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Rewriting the Environment, Remaking Humanity: Niche Construction, Creativity, and Cultural Evolution

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Rewriting the Environment, Remaking Humanity

Niche Construction, Creativity, and Cultural Evolution

The issue of "extended writing" is addressed in comparison with traditional writing in a wider context considering the cognitive and the environmental dimensions of the issue. Reflecting on the notions of niche construction and affordance – and the consequent idea of a strong organism-environment complementarity – we emphasize how human cultural niche construction is creative, rich in meaning ("meaning-full"), and teleological. Hence, after discussing some analogies and differences between "traditional" and extended writing, we highlight how the aesthetic use of extended writing might favour the emergence of novel ends for such a technological practice – in line with our understanding of cultural evolution more generally. We conclude by emphasizing that "rewriting the environment" – with its links to affordance perception, niche construction, creativity, meaning richness, teleology and cultural evolution – has brought, currently brings and likely will bring about substantial "remaking of humanity". Extended writing is thus framed within this wider, empirically based, conceptual framework.
Keywords: Affordance, Creativity, Cultural Evolution, Meta-Operation, Niche Construction.

1. Introduction

The notion of "extended writing" refers to an emerging form of expression and communication intertwining different modalities (images, words, sounds, etc.) in a coordinated manner. In his recent book *Technological Destinies of Imagination*, Pietro Montani builds on the notion of "syncretic writing" and states that:

> It is a fact that the emergence of the interactive Web supported the emergence of a form of *syncretic writing* that does not only combine image, word and sound but also very frequently exploits their reciprocal relations in order to obtain significant effects of meaning from this intermedial comparison – for the moment predominantly tuned into a playful, ironic and paradoxical register (I am thinking of all the "meme" forms). As well as not excluding significant evolutions and further differentiation, this

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aspect in itself already guarantees great (and spontaneous) reflexive control of the semiotic material manipulated (Montani 2022: 162).

Hence, this "syncretic writing" is not just the combination of heterogeneous elements coming from different expressing codes and soliciting different types of communication and modalities of perception. Indeed, also in the "traditional" writing there is already a combination between graphic sign (orthography), sound (phonology) and linguistic lexicon/meaning. In the intermedial context that characterizes the interactive web, the syncretic writing can be conceived, according to Montani, as an "extended writing":

> I have suggested calling this practice as "extended writing", adding that significant innovation might develop in the technologies of human expression. Indeed, the first thing to do is study the internalization processes and feedback on the imaginative and cognitive conduct of those using it (but this is a mass phenomenon) (Montani 2022: 162).

The cooperation and comparison between the "effects of sense" deriving from different media are a key feature of extended writing, which exploit a multiplicity of iconic, semiotic, textual, musical, and aesthetic sources to produce, in some relevant cases, a critical detachment between the user (or, better, the *prosumer*) and the digital content.

However, as we have suggested above, the conditions for the emergence and working of extended writing are rooted in the main mechanisms grounding the particular technology that ("traditional") writing represents and, more generally, sustaining human cultural evolution (Colagè and d'Errico 2018; d'Errico and Colagè 2018). The way extended writing works unveils important features of the general functioning of our cognitive faculties. This approach to extended writing is based on a philosophical and scientific view that takes into account the inextricable interconnection between (embodied) cognition and environment. In fact, in our view, any form of writing – *a fortiori* extended writing – should be considered as a technological development through which human cultures shape aspects of the material world that in turn affect their relationships with the environment (e.g., Malafouris 2013) and, hence, their "form of life".

In the next section (§ 2), we will show how current biology emphasizes the role of the environment in shaping the organisms dwelling in it not only through natural *selection* but also favouring the emergence of novelty in behaviour and cognition (and not just on the morphological, anatomical and physiological level). The key point is that a so-conceived environment is constantly modified and shaped by the organisms themselves in their *niche constructing* activity (Odling-Smee *et al.* 1996; Laland *et al.* 2016). This gives rise to a strong form of organism-environment complementarity (Odling-Smee *et al.* 2003; Buffon and Colagè 2022).

Then, in the following section (§ 3), we will argue that in the human case, niche construction not only is exalted in extent but also acquires specific dimensions along cultural evolution: it is creative, rich in meaning (or, "meaning-full"), and teleological. It is creative not only in the sense emphasized by cumulative culture but also, specifically, as technological developments and cultural innovations – such as, e.g., writing – affect the way in which human beings *perceive* aspects of their environment, favouring the emergence of *new affordances*. It is "meaning-full" in the sense that, through it, novel "meanings" (technical, operative, social, symbolic, as well as theoretical) emerge, spread and stabilize. It is teleological in the sense that emerging cultural novelties cannot be entirely explained by the need to solve immediate, utilitarian challenges but appears to imply elaboration of novel (often genuinely social and cultural) ends to be pursued.

After outlining the above scenario, we will come back to the topic of extended writing (§ 4) with three main focuses. First, enquiring into the analogy between traditional writing systems and extended writing according to their capability of intermingling different elements: the graphic sign (orthography), the uttered/utterable sound (phonology) and the linguistic lexicon/meaning for traditional writing; the text, the sound, the image, etc. for extended writing. Second, highlighting that the main peculiarities that extended writing enables are related to niche-construction processes; specifically, these concern the temporal (very rapid interactions) and spatial (global range) dimensions of current technologies making huge arrays of information available. Third, elaborating on the idea that the "aesthetic" feature of such practices allows for their "purposeless" usage that in turn promotes both: (i) the improvement of the technological *means*, and (ii) the emergence of novel *ends* irreducible to the satisfaction of vital needs.

The paper will conclude (§ 5) emphasizing that, as for some past cultural innovations, the repeated use of extended writing *will* affect human cognitive and even neural constitution through the modification of the environment and the *repurposing* of existing (cultural) items (Colagè and d'Errico 2023). This conclusion will hint at a further reflection on the nature/culture dichotomy thanks to the consideration of the "form of life" notion.

2. Niche construction, affordances and culture

In this section, we will deal with the interrelationships between two key notions (and their behavioural counterparts) in contemporary life sciences: niche construction and affordances. Both topics would deserve careful discussion, quite beyond the scope of the present article. However, some interesting features of their mutual connections seem to be crucial to unveil the anthropological implications of extended writing.

The notion of "affordances of the environment" – famously introduced by J.J. Gibson in the late 1960s – points to what the environment «*offers* the animal, what it *provides* or *furnishes*, either for good or ill. [...] It implies the complementarity of the animal and the environment» (Gibson 1979: 127). Interestingly, affordances concern an organism's perception as well as its possible actions and *behaviour*. For an organism to perceive an item in its environment as an affordance, both objective characters of the item and intrinsic (or, "subjective") aspects of the organism play a role. To put it sharp, a grassland certainly cannot afford a context to swim or fly; but whether it is perceived as a place to hunt, to dig a den, or to gather seeds depends on the organism perceiving it. And, patently, how an organism perceives an environmental item fundamentally depends on the *actions* it can, or must, perform. As recently emphasized by Tomasello (2022: 35), the perception of affordances is also affected by the attentional focus of the organisms in specific situations.

Niche construction is the process by which organisms alter environmental features thus modifying the life conditions of their own, their offspring, or organisms of other species in that environment. Thanks to niche construction, an «organism influences its own evolution by being both the object of natural selection and the creator of the conditions of that selection» (Levins and Lewontin 1985: 106). Construction of nests, dens or dams are the most evident examples of a widespread biological phenomenon (also encompassing relocation and migration) performed by virtually every form of life (e.g., Odling-Smee *et al.* 2003; 2013).

Now, in many relevant cases, perception of affordances and niche construction processes mutually affect and sustain each other. Affordance exploitation often turns out to be part and parcel of niche construction. We emphasize that, sometimes, niche construction leads to the *emergence of new affordances*, i.e., to a process by which some environmental aspect unveiled or produced by niche constructing activities comes to be perceived as a new affordance, as something profitable.

An eloquent example drawn from animal ethology is the case of terrestrial hermit crabs niche-constructing activity affecting so deeply their form of life to the point of triggering intra-specific social dynamics among genetically unrelated individuals of an otherwise asocial species (Laidre 2012; 2019). These crabs need a shell to survive and reproduce, but they are unable to produce one; thus, they use gastropod shells found in the environment. Importantly, these shells are extensively modified by the crabs to be lighter, thinner and more sizeable – this is the core of the terrestrial hermit crabs' niche-constructing activity. Crucially, individuals have to change shell as they grow, so that the abandoned shells can be reused by younger crabs. Field observation and experimental research showed that terrestrial hermit crabs developed a sort of "market of shells" and

ascertainable social dynamics as a consequence of their niche-constructing activity. The form of life of these crabs has been profoundly affected by niche construction, and the occasions in which shells are transacted let new social affordances emerge. Quite generally, therefore, organisms and environment show a high level of complementarity, by which organisms modify the environment and environmental aspects shape organisms' form of life (Buffon and Colagè 2022).

The process sketched in the previous example, as well as organism-environment complementarity, is exalted in humans. Massive human niche construction is so apparent that it does not need to be argued for: we modify our environment extensively and in many ways. Agriculture and farming, or the construction of stable settlements and cities, are – among many other ones – extreme (and recent) examples of human niche construction, whose effects and consequences on the human form of life are momentous (e.g.: Laland *et al.* 2010; Zeder 2017; 2018; Meneganzin *et al.* 2020). Two points are worth to be stressed here. First, human niche construction is essentially cultural; or, vice versa, culture is how human beings construct their niche. Second, through niche construction, not only practical aspects are tackled or novel action possibilities elicited, but the very *perception* of environmental items is modified. To put it straight and simply, once, e.g., agriculture and farming have been invented by a population, the perception of a forest or a grassland by the members of that population is deeply modified: *new affordances* are perceived there. And further developments can be built upon such newly perceived affordances. This grounds at a fundamental level human cumulative cultural evolution, «a process by which innovations are progressively incorporated into a population's stock of skills and knowledge, generating more complex repertoires» (Legare 2017: 7877). The interplay of niche construction and affordance perception might play a key role in the emergence of cultural innovations through cumulative cultural evolution, whereby new natural phenomena are exploited (Derex 2021), and novel combinations and repurposing of known environmental features or previously devised cultural solutions happen (Colagè and d'Errico 2018; 2023). This is consistent with the idea that human imagination is able to grasp "supervenient" features of an object related to its potential and future uses (Montani 2014; Cecchi 2022).

3. Cultural evolution, writing and the cultural niche

Cultural evolution is an expanding research topic nowadays, involving more and more disciplines (from genetics to sociology; from animal ethology to archaeology, etc.). Culture and cultural evolution are progressively acknowledged in the animal kingdom, quite beyond the human lineage

(Whiten 2019; 2021). Here we briefly discuss one of the most recent and consequence-rich cultural innovations of our species: literacy. The first known writing system (the Mesopotamian cuneiform invented 5,400 years ago), basically consists of marks on surfaces (and all writing systems nowadays maintain this basic feature). There exist several objects bearing marks on their surfaces that have been interpreted as "artificial memory systems" (AMS) – i.e. as objects whose marks store information outside the body (d'Errico 1995; 1998; 2002). These objects are as old as 44,000 years ago, much older than the cuneiform, but are not considered as proper writing systems mainly because they lack an explicit link with a spoken language. The marks on Upper Palaeolithic AMSs were meaningful for their producers and users – they pointed to objects or events – but did not render, or establish links with, the phonology of a spoken language. Proper writing systems, on the other hand, convey meaning as they are a graphical/visual instantiation of (elements of) a spoken language. This does not mean that the linkage between meaning, phonology and orthography is univocal, one-to-one, or strict: polysemy and homophony are widespread phenomena in natural languages, and the relations among the spoken and the written language might be very complex (Harris 1993; 1995). However, writing realized for the first time a triadic conventional relationship between content/meaning, phonology/spoken words and a visual mark/orthography.

This unveils a first level of recursion and meta-operation, i.e., operating upon operations, (Garroni 2010: 177; Virno 2010) in that the establishment of an arbitrary and conventional link between a meaning and a sound (typically, a spoken word) characteristic of a spoken language is reiterated by the invention of writing and the consequent establishment of arbitrary and conventional relations among spoken words (or more basic phonological elements) and orthography or specific visual marks (d'Errico and Colagè 2018).

Marks, however, have a long history across the human lineage. 2.6 million years ago, our ancestors left marks on bones when they butchered carcasses with stone tools. These were mere by-products of a subsistence strategy. At a later time, however, those marks came to be perceived in a new way, as a potential *affordance* to convey some sort of meaning. The ability to incise marks on hard surfaces was thus exapted (co-opted) for new purposes (d'Errico *et al.* 2017). This, in turn, disclosed further possibilities to exploit this capability in more and more conventional and symbolic ways (d'Errico and Colagè 2020; 2023) – up to Upper Palaeolithic AMSs. As mentioned, with writing, the conventional and symbolic use of marks comes to be combined with spoken language to give raise to proper writing systems like the cuneiform. This combining and repurposing attitude captures a fundamental dynamic of cultural evolution whereby *creativity* is elicited and brings innovations about (Colagè and d'Errico 2023).

In the introduction (§ 1), we also mentioned that cultural evolution and niche construction progressively acquires a dimension of *meaning-full-ness* (i.e. progressively becomes richer in meaning). This is evident as far as the emergence of AMSs and writing systems are concerned. However, the use of iron-rich mineral pigments, often called ochre, along the Palaeolithic shows how this dimension is progressively built through cultural niche construction. Ochre has been used in the human lineage since 500,000 years ago (Dapschauskas *et al.* 2022). Ochre may have had utilitarian and symbolic functions. It can serve to protect skin, for example from UV radiations or insects, as well as to decorate the body, clothes and a variety of objects. A plausible scenario would be that utilitarian use of ochre predates its use for body decoration, which in turn predates its use to colour objects. Interestingly, the repurposing of ochre pigments (from utilitarian purposes, to body painting, to object colouring) would parallel an increase in their symbolic import, possibly accompanied by complexification of social structure and symbolic world.

Finally, we also mentioned above that cultural evolution and niche construction progressively becomes more *teleological* – meaning with this that emerging cultural novelties cannot be entirely explained by the need to solve immediate, utilitarian challenges but appears to imply elaboration of novel (often genuinely social, symbolic, and cultural) ends to be pursued (Colagè 2015). Patently, literacy matches this character, as symbolic use of ochre does too. The cultural evolution of the use and manufacture of shells as ornamental beads and, more generally, of body decoration, expands on this idea (d'Errico *et al.* 2023). Ornamental objects progressively acquire socio-cultural significance as inter-ethnic markers and intra-group signals of social status, and likely parallels the complexification of the social structure of our Palaeolithic ancestors. This indicates how new purposes – in this case, social ones – are progressively attributed to material cultural elements like ornaments which in turn contribute to build a *socio-cultural niche* featuring new affordances and affecting the form of life of the individuals exposed to it.

4. Extending writing: towards intermediality

Up to this point, we have seen how the origin and spread of writing systems should be placed in the context of cultural evolution whose dynamics resort to cultural-niche constructing abilities prompting: 1) the creative combination and repurposing of natural and cultural items by means of recursive and meta-operative processes; 2) the expansion of meaning externalized to the environment through the production of artefacts; 3) the emergence of novel socio-cultural ends and purposes. Importantly, we

pointed out that writing implies the establishment of relationships between different elements and codes such as graphic signs, sounds and the lexicon (the meanings of the spoken language words). If we now turn our attention back to extended writing, a comparison with "traditional" writing reveals important similarities but also interesting differences.

Indeed, the peculiar cooperation between image, sound, text, etc. that characterizes extended writing can be traced back to the triadic relationships between meaning, phonology, and orthography characterizing traditional writing. Compared to it, therefore, extended writing implies a multiplication of the codes and means of expression involved, but does not determine a real discontinuity: in other words, with the extended writing the means of expression increase in a non-predeterminable way but the use of multimodal and multisensory resources remains common to both types of writing.

On the other hand, as we have already seen at the beginning of this article, Montani makes explicit that extended writing is not simply syncretic writing. The original aspect of extended writing should be sought: first, in the innovation it brings about in the field of communicative technologies, with a significant impact on the kind of experience its "readers" are invited to have; second, in the recursive and meta-operative way it engages our cognitive faculties, especially those also involved in decoding traditional writing.

In this perspective, we can point out two main differences between "traditional" writing and "extended" writing that are related to the temporal and spatial dimensions of each of them. Indeed, nowadays, the amount of source-material and the reachable audience of extended writing is enormous, and the timings to develop and spread its products is extremely quick. In other words, extended writing expands the involved resources and users, and shortens communication timing. Of course, one could object that, from a strictly ontological point of view, a quantitative difference such as that between the two forms of writing does not seem to entail a real qualitative difference. However, what appears to be a merely quantitative difference on the ontological level indeed determines an appreciable qualitative difference on the phenomenological one. In spite of the fundamental affinity between traditional and extended writing, the difference we are trying to outline concerns the logical level on which the two different forms of writing are situated. From this viewpoint, extended writing is not just a more complex kind of writing but properly a form of *recursive* writing, applying the meta-operativity beneath cultural evolution to "traditional writing". Extended writing stems from a meta-operation on writing; it realizes a new relationship (on a different logical level) between image, sound, and traditional writing – the latter being in its turn based on an analogous relationship between the graphic signs (orthography), the sounds (phonology) and the linguistic meanings (*lexicon*).

What we are arguing for is not simply a sociological difference. The fact that extended writing takes advantage of numerous expressive resources and spreads through the Internet and technological devices to an extremely large number of people in very rapid times does not make of it a "qualitatively new" communication system. Instead, what characterizes extended writing is that it implements on a further, meta-operative and recursive level what traditional writing operates at a prior logical level. This would explain the reason why, although we do not necessarily have to distinguish traditional writing from extended writing on the ontological level, on the phenomenological level the two are qualitatively different.

Finally, we can now point out a specific aspect of extended writing related to the issue of its actual uses. As Montani says, extended writing is inclined to playful and ironic usages, which reveal a form of critical distance between, for instance, user and digital content. If extended writing is, as we have suggested, a sort of recursive writing, we can now add that its purposeless usage can be seen as a key step towards *new purposes* which might well be neither related to survival needs nor straightforwardly utilitarian. It is here worth quoting at length a passage from Emilio Garroni emphasizing the deep anthropological import of this aspect:

> Actually, in a human tool there already is, necessarily, a meta-operative component as its condition of possibility. The human tool is thinkable and explicable only if, at the genetic level, a creative capacity to operate on operations – and not just the capacity to operate only directly, by contiguity, on objects – has developed. [...] But the fact that a meta-operative dimension has grown within the operating, radically transforming the latter, supposes precisely a meta-operative consciousness capable of expressing itself even in a relatively autonomous way, that is, on levels of increasing generalization and of increasing *detachment from purposes*. [...] The human being recognizes himself as such [...] precisely in this liberation from the preoccupation with immediate purposes (Garroni 2010: 177-179, our translation, emphasis added).

Now, since it is a form of recursion of writing (i.e., a meta-operation on the operation of writing), extended writing can be unconcerned with the ends and goals of lower level operations – and so it can appear as *purposeless* – but at the same time, being *creative* in a technical and not generic sense, it can give to itself new purposes – some of which might still have to emerge in the future. In this sense, extended writing can be conceived as meaning-full and peculiarly teleological on a higher logical level in comparison with traditional writing.

5. Conclusions

As we have seen, the invention of writing has been one of the greatest and most recent innovations for humanity, whose consequences on the

human form of life are widely varied and momentous (e.g., Ong 2002). Some of these consequences can be ascertained at the neural and the cognitive level (e.g., Dehaene and Cohen 2007; Dehaene *et al.* 2015): learning to read causes measurable changes in the neural substrates and the cognitive faculties of literate individuals. This has happened (and happens repeatedly at present) without any concomitant and causally related genetic change in our species' genome. Hence, a cultural practise invented at a certain time-point is able not only to modify the behaviour of the organisms inventing and using it, but also their neural and cognitive constitution (Colagè and d'Ambrosio 2014; d'Errico and Colagè 2018). Now, if we add this point to what we have elaborated in this paper, it appears – also on scientific grounds – that cultural innovations have a marked potential to shape the populations devising them, even in absence of corresponding genetic changes. This should unveil the reason behind the very title we gave to this article: rewriting the environment – with its links with affordance perception, niche construction, creativity, meaning-full-ness, teleology and cultural evolution – has brought, currently brings and likely will bring about substantial remaking of humanity. Two further implications follow from this.

First, that technological developments such as extended writing are worth of careful enquire and reflection, not just at a phenomenological, practical, applicative or even ethical level, but specifically at the deeply anthropological level, as something with the potential to change our own form of life in ways that are not always easily predictable – quite like the invention of (traditional) writing, whose consequences where out of the sight of those who first invented and implemented it.

Second, and consequently, that technological developments can affect the form of life of a population to a dramatic extent without modifying the species-specific genetic endowment. The latter is often regarded as the core of the biological identity of a species – whereas the form of life of a population or species is considered to pertain to the behavioural sphere, which in the human case encompasses culture. The form of life, moreover, is sometimes regarded as an epiphenomenon of the species-specific identity as rooted in the genome. However, we have seen in all what precedes that the form of life can change, dramatically, even independently of genetic changes. Hence, the conceptual relationships between "form of life" and "biological species" should be reconsidered also in the light of the impact that [...] "rewriting the environment may have on remaking humanity".

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