Snakes and ladders in the evolution of language

A comment on "`Snakes and ladders' in paleoanthropology: From cognitive surprise to skillfulness a million years ago" by H. M. Manrique, K. J. Friston and M. J. Walker

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Manrique, Friston, and Walker [1] point out that it is not enough to invent a handaxe. It is also not enough to invent a handaxe, notice its utility, and employ this new knowledge to update one's neurocognitive model of chopping things. It is not even enough to do all that, and also remember the kinds of motions needed to make the handaxe, be able to replicate them, infer that a new handaxe is needed when overuse renders the original one dull, and be motivated to make another one when these new circumstances arise. For handaxe making and use to "stick" in the anthropological record, the companions of the inventor also need to notice and incorporate this information, updating their models not just of chopping, but of the affordances of particular kinds of stones. As with mates for "hopeful monsters" [2], this is never assured. As Manrique, Friston, and Walker put it, the handaxe inventor "might discover novel ways of attaining predictable (unsurprising) outcomes, though her behavior, and its outcome, may well have been disregarded by her companions, who learnt nothing from it, much less foresaw potential uses for the novelty" (p. 9).

The deep history of handaxes, as Manrique, Friston, and Walker explain it, tells us two things about the Free Energy Principle (FEP; [3,4]) and its manifestation in active inference. First, while the FEP is, in an important sense, "just physics" [5,6,7,8], it is the physics of very complicated, multicomponent systems. Whether individual cells or complex multicellulars like humans, these comprise not just hierarchically mechanistic control systems or "minds" [9], but also hierarchically mechanistic bodies that are capable of some force-delivering motions but not others. Second, the "system of interest" in virtually any biological setting – including any human setting – is not an individual organism but a group. Inference with sticking power is federated inference [10]. Hence while we know that not just ancestral hominins but animals of many species are capable of tool use, what counts is the emergence of tool cultures that standardize and preserve this capability over the long term [11,12,13].

To work in a setting in which snakes – moving parts, potential points of failure – always outnumber ladders, the physics expressed by the FEP must be very robust. One source of robustness is ubiquitous redundancy and hence error-correction capacity. Manrique, Friston, and Walker point out that redundancy can also be a snake: a plurality, at least, of redundant components must be convinced for an innovation to be preserved. One solution is to copy redundant components from a single source, e.g. proteins from DNA, but this just hides the problem under a different shell – mechanisms like gene duplication inject redundancy into "memory" structures, and the community-agreement game must be played again in this new setting.

The parable of the handaxe drives us, therefore, to the question of what makes community recognition of useful innovations possible in the first place. What enables federated inference in collectives, and why would collectives listen to minority voices? We can ask this question about microbial mats [14], biochemical pathways [15] or nucleic acids [16], but in humans a particular answer stands above the rest: language. Once humans had language, innovative ideas and techniques – and maybe more importantly, recognition of their significance – could be explained, and then spread by word of mouth, or later, by written records.

Pointing to language – indeed to any communicative system, even paracrine signaling – as a solution to the innovation recognition problem is, however, once again just hiding the problem under a different shell. Innovations in communication must be recognized and adopted by a community to be effective. As Wittgenstein [17] argued long ago, a language used only by a single agent accomplishes nothing.

Linguists disagree about whether extent human languages derive from one single protolanguage or from many [18,19]. The impressive abilities of large language models (LLMs; [20]), which are statistical models of samples of human language use, pose an additional challenge to the idea of a single, innate universal grammar, and hence to the idea of a single origin of language. If languages are like handaxes, this debate can be extended in time. How often did language-like communication systems arise in small communities, only to die out before they could be recognized and adopted by a large enough group to remain viable? Simulations suggest that languages initially shared by only a small subpopulation can "stick" given sufficient time [21], but sufficient time is never guaranteed. Could there have been dozens of "origins of language" events, with only one or a handful of these making any contribution to extant languages? What were the "ladders" that allowed one, or some, of these communicative innovations to survive and spread? These questions are analogs of questions asked in origin-of-life studies. A classic paper of Raup and Valentine [22] argues that at least ten independent "origins of life" would be needed to yield a reasonable probability of one lineage – ours, "life as we know it" – surviving, while even the assumption of a single origin leaves open the possibility of many dead-end lineages branching prior to, as well as after, the last universal common ancestor (LUCA) of the lineages for which we have evidence [23].

Innovations not only need the ladders of recognition and broad adoption to survive, they become ladders themselves if they are adopted. Advanced weapons like handaxes and advanced command-and-control systems like language are clearly advantageous when confronting competing groups that lack such tools. A ladder for one group, in other words, can be a snake for another, often one leading to extinction. More interestingly, ladders in one context can be snakes in another. Internecine conflict with advanced weapons is more likely to result in a crippling bottleneck or even annihilation that a similar conflict without them. The virtual realities enabled by language, e.g. religion, government, and finance [24], give human groups both greater fighting power and much more to fight about. Such innovations can lead to bottlenecks among the innovators as well as among their less-innovative neighbors.

By framing innovation in terms of the FEP, Manrique, Friston, and Walker emphasize that epistemic significance – meaning – is what must be shared for innovations to be adopted. Organisms are niches for meanings, and some have more "sticking power" than others [25]. They are also notoriously opaque [26]; arguments that no amount of shared experience can guarantee shared meaning go back at least to Quine [27]. Hence while they may be public pragmatically, languages are deeply private semantically. Snakes and ladders indeed.

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