
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. **Note:** *This is an updated BBS commentary on Morin (2023). Some notable changes include the addition of several references that were absent in the original.*

Keywords. cultural evolution · evolution of writing · graphic codes · computational constraints

1 Introduction

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 (for a broader argument on this point, see Winters and Charbonneau, 2025). 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 (Berwick *et al.*, 2011) and communication (Fedorenko, Piantadosi and Gibson, 2024), 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” (Morin, 2023; sect. 6.3, para. 4). This is evident in the early evolution of writing wherein it 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, only evolves centuries after its invention (Morin, Kelly and Winters,

2020; Morin, 2022) 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. Although spoken and signed languages constrain and delay the emergence of sophisticated graphic codes, such as writing, there is also a case to be made that language is 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. Writing is eminently more learnable than an ideography, largely because of its parasitic relationship with language, and it fulfils all of the same functional roles in the computational niche as a hypothetical ideography.

In fact, as Morin highlights, the key advantage of an ideography is its independence from language, which, in principle, would mean an individual who speaks Mandarin could readily communicate with an individual who spoke English or Darija – so long as populations invested time and resources in learning this system. Yet, even in this specific instance of cross-linguistic communication, it seems unlikely an ideography is particularly advantageous, especially in a world where translation technologies are at our disposal. But 🤖 (who knows)?

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