In *The Origins of Monsters*, David Wengrow tackles a very interesting historical phenomenon: a sudden surge in images of fantastic animals accompanies the rise of urban life in Mesopotamia. In contrast, such images are excessively rare in pre-urban, prehistoric art. Wengrow contends that the reasons behind this phenomenon are cognitive, socio-economical, institutional, and to some degree technological.

First, let us be clear as to what sorts of images Wengrow is interested in. Images of fantastic animals – or composites, as Wengrow calls them – are composed by the joining together of body parts of different species of animals. Consider the following image.

Black and white crop of full plate scan, from Austen Henry Layard's 'Monuments of Nineveh, Second Series' plate 19/83, London, J. Murray, 1853 (no copyrights)

The creature is an example of a composite: a bird's body, together with bird wings and a bird tail, but with lion forelimbs, a lion head, and bovine horns. Composites act as a modular system of representations because their different body parts are interchangeable between species. Although many sculptures depict such imaginary creatures (think of the Great Sphinx of Giza), Wengrow is more specifically interested in images engraved or printed on portable objects such as vessels or weapons.

Following the work of cultural epidemiologists such as Dan Sperber, Lawrence A. Hirschfeld, and Pascal Boyer, Wengrow argues that the success of composites relies in part on the violation of our expectations of what real animals look like. However, even though composites shock us by their fantasy, they retain an 'anatomical correctness' that allow us to understand them as animal-like creatures rather than inarticulate blobs of body parts. The expectations we have about what a proper animal looks like, how to classify animals, and how we intuitively reason about them is part of our innate psychology, what is commonly referred to as our folk biology. Wengrow agrees with cultural epidemiologists that it is the shock-value of such representations – how they are slightly off our folk-biological expectations – that makes them so memorable and popular: "On the expectations of this model, images of composite animals, with one foot in anatomical reality and the other in fantasy, should provide good materials for an "epidemiological" study. We might reasonably hypothesize that, as minimally counterintuitive images, they constitute robust points of reference for ideas about the supernatural, capable of crossing cultural boundaries and acting as ready vehicles for a multiplicity of ritual, theological, and mythological discourses." (p. 24)

However, our folk biological cognitive dispositions are not sufficient to explain the success of composites. Wengrow rightly argues that prehistoric people had the same folk biology as urban

Mesopotamians. Nevertheless, very few images of the kind were produced in pre-urban societies. It is at this point in Wengrow's argument that socio-economical and institutional factors come in. With the rise of urban societies, the increase of demographic density, the proliferation and networking of economic goods, and the expansion in maritime commerce, adopting means to indicate the origins of products and their ownership became a necessity. If I understand Wengrow's argument correctly, composites spread because they were recruited to serve as brand names and as the basis of a system of heraldry (secular and religious). For instance, a vessel on which some composite was printed – such as the one depicted below – could be traced back to the producer of the vessel (and its reputation) because only that specific producer was authorized to use, let's say, a human-headed griffin. In contrast, another producer might use a snake-headed griffin, etc.

Cylinder Seal with Human-Headed Griffin Attacking a Horse, between 1400 and 1200 BC (Middle Assyrian)
(Photography by Walters Art Museum)

If this is right, then it is unclear why Wengrow bothers at all with the shock-value of the counter-intuitiveness of composites. In fact, cognition *per se* seems to play no distinctive explanatory role in the argument: the success of composites in new urban societies seems to be due to their socio-economical usefulness as a modular system of representation for an increasingly institutionalized world. This usefulness, in turns, is based on their flexibility as symbols – their modular nature allows an indefinite number of animal part combinations – and their expressivity – they can be used to arbitrarily represent many different things (p.71–73).

In what follows, I suggest that cognition did in fact have an important role in the rise of composite imagery, but that contrary to Wengrow's thesis, this role is not one of shock-value. In fact, I argue exactly the opposite: composite only rarely shock our folk-biological intuitions. The naturalness of composites is the rule rather than the exception. The very modularity of composites – the fact that they are flexible symbols – and the centrality of "anatomical correctness" for imaginary creatures – the fact that they are flexible, yet constrained in this flexibility – points to the underlying cognitive processes involved in the "assembling" of composites. I suggest that these cognitive processes have an important role in explaining the distribution of different composite images, more specifically in explaining why specific *variants* of composite images – specifically natural, well-formed fictive animals – are persistently reconstructed whereas others, less-intuitive forms are less readily reconstructed.

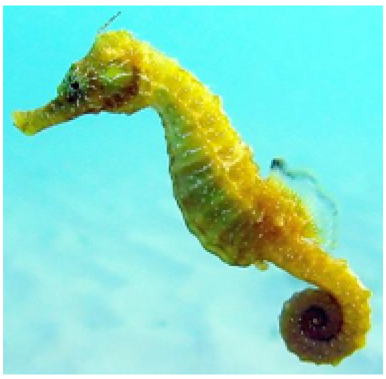
Shock-value or flexibility?

As mentioned above, composites represent fantastical creatures, but creatures that nevertheless maintain a certain "coherence on the anatomical plane". Composites are "anatomically correct", even though they do not represent any real species of animal with which their correctness can be compared. Wengrow explains this idea by claiming that "n violating some limited part of intuitive biology, composites thus typically affirm many of its underlying structural principles. Legs are still positioned for walking, eyes for seeing, wings for flying, […]" (p.28) Wengrow suggests that the "structuring principles" are part of our folk biological intuitions. I concur. However, Wengrow fails to offer any detailed account of these "structuring principles" and how they are used to assess the correctness of a composite's anatomy.

This lacuna becomes especially salient – and confusing – when we ask what is supposed to be shocking in an imaginary creature if it is nevertheless "anatomically correct". Wengrow claim that composites are shocking because they have one foot in reality and the other in the supernatural, this being due to their fictive character (see the first quote above). However, nowhere does he explain what in the mixture of fiction and composition is supposed to lead to the supernatural. In fact, most composites dealt with by Wengrow could be part of Earth's natural history, at least intuitively.

Consider that some existing animals may well be described as composites. That would not contradict their naturalness. The platypus is basically a muskrat's body, a beaver's tail, and a duck's bill. Here, although we could represent the animal by joining together the parts of the different species, it does not make the platypus a supernatural creature, nor even a particularly shocking being for that matter. Contrast now with the hippocampus, a Greek and Phoenician mythological creature composed of a fish's body and a horse's head and neck. The composite was likely a fiction then, and according to Wengrow, its composite nature is supposed to shock our intuitions and evoke the supernatural. However, later on it was discovered that hippocampi or sea horses – fishes with horse-like heads and necks – do in fact exist. What these two cases show is that composition and fiction do not make an image shocking and unnatural. At the very least they are not sufficient conditions for producing intuition-shockers.

Section of mosaic floor from the Roman Baths at Bath, representing a sea horse.
(Photography by Andrew Dunn)



The Black-Sea seahorse (Photography Florin Dumitrescu)

Contrary to Wengrow, I believe that early-urban composites are in fact rarely if ever shocking. On the contrary, I believe that they tend to maximally satisfy our folk biological intuitions. Only in specific circumstances do they fail to do so. I suggest that this is because there is a "proper" way to build composites, one deeply based on our cognition, but not one based on shock-value. Rather, I argue that the flexibility of composite is due to their modular structure, and that this modular structure is in fact a product of our folk biology. Thus, when the Mesopotamian start exploiting the flexibility and expressivity of composites for socio-economic reasons, they in fact exploit their cognitive makeup to serve new cultural functions, namely to assemble modular interchangeable animal parts according to a schematic body plan structure. The remainder of this critical comment aims to offer a basic skeleton of what role cognition may in fact play in the advent of composites.

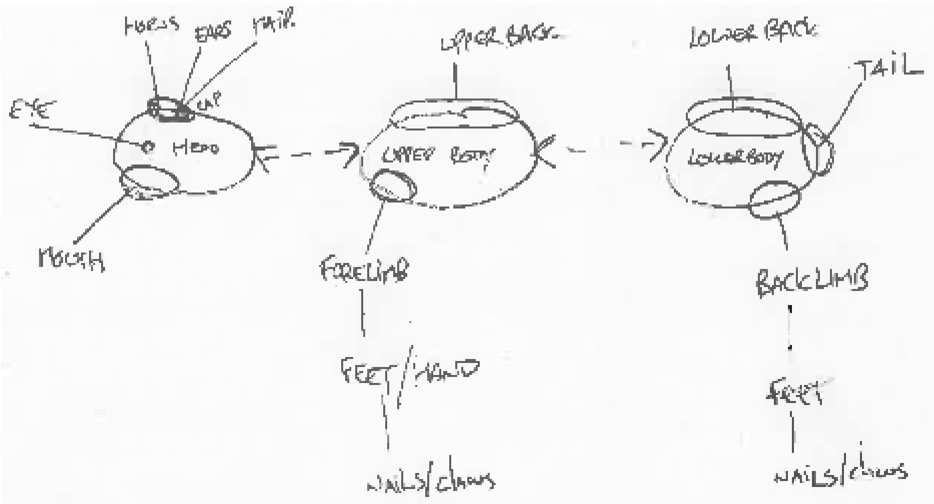
The modular structure of composite body plans

The imaginary creatures discussed by Wengrow exhibit a very strict uniformity in body plan. Their anatomical variation seems highly constrained. In fact, they share important body-plan properties that could have been altered but are not, or rarely so. Composites usually represent imaginary animals with bilateral symmetry and with an anterior-posterior axis. Composites always have sensory and locomotory organs, etc.

In contrast, the specific body parts they are made of greatly vary, but in systematic ways. First, the interchangeable body parts all serve a distinct function. We find full paws or full eyes, but no half-eyes or finger-less paws. Second, the varying body parts usually serve the same function in the composite as they did in the original animal. Heads are used as heads, torsos as torsos, limbs as limbs, tails as tails, etc. We do not encounter composite using their horns to walk, their legs to eat or bite, their tail to see, etc. The organ's specific function is preserved. Third, the general anatomical relationship between functional parts are maintained. We do not see (or rarely do so, see below) composites with mouths located where we would expect eyes, with tails where we would expect a mouth, or torsos where we would expect legs, etc. The "location" of the body part in the general economy of a typical animal body plan is generally preserved in composites. Fourth, not every body parts are used as detachable modules for creating composites. Variation in composites seems to concentrate around the joints of a general body plan structure, with specific functional organs serving as interchangeable modules. Legs and hands/paws are used interchangeably, but not knees nor calves, for instance. So not all salient organs serve as modules for composition.

All together, these four regularities in composite variation suggests to me that the interchangeable parts – the building blocks of composite imagery – seem to be individuated in terms of their folk biological, relevant functions. Head parts (eyes, mouths, horns, etc.) and appendages (limbs, claws, wings, etc.) tend to be important when it comes to identify and interact with an animal, such as a predator or a prey. They also tend to be used as interchangeable modules in the production of composites. Other body parts do not seem to vary in composites. A composite's legs (considered independently from the feet/paw) is usually borrowed as a full leg – of a human or of an animal – including a thigh, a knee and a calf. We do not encounter composites with lion thighs, human knees and fox calves. This is because calves and thighs do not have their own unitary function, at least, not in folk biological terms. They participate to the legs unitary function: walking, jumping, and running.

What these observations suggest is that composites are built according to a basic body plan. This schematic animal body plan appears to be organized in terms of a hierarchical organization of functionally differentiated morphological parts. Some features are subordinate to others, such as eyes always figuring on heads but never the opposite. Others can be understood as being set at the same level, such as eyes and mouths both figuring on heads, or heads and torsos serving as two superordinate body parts (see drawing below). Creating composites seems to obey the following general rule: when using a body part of an animal to assemble a composite, the location of the part in in the composite must be the same as in the original animal's body plan. Heads are accordingly exchanged with heads, forelimbs with forelimbs, etc. Superordinate parts such as heads typically bring with them the transfer of their subordinate parts (e.g. eyes). However, subordinate parts can be transferred independently of their superordinate system (e.g., you can exchange feet for paws while keeping human legs, as in the two first composites depicted above).



Wengrow does not tell us where the modular structure of a body plan comes from, or how it is articulated. He does suggest that it is only when the techniques used to represent animals get more precise and subtle that the animal image becomes properly modular: “Precisely because of their fictive character, the creation of visually compelling composites requires *enhanced* accuracy in the depiction of individual body parts, each of which should be rendered at a common scale and should be clearly identifiable, in and of itself, as belonging to a certain kinds of species” (p. 26; emphasis in original).

Of course, in order to systematically produce composite images, it is necessary that each body part be representable independently from their original animal. However, artisanal techniques and social norms are insufficient to explain the modularity of composites. First, they do not explain how the body parts were individuated in the first place, nor why there is a preference to exchange body parts with similar functions instead of some other relations. In contrast, assuming a folk biological origin for the modular body plan of animal representations answers both problems. Second, even when accurately depicted and following social norms of representations, not all such body parts are used in a modular way. Consider the very well defined and impressive standardization of human calves in Mesopotamian relief carving (see figure below). We do not encounter composites with lion thighs followed by human calves and then lion paws. Although visually salient and following strict norms of representation, human calves simply do not appear to be a composite’s module in Mesopotamian imagery.

Part of ‘Relief with Winged Genius’. This relief decorated the interior wall of the northwest palace of King Ashurnasirpal II at Nimrud, which is situated in present-day Iraq.
between 883 and 859 BC (Neo-Assyrian)(no copyrights)

Analogical reasoning and coherence maximization

So far, our folk biological expectations about the basic scheme of an animal body plan and our intuitions about the biological function of body parts offers an explanation of the modular "joints" of composites in Mesopotamian fantastic imagery. Now I turn to the rules apparently used for creating composites, which I also suggest originated in our cognitive faculties. More specifically, I argue that composites are assembled by reasoning analogically over the functional structure of a generic animal body plan (such as the one drawn above).

Cognitive theories and experimentation on analogical reasoning typically agree on three key points. First, analogical reasoning is a structure-mapping process where two abstract structures have their different parts mapped onto one another (Gentner 1983). An analogy is not based on superficial similarities between two objects such as shared material properties. Planet Mars is not analogous to a tomato because it is also red and round. Analogies also do not concern specific relations between two objects. Planet Mars is not analogous to a tomato because they both have water under their surface. Rather, analogies concern abstract relationships, or relations of relations, such that sound propagation and electromagnetic radiation are analogous because they both can be described through a wave function. A body part in one species is analogous to another if, for instance, they share a common biological function. So lion limbs and human legs are analogous because they are both used for walking, running, jumping, and standing.

Second, analogical reasoning consists in inferring something new on the basis of the matching of two abstract structures. In the specific case of composite imagery, the novelty is the composite itself, with the "sources" of the analogy being the different animals the parts of which have been borrowed.

Third, the "quality" of an analogy relies on satisfying several cognitive constraints, such as structural consistency and semantic similarity, which should be optimized to increase the strength of the analogy (Holyoak & Thagard 1989). In the present context, the maximization of structural consistency can be understood as the maximal conservation of anatomical relationships in the composite, such that the borrowed animal body parts will tend to maximally respect the structural schema of the animal body plan, as drawn above. The maximization of semantic similarity means here that the animal body parts borrowed to assemble the composite will tend to serve the same biological function they did in the original animal.

I suggest that the construction of composites is a result of analogical reasoning and that composites will generally tend to optimize the structural match between similar functional parts of the animals used as sources for the composite. It is by assessing the structural consistency and the semantic similarity of a composite with that of the source animals' body-plans that we measure anatomical correctness in fantastic creatures. The less a composite satisfies these two factors, the more aberrant it will be. I will use 'coherence' when referring to structural consistency and semantic similarity together.

If the hypothesis suggested here is roughly correct, we should expect two kinds of observations. First, we should observe that maximally coherent composites constitute most of the repertoire of composite imagery found in the archaeological record. A corollary to this observation is that more aberrant forms do exists, but that they will be less frequent. Second, composites made from source animal parts having conflicting locations and/or functions will tend to maximize either their structural consistency or their semantic similarity. When this is not possible in any principled way, composites made of the very same conflicting parts will tend to solve the tension in different ways, thus leading to more anatomical variability in these problematic cases. The first hypothesis is straightforward. Most composites should not be very aberrant, and they are not. However, this also means that most composites have very little shock value as they typically are well-organized creatures that could exist in the natural world (remember the hippocampus). The second hypothesis is less obvious, and requires some further elaboration.

Imagine that we want to create a composite with two source animals that differ in some of their body parts such that one of the two animals has a body part with a specific function that the other animal lacks. For instance, imagine you are producing a composite with a bull and a lion as source animals. Bulls have horns, lions don't. The semantic similarity condition cannot be perfectly satisfied here because lions have no body parts functionally analogous to the bull's horns. There are two solutions to this problem. The first one is simply not to use horns in building the composite: the tension is resolved through omission. The second solution would be to use the horns but to use them such that structural consistency remains maximized. In the latter solution, the problematic part (the horns) can be joined to the composite so as to reflect their anatomical location in the original animal's body plan (the bull). Bulls' horns are located on their forehead, lions have forehead, then the natural location for bull horns on a composite with a lion head would be to fixed them on the composite's forehead. Following the same principle, a fish dorsal fins goes on the back of an antelope (see figure below).

Ritual Knife with rows of animals on both sides of the handle (close-up), ca. 3300-3100 B.C.E. Flint, elephant ivory, 2 1/16 x 9 3/16 in. (5.3 x 23.4 cm). Courtesy of Brooklyn Museum, Charles Edwin Wilbour Fund, 09.889.118. Creative Commons-BY; modified for close-up.

A second kind of problematic composite appears when two body parts of different functions conflict for a same location on the composite's body plan. Consider the cases of composites with non-bird (e.g., land mammalian) body plans that nevertheless possess wings. No land-based mammalian possess clear functional analogues to wings. In the case of the lion with the bull horns, we could simply add the supplementary part where it was "missing". However, wings and mammalian forelimbs conflict as they both occupy the same structural location on an animal body plan – they are forelimbs, see body plan scheme above –, but they do not have the same function.

Is there such a thing as an anatomically correct location to put wings on a land-based animal composite? Contrary to the case of the lion with horns, there is no obvious answer or clear rule to follow as to what would maximize the coherence of such composites. One solution would be to replace the forelimbs with wings. Another would be to start the wings under the arm pits so that they are both located in the same place. Inversely, we could put the wings on the shoulders or on the upper back of the composite. Then again why not on the lower back, the head or even the feet? There is no necessity to solve the problem in any of those ways since they all seem to offer some coherence to the composite without any solution being obviously better than the others. Perhaps it is more satisfying to have the wings close to the shoulders – with the shoulders serving as an attractor point – but then again, there is no clear rules as to how to choose the "best" solution.

The lack of principled solutions to these sorts of problems means that we are likely to observe many different solutions for a same set of conflicting parts. This in turn will result in more variation in composites with the conflicting parts – i.e., in the location of wings on land animals' body plan (e.g., wings on heads, wings on upper back, wings on arm-pits, wings on lower-back, wings on feet, wings instead of upper limbs, etc.) – than we would with composites with no conflicting parts (e.g., composites with an head usually all have their head where we would expect it). At the same time, among this variation, we should expect to find wings more often around the upper limbs of the composite, such as replacing the arms, on the upper back or under the arm pits, since it is in that structural region that wings are located on birds. Wings elsewhere would be less intuitive, but not dramatically so. This prediction seems to be supported the sample of composites Wengrow uses in his book. The table below shows a count of such winged composites found in the figures used in *The Origins of Monsters*. Obviously the data set is not large enough to make any conclusive demonstration; I can send the list of figures on demand.

Wings as arms	6 composite images
Wings under arm pits	7 composite images
Wings on upper back/shoulders	4 composite images
Wings on head	3 composite images
Wings on middle and lower back (perhaps should be divided as two variants)	5 composite images

Note: as far as I could find, no winged land animal composite clearly had their wings closed on their side, whereas there are representations of birds with their wings closed on their side.

Finally, even among profound composite aberrations there seems to be some rules of maximizing coherence. An example of composites failing to maximize their coherence are those that break the rule of an anterior-posterior axis. For instance, the figure below is engraved with a composite breaking the rule of an anterior-posterior axis by having two heads and no posterior (limbs have been replaced by the symmetric repetition of the upper body). The modular structure of the body plan identified above shows why the anterior-posterior axis is generally respected: it is implicit in the fact that anterior and posterior appendages do not have the same functional role and structural organization. However, in this special case, the aberration might be better explained by its role in the general decorative economy of the object. The two-headed aberration is centrally located so that its symmetry axis is aligned with the symmetry axis of the object on which it is engraved. Aberrations of this kind might be better understood as satisfying esthetic desiderata, but this is an empirical investigation in which I will not commit myself here. Moreover, notice how the body plan remains highly coherent on each side of the symmetry. The symmetric freak does not disintegrate into a chaotic mush of body parts arbitrarily sown together. As developmental biologists know very well, even monsters follow strict rules (Gould 1977).

Egyptian apotropaic wand (or “knife”) made from hippopotamus ivory, 19th–17th centuries BC, in the British Museum (no copyrights)

Conclusion

The lack of a clear theory of what the modular structure of composites consists of belies the fact that Wengrow does not really develops on the *cognitive factors* (vs. social-economic and technological factors) of the *production* of composite imagery. This is surprising given that cognition might serve as a unitary basis for the multiple historical origins and convergences of composite imagery, such as in China, Meso-America, the Pacific North West, etc. In fact, Wengrow even acknowledges that his theory is limited to the Mesopotamian origins, arguing that the case for China does not depend on mechanical reproduction (pp. 83–87).

Here, I have argued that shock-value has very little to do with the composition and cultural success of composites. Rather, it is their flexibility and their expressivity that makes them so useful, and both flexibility and expressivity rely on our folk biological intuitions about anatomical correctness and our generative capacity to assemble arbitrary forms through analogical reasoning. Finally, analogical reasoning is based on a logic that seeks to maximize the coherence of the composites by maximizing their coherence. Contrary to Wengrow, I feel that non-aberrant, natural (but fictive) monsters are more popular than intuition-shocking, supernatural aberrations.

Modern impression on clay of Achaemenid cylinder seal, 5th. cent. BCE. A winged solar disc legitimises the Persian king who subdues two rampant Mesopotamian lamassu figures.
(Credit: Hjaltland Collection. CC BY-SA 3.)

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