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The design space of human communication and the nonevolution of ideography

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Abstract

Despite the once-common idea that a universal ideography would have numerous advantages, attempts to develop such ideographies have failed. Here, we make use of the biological idea of fitness landscapes to help us understand the nonevolution of such a universal ideographic code as well as how we might reach this potential global fitness peak in the design space.

Universal ideographies – graphic languages in which symbols encode conceptual rather than linguistic content – hold many apparent advantages, such as transmission of information across time and space, operating across language barriers, and the potential iconicity of symbols increasing ease of learning. Despite this, there are no successful examples of such ideographic communication systems. Morin's proposed solution to this "puzzle of ideography" is to explain their absence as resulting from a standardization problem, with such systems suffering from the inherent challenges raised through the need for everyone to use the same meaning-to-symbol mappings. This becomes ever more difficult as the number of symbols increases and thus restricts them to narrow domains. Here we aim to further advance Morin's suggestion that the nonevolution of ideography is largely a result of spoken (or signed) languages having been "locked-in" earlier because of their easier standardization, to the detriment of other codes. We do so through use of the concept of the "fitness landscape," which can be borrowed from its biological context to aid in understanding the nonevolution of "bad" solutions to cultural problems.

At the very end of his article, Morin notes that a "complete ideography could be seen as a peak in the design space of graphic codes (Acerbi, Tennie, & Mesoudi, 2016; Dennett, 1995; Mesoudi & Thornton, 2018)" (target article, sect. 7, para. 3). This type of thinking about cultural artefacts in terms of a "design space" inspired by the notion of fitness landscapes has proven highly useful in the past, and we wish to explore the suggestion further here, particularly in relation to the "lock-in dynamics" (target article, sect. 7, para. 4) Morin discusses. Wright's (1932) fitness landscapes posit that we can model the relative fitness of different phenotypes as a "landscape" across which there are fitness "peaks" where organisms are doing as well as possible within the "local" set of possible phenotypes, and "valleys" in which they would be doing very poorly. They provide a useful tool for thinking about why some species appear to be "stuck" in suboptimal solutions to their ecological problems, with the path towards a higher peak involving passing through a fitness valley, requiring the organism to become temporarily less fit than others in the population, and thus often blocking the path towards better solutions. Similarly, cultural innovations such as communication systems may be stuck at a local fitness peak in the design space with no way to move to a better system (the global optimum) because any individual shifting their strategy would be initially worse off, through the high costs of learning a new system, and inability to communicate with others in the community.

The effects of standardization that Morin describes may very well be the reasons for the existence of fitness "valleys" that prevent the development of ideographic communication. This is in line with another example Morin raises – that of the lock-in of the QWERTY keyboard which, as Morin points out, is now commonly regarded as less quick or efficient than other keyboard arrangements (David, 1985; David & Rothwell, 1996). However, its early adoption has led to it becoming a local fitness peak, where movement to another (perhaps higher) peak carries the cost of having to temporarily move across a lower space in the fitness landscape.

One common criticism of using the model of fitness landscapes is that, as they are typically presented, they are static and fixed. However, this is of course only an idealization and one that has been frequently criticized (Kaplan, 2008) – not a necessary feature of the model. It is entirely possible and now common to construct dynamic fitness landscapes that represent changing conditions. For example, as environmental conditions change, a strategy or technology that was once the most optimal might turn instead from a fitness peak into a fitness valley. The more rapid pace of cultural change makes this model even more plausible for cultural fitness landscapes.

Thinking about a dynamic design space allows us to explore the technological and societal changes that may be required to create slopes or neutral ridges that would shift agents towards the alternative peak of a universal ideography. As Morin has argued, spoken language has restricted us from exploring alternative strategies and here we may find ways to promote the advantages of ideographic communication. This requires acknowledgement of the difficulties facing such a change. As Morin proposes that the cultural "fitness" (target article, sect. 7, para. 4) of different communication systems is largely driven by standardization of conventions between users, this will thus be a key issue for improving the design of ideographic communication systems. For instance, network effects make languages more useful the more people use them and thus force standardization between users. This implies that the only way to make ideography viable is to improve it through use of new means.

Here, as Morin also suggests in the conclusion to his article, we think that use of new technologies provides an opportunity. In particular, online communication provides many of the benefits Morin attributes to face-to-face spoken and signed communication – signals are cheap, (semi-)transient, and there is opportunity to repair miscommunication. Indeed, this has already brought us quite a long way – think of the standardization of emojis across platforms. Although Morin is right to point out that there is still disagreement about the meaning of emojis, we think he underestimates how standardized their usage already is, especially among those populations that use them most frequently and have grown up with them. The differences in use occur most often between cohorts, not within them. This then suggests that we might be on our way towards the elimination of this ambiguity, or at least for it to be diminished, to the same extent as there is persisting acceptable ambiguity in spoken languages. Standardization of meaning does not have to imply universal agreement. We suggest that changes in communication technology may sufficiently alter the fitness landscape to make the peak of a general ideography accessible, but that more work would be needed to refine the model and test the predictions.

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Graphic codes, language, and the computational niche

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Abstract

Human language looms large in the emergence and evolution of graphic codes. Here, I argue that language not only acts as a strong constraint on graphic codes, but it is also a precondition for their emergence and their evolution as computational devices.

Graphic codes are ultimately a collection of human technologies that serve a computational role: To store, transmit, and process information across space and time. In this respect, the emergence and evolution of graphic codes is (partly) a story of how humans have continually optimized and expanded the computational resources at our disposal. Thinking of graphic codes as occupying a computational niche helps enrich Morin's general argument in two ways. First, because of the presence of language, which itself is a powerful computational system for thinking and communication, we should expect graphic codes to fill in functional gaps in the storage, transmission, and processing of information. Second, any expansion of graphic codes is dependent on language, which serves as a strong constraint on the emergence and evolution of such codes.

As Morin aptly put it, language acts as an "oral crutch" that "prevents graphic codes from learning to walk" (target article, sect. 6.3, para. 4). This is evident in the evolution of writing that was initially restricted to transcribing proper names (Morin, 2022). The latent potential of writing, as both a general-purpose glottography and its use as an asynchronous communication device, evolves centuries after its invention (Morin, 2022; Morin, Kelly, & Winters, 2020) and illustrates how language acts as a strong constraint: It is not immediately obvious that a general-purpose glottography is useful when oral language already exists, and it is only when this functionality is discovered that asynchronous communication is distinctly advantageous. However, although spoken and signed languages, because of the ease by which they are standardized, constrain and delay the emergence of sophisticated graphic codes, such as writing, there is a case to be made that language is also an important enabling condition.

One possibility, which was absent in Morin's target article, is that language lowers the barrier for graphic codes to emerge in the first place. A tally system, for instance, is far easier to invent and disseminate in a species where language is the basis for communication and learning. This is possible because: (1) The expressive power of language allows graphic codes to be massively underspecified and (2) language serves as the basis by which humans acquire knowledge of how to use the code. By filling in gaps in inference and interpretation, language makes it possible for simple graphic codes to exist by enriching the context in which these codes are learned and used. Moreover, the use of language as a pedagogical tool helps explain how graphic codes can rapidly spread and become standardized in a community. It is, of course, possible to envisage graphic codes that emerge and are standardized through observation and other nonlinguistic behaviours. However, it is telling that we do not observe even rudimentary graphical notation in nonhuman animals – simple graphic codes appear out of reach for the inventive capabilities of most species. In cases where we do observe the use of graphic codes in nonhuman species, such as Kanzi and his lexigrams (Rumbaugh et al., 1973), the underlying systems are invented by humans.

A similar argument can be made for the impact of writing on the emergence of subsequent graphic codes. The standardization account can point to why powerful and specialized graphic codes, such as rich systems of mathematical and musical notation, are difficult to discover without writing. A world in which writing has been invented, and serves as a coordination device in a population, makes it far easier for individuals to invent, standardize, and learn novel graphic codes. Crucially, it is the ability to communicate general-purpose information asynchronously, which lowers the barrier for our modern systems of mathematical and musical notation to exist. This leaves us with a key unanswered question: Are such systems likely to emerge in a counterfactual world where writing was never invented?

Lastly, if writing is adapted to exploit and expand the computational niche in which it is situated, then this helps explain why a fully fledged ideography is unlikely: A richly structured ideographic system is unnecessary in a world where writing exists.