ancestors a very limited sense of perspective. Consequently, these patterns were bound to appear much closer than they are to the educated modern brains. When the prehistoric night sky was not clouded or blurred by volcanic ashes, the lack of atmospheric pollution undoubtedly made stars and constellations strikingly vivid and proximal. There are still some places in the world such as the Atacama plateau in Northern Chile from which the naked eye can perceive the starry sky with extreme acuity. Making sense of the phenomenal richness of this experience was bound to challenge the nascent cognitive adaptations, even more so since the bright points that are particularly salient during moonless nights are not evenly distributed. Looking for significant patterns necessarily appeared very early in organisms when vision emerged in its many forms across species. We can assume that early humans saw patterns in the sky and strived to find meaning in them. The first step can be expected to have been the iconic identification of objects with which they were familiar in their diurnal environment. Foremost striking are the evocative shapes of the nebulae. There is evidence that the early native populations of the Andes "saw" such darker patterns that looked like mammals and birds, believing for instance that one of these that evokes the outline of a lama was actually the "mother" of all lamas. More abstractly, we can also assume that the perceptive bias that drives us to connect proximal points by lines and create differential geometrical figures that foreground patterns in the sky is an early cognitive adaptation. It is difficult to assess the origin of the names of the constellations -- that is, the grouping of points to form an identifiable pattern – that modern cultures have inherited from literate past civilizations. It is plausible, though, to consider the identification of such patterns as a very early cognitive adaptation because of the unique capacity of these nocturnal "signs" to facilitate orientation on land or sea as a precious, more reliable complement to cues from the landscapes, a kind of natural GPS, so to speak.

It can be expected that the cumulative knowledge acquired from the observation and codification of the night sky became such a precious resource that it was bound to be recorded in one form or another, thus creating vital databases with the means available at the time. This would have been a crucial semiotic step toward the discovered capacity of patterns to refer to or represent relevant aspects of the lifeworld.

Towards an archaeology of writing

The archaeologists who focus on rock art are confronted by abundant painted and engraved geometrical patterns which could be heuristically construed as scripts because of their limited diversity, their relative proportions, and the fact that they often form clusters in which signs appear to be in complementary positions. However, prehistorians have coined the term "scriptoids" to designate these patterns which they tend to consider in isolation as decorative marks or schematized objects and body parts. Even cautious attempts to treat these signs as representing various forms of astronomical computation

(e.g., Marshack 1964) or, more generally, systems of notation (e.g., d'Errico 1994) have been met with curiosity and skepticism, and do not seem to have inspired large scale, systematic research programs. In general, mainstream archaeologists claim that these sets of patterns only look like scripts but are not truly so. Their assessment of palaeolithic "abstract signs" as well as, incidentally, "iconic representations" is biased by a set of assumptions they uncritically hold concerning the technology of writing and its history as well as the cognitive capacities of "primitive" humans who populated the earth during the last fifty-thousand years or even much more. As a matter of principle these prehistoric signs are excluded from the emergence and evolution of writing, a technology archaeologists equate with the birth of civilizations which is also the birth of history. From this point of view the expression "prehistoric writing" is an oxymoron. The rationale that is offered for the invention of writing systems is that these devices were created in Egypt, Mesopotamia, and China around 6000 years ago at the most in order to answer the administrative and accounting needs of emerging complex societies. There is obviously a kind of circularity in this argument since societal complexity and writing presuppose each other. In this functionalist, mechanistic approach that construes writing as an administrative tool, created *ab nihilo*, language itself is taken for granted and the reasons for which writing appeared as a parallel system of communication and representation is reduced to an external, basically political, and economic cause. Some archaeologists have early questioned the dominant theory of the invention of writing (e.g., Piette 1905; Petrie 1912) and have retraced the evolution of obviously functional symbolic markings in much deeper time than the few thousands of years that are granted to writing technologies (e.g., Raphael 1947; Forbes and Crowder 1979; Schmandt-Besserat 1992). But retracing over tens of millennia the resilience and evolution of individual marks that could have been either a way of encoding concepts or a way of encoding vocal sounds does not constitute a sufficient ground for assigning a writing status to these marks. It must be demonstrated, in addition, that in a given cultural area these differential marks constitute a semiotic system, that is, a closed set of types whose tokens can be combined according to some syntactic rules in order to convey specific meanings. The primary goal is not to decipher the hypothetical "texts" but to demonstrate whether or not the archaeological record available for a hypothetical "cultural" area exhibits the formal properties of a system that meets the semiotic requirements of a writing system such as iteration. Ultimately, the skepticism that is commonly expressed toward any form of script hypothesis is grounded on fallacious assumptions concerning language itself.

Language is usually perceived by archaeologists from the vantage point of a literate society according to which a language is a stable code which makes it possible to express thought. But this conception of language comes from a state of affairs in which formal spoken languages are anchored in writing systems in spite of blatant discrepancies between spellings and their corresponding oral forms. George Bernard Shaw pointed that out with his celebrated example of what could be an alternate "logical" spelling of "f-i-sh" in English: "gh-o-ti" [gh- like in enough; -o- like in w**o**men; ti like in nation]. We could heuristically fancy a similar sequence composed of figurative drawings. Writing systems have a logic of their own that may or may not be consistent, and are based on *ad hoc* social conventions. Like languages, writing systems do not have a life of their own but live in symbiosis with social groups which can go extinct and precipitate the

disappearance of these systems at the same time (Baines et al. 2008). But if these systems were recorded on resilient material, they can be considered as fossils and studied as such like any other paleontological objects according to taphonomy laws and, ultimately, in evolutionary perspective by relating their "skeletons" to each other following cladistic principles. The relationship of a natural or artificial language with its written counterpart is much more complex than the point of view a literate society implies. When we say that a word is pronounced as it is spelled, we actually refer to an arbitrary convention which is time-sensitive as language itself is, but follows its own evolutionary dynamic. Neither spoken language nor its recording in lasting visual marks can escape continuous transformations and re-structuring. As Saussure emphasized in his writings, change is a universal property of spoken languages. Anthropologists who have documented the languages of non-literate cultures have simply recorded the linguistic system of a moment on a long continuous line of language transmission that keeps changing from generation to generation, and often within the same generation since generations overlap. As long as the demography of a population remains within the range that allows its members to stay in close contact, they keep monitoring these changes and keep track of the transformations of their values. They constantly update their language in view of its random changes without being aware of the subtle, cumulative transformations that are constantly going on. But if the demography expands and leads to fissions, the new groups soon use languages which have diverged to a lesser or greater extent. If these groups maintain friendly or hostile relations with each other, and need to keep track of kinship, common myths and ritual which often embody vital information resources, a need for developing some kind of script emerges. As these changes are random and trigger constant re-orderings, languages (or writing systems) that may be related to a common ancestor language (or writing system), new languages and scripts keep emerging. As in all aspects of cultural evolution, transmission with variations, imitation, contagion, protection of information, etc. motivate the constant emergence of scripts. When one considers the mosaic of writing systems that exists in the world or whose existence in the past is documented, there is no reason to suppose that this cultural evolutionary dynamic started suddenly with complex societies.

From the emergence of speech to the craft of scripts

The emergence of articulate speech as an adaptation that enhanced the fitness of hominins is beyond the reach of observation but there seems to be a general consensus based on anatomical and brain capacity data that its earliest forms appeared some two millions years ago. Although it is impossible to figure out what kind of languages were spoken by prehistoric populations, there are a few features which can be considered as certain: (i) there is a necessary continuity between these languages and those which are spoken today because there is no absolute beginning in individual languages; (ii) these prehistoric languages kept changing within the groups which were speaking them, and they kept diverging whenever populations branched out; (iii) whenever related populations were separated, even by moderate distances, the "speciation" of their languages had to be dealt with if there was any modicum of interest or advantage attached to the possibility of communicating among groups. One way of controlling linguistic divergence is to rely on agreed upon signs in an ad hoc manner. Whether these

visual marks refer to an individual person or landmark, verbal sounds, or concepts, is irrelevant here. A script is not a phonetic code. It is a system of visual differences of patterns that can be mapped onto the differential system of a natural or artificial language. The sharp distinction between so-called ideograms and syllabic or alphabetical systems is a fallacy because most scripts blur the boundaries. The logogrammatic logic, or *rebus* principle, seems to be at the root of most scripts. This is why, in assessing the semiotic status of Pleistocene rock art, figurative and geometric data should not be a priori separated as necessarily distinct, and the possibility that their clustering could form scripts should not be a priori excluded. An article by Sauvet and Wlodarczyk (2008) – probably a translation into English of the authors' earlier piece which appeared in French in 1995 – attempts to uncover the "syntax" of the parietal art of a particular prehistoric cultural area. Typically, they deliberately exclude from their data the geometric signs and they take into account only the identifiable representations of the fauna without considering whether bodies are represented whole or in part. They end up by mapping consistent associations between species in various sub-regions of the area considered.

The relationship of writing systems to spoken languages is far more complex full or in than the common-sense view believes. The conceptualization of writing as exclusively the linear representation of spoken language either through syllabic or alphabetic signs is a fallacy. A distinction has been proposed between "semasiography" (the signs are not attached to necessary forms of speech) and lexigraphy (the signs are necessarily attached to forms of speech). For the former, the examples given are petroglyphs, proto-cuneiforms, airport signage, and mathematical notations. For the latter the alphabet is the prime example (e.g., Robinson 2009). But the distinction between these two semiotic modes is very arbitrary. Why should a petroglyph (say a circle with two "arms") not be a syllabic sign, and a letter of the alphabet (say a circle with a vertical "leg") not be a semasiographic sign? Why the letter A which is found in all possible orientations including its earliest occurrences "up-side-down" or even its figurative origin that is the head of a ox, not be a semasiographic sign? The case can be made that all the signs used in all forms of scripts are essentially semasiographic and that, conversely, all semasiographic signs correlates to a lexical or textual segment. It is an illusion to believe that we always apprehend words analytically. The lexical units from which we build meanings are processed as global patterns replete with redundancies. Powell (2009) convincingly shows that jumbling the letters in any word as long as the first and last letters remain in place interferes only minimally with reading: "in waht oredr the ltteers in a word are the olny improatnt tihng…". Powell argues that the purpose, origin, and function of writing are not to represent speech; that writing did not originate in pictures; and that writing systems did not necessarily evolve toward more efficient phonetic representations (Robinson 2009:38). Harris (2000), in his illuminating efforts to rethink writing, points out that a semiological approach implies the following principles: (a) writing is not a mere set of individual marks but a system of differences; (b) the shapes of the marks are irrelevant as long as they can be clearly distinguished from each other; (c) the identity and value of each mark (character) depends on the other marks of the set; (d) the introduction of new marks or the elimination of some existing marks cause a restructuration of the system; (e) the fact that some marks may be observed in the past in different contexts is irrelevant. What counts is the system of marks and their respective differences as they are used at a given moment. The emergence of writing cannot be

visualized as a linear history according to which successive improvements would have followed from a one-time invention, It has often been contended with the support of good evidence that the alphabet is no more efficient than other systems which have served their purpose according to their particular logic. It is necessary to approach the question of the archaeology of scripts from a broad disciplinary perspective and an open mind without being constrained by the model of the alphabet considered as the crowning point of an evolution toward progress. Writing systems are ruled by cultural evolutionary dynamics which can be controlled by human agents only to a very limited extent.

Conclusion

In investigating the archaeology of semiotic behavior focused on the earliest forms of potential scripts, there are some basic methodological principles that must be followed: First, it does not make sense to draw conclusion from an open-ended repertory of "scriptoid" patterns gathered from extensive areas across extremely long span of time. Secondly, the contemporariness of closed set of signs must be established. These set may include both figurative and geometrical patterns. Once a corpus meets the criteria of plausibility in view of the taphonomy of the data and the reliability of the dating, its tokens must be calibrated in order to establish a set of distinct types. Then, once sizeable potential "texts" have been transcribed and coded they must be tested with algorithms in order to verify whether they conform to the properties that can be expected from a script.

The first goal cannot be the deciphering of rock art data but the demonstration of formal properties determining the logic of collocation of sets of differential signs. Until the latest progress in Artificial Intelligence such as GPT, attempting to complete this task with the recording and computing means that were then available would have been utopian. There is no doubt that the new computing powers that have now become operational can once for all resolve the issue of determining whether the signs, both geometrical and figurative, have been generated by random singular gestures or were instances of systematic, recursive rules of composition that met communicative demands.

Paul Bouissac
University of Toronto
Victoria College
73 Queen's Park Crescent
Toronto ON
Canada M5S 1K7
Email: paul.bouissac@utoronto.ca

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