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The presence of infinity: Linguistic universals

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Abstract

Language and languages: trying to reconcile these two facts has been maybe one of the most important motivations in the history of linguistics; certainly this is what today represents the most important challenge in understanding the nature of the mind, and at the end, of human beings. At which point are we today on the research of the linguistic universals? Let's take a step back and have a look at this.

1. Introduction

There exists two facts which belong to the basic experience of almost everyone: on the one hand, language appears like an universal experience, elementary, as fundamental and constitutive of the human being as to be able to define him: The human being is the being capable of language. On the other hand, the astonishing recognition of the diversity of languages: the irreducible experience of the particular, of the restrained, of the chaotic. Obviously, there are also marked differences in the expressive capacity of individuals, especially in the number of known words, but this is negligible compared to the substantial sharing of the immense complexity of the linguistic code by part of all human beings. We can consider for example the system of verbs declination or the almost unsurpassable difficulty of giving explicit meaning to words of common use, like the very simple case of the word "maybe". It is not, that is for sure, a strange word, but to define its meaning is an extremely complex enterprise that requires calculations and sophisticated formal models. Language and languages: trying to reconcile these two facts has been maybe one of the most important motivations in the history of linguistics; certainly this is what today represents the most important challenge in understanding the nature of the mind, and at the end, of human beings. At which point are we today on the research of the linguistic universals? Let's take a step back.

2. Universality of the language forms

Roger Bacon, the franciscan monk known by his contemporaries as *"Doctor Mirabilis"*, one of the greatest philosophers of the middle ages, summarized the idea of the universality of language forms in an unequivocal way: "Grammar is one and only one according to its substance in all languages, even if there can be accidental variations." This conclusion, literally deduced from the hypothesis — guaranteed from the theological side –- of a substantial symmetry between perception, language and reality, could not contrast in a neater way with that of Martin Joos, an American linguist, that correctly summarizes the dominant convictions of the middle of last century: "Languages can differ one from another without limits and in an unpredictable way." This was also an ideological deduction, so to speak; that is, substantially based on a theoretical prejudice, namely, that a language is, in all of its aspects, a purely arbitrary convention.

This chaotic vision has been recently proved false, both on the formal side [1, 2, 3] and in the neuropsychological side (see [4] and references therein). Nevertheless, apart from the *lack of* experimental studies that rendered it plausible, it is interesting to note how this vision was welcomed because of the defence of epistemological relativism that it carried associated to it, as it was perfectly suited to justify a technological vision of the mind that today seems to return dressed as "biological discovery." In addition, the effort towards the reduction of cognitive capacities to formal mechanisms that are essentially predictable once the contextual conditions have been defined –- an idea once called "cybernetics", and that now resists, even with a loss of popularity, with the tag of "artificial intelligence" — was also sustained by a mobilization of funds and people that in fact constituted a mode to recycle the experiences accumulated in the sector of military communications during the second World War.

There is also in this case a direct testimonial that I believe will be clearer than any other elucubration. Who speaks are logicians and mathematicians of great fame, from the electronics laboratory of one of the most prestigious technical universities of the United States, the Massachusetts Institute of Technology: "There was in the laboratory the general and irresistible idea that with the new knowledge of cybernetics and with the recent techniques in information theory we had arrived to the last step towards the complete understanding of the complexity of communications between animals and between machines" [5]. It was precisely at the MIT that, also as a reaction to this reductionism, Noam Chomsky showed, using a mathematical model, that none of the known algorithms could automatically generate a complex structure like that of human language [6].

With this, Chomsky recognizes immediately that the heart of human languages is constituted by a capacity of manipulating primordial elements (words) producing potentially in-

finite structures (phrases) following schemes that are discovered just as physical laws are discovered, traditionally known as syntax. The manifestation of infinity on a basis of finite elements — i.e., syntax – can be qualified as the distinctive tract of all human languages, and therefore of language as well.

This discovery has in fact completely changed, not only the status of linguistics, but also that of neuroscience in general, putting the language back at the centre of empirical studies and in many cases making language the model for the study of other cognitive capacities, like those related to mathematics and to music. There exists at least three important consequences that follow form this first intuition.

The first consequence follows directly from Chomsky and can be immediately understood from this quote: "The fact that all normal children acquire comparable grammars of great complexity with notable ease suggests that human beings are *in some mode designed* for this activity, with a capacity of dealing with data and to formulate hypothesis of unknown nature and complexity" [7]. The second consequence is in some sense implicit in the first one: if man is designed in an special way, this design must be somehow established biologically, and thus it should be possible to trace back the neurobiological elements to which they are correlated; such elements cannot but be universal, as universal are all biological features of human beings. Such an intuition, based on observational data of a comparative kind, has been verified in a substantial way in the last decade by radically innovative experiments performed using the techniques of neuroimaging. The clinical foundation, that since always had constituted the master way for the study of the biological fundamentals of language (see for example the classic work of Lennerberg [8]), is indeed now complemented by new methods that avoid the need of proceeding only in the presence of pathologies.

3. The limits of Babel

The universal linguistics, at least that related to the syntax, can be in some way traced back to the functional and neuroanatomical structure of the brain, giving new voice to the intuitions so easily abandoned in the conventionalist interpretation of language in the first half of the last century. The limits of Babel, therefore, not only exist, but they can also be discovered in our flesh before any single experience: they are not the effect of an arbitrary convention – for a critical illustration, see [4] and references therein[1].

[1]The chosen technique to investigate the brain in the experiments described here is the so-called neuroimaging technique: in practice, the study of the metabolic activities of specific encephalic regions by measuring blood fluxes. The two main techniques are the Functional Magnetic Resonance (fMRI) and the position emission tomography (PET). It is important to beware of easy illusions. The research on neural networks with neuroimaging techniques can in some sense be compared to the attempt of reconstructing the map of the different cities of our planet having as unique data the flux of passengers at the airports: one can expect at the very best to have an approximate idea of the dimensions of the cities. The comparison is overly optimistic though: the number of possible circuits constituted by the hundreds of billions of neurons that on average

Finally, the third consequence consists on acknowledging that this linguistic model, based on the capacity to construct infinite structures starting from a finite set of elements, is unique of the human species. All living beings certainly communicate, but only human beings have this capacity for producing potentially infinite structures. Despite some surprising resistance, that this is the status of affairs is known at least since the seventies [10]. This conviction is such, for someone that studies the structure of communication codes, that it was the object of a plenary conference of the American Association of Linguistics [11], and even that, as it is easy to imagine, carries a definitively ecumenical character.

This characteristic of unicity, combined with the property of producing potentially infinite structures, has in turn a fundamental consequence that cannot be forgotten in any speculation about the evolution of language, or better about its filogenesis. Indeed, it must be clear that, being the capacity of producing potentially infinite structures, a specific character of human communication, it is theoretically inadmissible to affirm that there exists a gradual difference of this characteristic between the animal species: infinite, indeed, is either completely so, or not at all. One cannot just have a slice of infinity. Therefore, there cannot be similar languages to the human language, since any finite set, large as it may be, cannot be similar to infinity. Finally, another remark of the linguistic relativism, based not on rules but in the inventory of words: in the fifties of the last century a hypothesis took canonical form (which in ways more or less explicit was already circulating for quite some time), namely the idea that different languages correspond to different world visions due to the different vocabulary that each language possess (the so called Sapir-Work hypothesis).

4. Measuring the world vision

Let us emphasize: there are not only ways which are more or less effective in acting in the world — this is so obvious as stating that anyone trying to master a given technique must at the same time assume the basic wording — but there are also true and real different sensorial perceptions. It is not difficult to understand how, beyond this incarnation of relativism, was hidden the attempt, more or less explicit, of providing a gradation of merit between different languages, as if some of them were more suited to the perception of reality. Let me insist: perception. It is clear, for example, that in a language such as German, where building composite words is much more frequent than in Italian, one has more experience in building new suitable terms that allow to avoid periphrases and paraphrases, but from this to say that whoever speaks German sees a radio (or a dusk) in a different way as someone who instead speaks Italian is an unacceptable logical leap.

form an human brain is of the order of 10^{10^6}: a network beyond imagination if one takes into account that the number of particles of which the universe is composed is around 10^{72} [9]. So it is little what can be seen, but it is nevertheless not negligible.

This implies that, on top of any ethical judgement, this hypothesis simply fails to reproduce the observed data. In the meantime, having a measure for the world vision is not possible: it does not exist even in theory a metric that allows us to understand if who speaks Italian or who speaks Tagalog perceive the world in different ways. It would be needed first of all to reach an agreement on what "world vision" really means. But in the very few cases where performing an experiment is acceptable, it shows that the world vision does not change by varying the language; if anything what might change is the interaction with the world. The example of the research of the colour names is paradigmatic in this respect. People called to distinguish different colours put over a table (without giving them a name) do not act in different ways: the perception remains the same even when the dictionary changes.

But let us mention that even this universalist vision has reductionist risks. We cannot forget that the scientific study of syntax is born in the second half of the last century to provide solely a description of the degree of variation of the class of human languages. The prediction of how and what an individual can say at a given moment, in a given context, outside banal cases, dares not enter in the research program nor be considered in a quantitative way, neither neuropsychologically nor at the molecular level: the linguistic creativity is not less true for this reason, but exactly as in the case of conscience, it is not measurable in quantitative terms.

This is not a nihilist resignation characteristic of weak thinking, though, just as it was not a nihilist resignation the decision of Newton to describe gravity as action at a distance, rejecting the contact mechanics of Descartes that was the orthodoxy at that time. It is an astonishing consequence that Chomsky refers precisely to Descartes when defining the fundamental capacity of human language — that of understanding and producing an infinite set of sentences — and that then he recognizes that in the very heart of language lays the mystery.

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