

Artifacts, analogy, and metaphor: Inferring the cognitive foundations of metaphor from an archaeological and comparative perspective

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Metaphor has been shown to be a central process in human language and cognition (Lakoff & Johnson 1980). Moreover, it has also been assigned an important role in the evolution of language (Smith & Höfler 2015; Ellison & Reinöhl 2022). Uncovering the evolution of metaphor and the cognitive processes supporting it therefore presents an important part of explaining language evolution. Importantly, metaphorical cognition should not be seen as a unitary ability, but instead of as a multicomponent mosaic of underlying abilities that constitute it (Holyoak & Stamenković 2018). Such a ‘decompositional’ view has the advantage that the individual cognitive processes underlying metaphorical cognition and their evolutionary foundations can be investigated separately (Pleyer et al. 2023). This also has the advantage that the evolution of the cognitive foundations of metaphor can be traced with a deeper time depth than if treating it as a singular ability. Specifically, it allows us to investigate whether any of these abilities are evident to a degree in the behaviour of non-human animals, and whether they can be inferred from the archaeological record. Here, we focus on tool use as a source of evidence for the evolution of one central process supporting metaphor: analogy. We focus on analogy because “metaphors are predominantly relational comparisons, and are thus essentially analogies” (Gentner 1983). Specifically, we present two sources of evidence to investigate the evolution of analogy: archaeological and comparative data on tool use.

From the archaeological perspective, we propose to look for analogical abilities in the creation of stone tools, as it is widely accepted that analogy plays an important role in tool production and the invention process (Krumnack,

Kühnberger, Schwering & Besold, 2020; Osiurak & Reynaud, 2020). Although it falls within the realm of cognitive archaeology, there are few examples of discussions of analogical capacities in prehistory (e.g., de Beaune 2004), and they concentrate on their evolution through different time periods. Here, we propose a methodology to look for analogical capacities in archaeological artifacts at a particular point in time. We suggest considering the productional diversity (i.e., different ways to achieve the same goal) of an archaeological collection. Differences in *chaînes opératoires* leading to the same productional goal may indicate the presence of problem-solving situations necessitating analogical capacities, as they presuppose the capacity to adapt known solutions to similar problems. Specifically, they do so based on analogical relations between a mental template representing a retrieval source on the one hand, and materials to be knapped or shaped, onto which inferences based on previous knowledge should be mapped, on the other. We develop this methodology using the examples of the Collection de la Pointe aux Oies, Wimeureux, France (Tuffreau, 1971) and the Collection de la Grande Vallée, Colombiers, France (Hérisson et al., 2016). The two collections differ in their modes of production: one consists of cores and flakes, and the other one of handaxes. The two examples will allow us to illustrate how our methodology can be implemented on different types of prehistoric tools.

From the perspective of comparative cognition, analogical abilities have also been found in tool use. For example, New Caledonian crows use two types of tools—hooked-twigs and stepped-cut tools—to achieve the same goal: looking for food in living and dead wood (Hunt, 1996). The manufacture of the hooked tools includes multiple steps with variations of material and ways of manufacturing (Hunt & Gray, 2003). Similarly, wild chimpanzees use leaves and moss as sponges to absorb water (Hobaiter et al., 2014), and their hands and folding leaves as “containers” to drink water (Sousa, Biro & Matsuzawa, 2009). They also crack nuts with a hammer-like tool on an anvil. The selection of the toolkit depends on multidimensional features, such as weight, material, distance to nut and the anvil (Sirianni, Mundry & Boesch, 2015). These data suggest that nonhuman animals can use different methods to achieve the same productional goal in an analogical fashion. Furthermore, there is also evidence for relational reasoning in nonhuman animals. Examples include honeybees, birds and nonhuman primates (Giurfa, 2021; Smirnova et al., 2021; Christie et al., 2016).

In sum then, we propose that investigating archaeological and comparative data on tool use and analogy can serve as a fruitful methodology to shed light on the evolution of metaphor and its underlying cognitive foundations.

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