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We have to change mind. Neural Plausibility and the Crisis of Cognitive Explanations

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Abstract The development of imaging techniques used by neurosciences, caused a crisis in psychology, the core discipline of cognitivism. Cognitive psychology provided a framework and a common language for different researches: linguistics, philosophy, informatics, and anthropology, carrying to models aimong to naturalization, to the attempt of explaining an "esse" with a "necesse esse", with the risk of confusing cultural creations with natural features. Innate architectures and philosophical beliefs led often to ignore linguistic data. The crisis regards three points:
(1) When shifted from a psychological context to the neuroscience, the meaning of cognitive metalanguage does not refer any more to mental functions but moreover to brain anatomical regions and their metabolism.
(2) The criterion of psychological plausibility is not sufficient to choose between alternative models;
(3) Both the innatist and the experience-based explanations are not in grade to express the relation between “mental” functions, cortical anatomy and its biological morphogenesis and phylogenesis.
Showing a series of examples referred to vision and space representation in language, the article aims to a different model of explanation, based on the criterion of neural plausibility, focused on learning and cortical plasticity, in which a central role is played by phylogenesis and morphogenesis, allowing feedback relationships between nature and culture.

Keywords: morphogenesis, language, vision, Cognitive Science, Semiotics

0. An overview

The first part of the article (§§ 1 - 2) investigates the reason why cognitive science entered a crisis: brief, neurology took the place of psychology at the foundation of cognitive building. The psychological metalanguage assured the translation between different academic perspectives (linguistics, informatics, anthropology, philosophy). The research program vanishes with its technical language. Even if neurology seems to inherit the same categories, its reference and meaning changed drastically. Disciplines which were not considered by cognitive explanations, as biology, today contribute to shift the paradigm. What really changed is a model of explanation, based on the proposal of psychologically plausible arguments, in which the

biological organizations are considered as a mere support of cognitive processes, in which mental features, considered "natural", innate , and universal, determine culture. In order to understand why this kind of explanation is not convincing anymore, the article (§§ 3 - 4) shows how the criterion is the psychological plausibility lead to the impossibility of a choice between the various modular architectures of mind that have been proposed. Furthermore, counterexamples based on neurobiological research tends to exclude each of them. Then (§§ 5 - 7) the article takes in consideration other cognitive stalemates between different models in the field of language, and in particular with reference to space representation. The first cognitive generation did not considered this problem because it mainly focused on “pure” syntax. The second generation tried to fix the problem by considering semantics; still, they could not found a convincing unique explanation in terms of universal cognitive primitives. Their models and examples are untranslatable in many languages. Basing to these data, the article (§ 8) tries to explain why both innatism and experience - based explanations are not neurologically plausible: innatism does not explain brain plasticity; on the other hand, experience is not a good base to explain language acquisition, because language in itself is part of the experience of the environment all around the baby. All the considered exampled tends to a conclusion: the criterion of neural plausibility should substitute the psychological plausibility. If this is true, the static models typical of cognitive sciences, need to be substituted with dynamical models compatible with brain processing, changes, cultural variety, ontogenesis: we have to change mind. Finally, the article (§§ 9 – 11) shows how the criterion of neural plausibility gives some interesting clues regarding vision and linguistic representation of space. We aim to a different model of explanation, based on the criterion of neural plausibility, focused on learning and cortical plasticity, in which a central role is played by phylogenesis and morphogenesis, allowing feedback relationships between nature and culture.

1. The reason of a crisis

Noam Chomsky criticized structuralism by requesting a psychologically plausible model of language. Naturally, there were different psychological frameworks about the development of language. The choice between these has not been “neutral”: Chomsky's beliefs about language as an innate faculty of human mind has been used in order to choose between different paradigms – see PIATTELLI-PALMARINI (1983). The development of cognitive linguistics pushed the development of cognitive psychology and vice-versa. Their academic success is understandable also because of their proposal of a unique research frame capable of linking other disciplines as Informatics, Anthropology, Neurosciences, and Philosophy. Other approaches were less comparable to this framework: as DONALD (1991:21) wrote:

> There is now a trend back toward synthesis, a rejoining of cognitive science and the Darwinian worldwiew. This is partly due to the limitations, now evident, of an experimental cognitive psychology that ignores the brain;

With the development of new technologies capable of inquiring the cortical functions by “filming the brain at work”, like *functional Magnetic Resonance Imaging* (fMRI) or *Positron Emission Tomography* (PET), the situation changed. As LEGRENZI - UMILTÀ (2011) noticed, the prefix “neuro-” substituted “psycho-” in many titles such as “neuro-aesthetics”, “neuro-ethics”, and “neuro-marketing” too. This does not

regard only pseudo-scientific publications: psychology lost its central position in the cognitive framework.

2. A metalingusitic crisis

Two generations of cognitive psychologists assembled a technical language which has been useful to translate different disciplinary problems into a single frame. A good example is the concept of *module*. According to FODOR (1983:69), modules represent the input systems of the information flow in psychological processes : <<modular cognitive systems are domain specific, innately specified, hardwired, autonomous, and not assembled>> (1983:37). They are really simple "machines": <<each module is supposed to have access to its current input, and to its proprietary database, and to nothing else>> (2001:91). Fodor calls *informational encapsulation* this feature of mental architecture. <<To a first approximation, nothing affects the course of computations of an encapsulated processor except what gets inside the capsule>> (2001:64). This point has been misunderstood, first of all by Chomsky: <<there is a usage proprietary to Noam Chomsky (…) in which a module is simply a body of innate knowledge>> (2001:57). The reason why a module has to be informationally encapsulated is simple: that was the only way of identifying them without opening the black box represented by cortical anatomy. Modules are the simples functional parts of the "psychological machine": they are software, not hardware. Sure they should be also anatomically hardwired, but if we identify them from the anatomy regardless to informational encapsulation *we change the meaning of the word "module"*. For example, I find really problematic the statement according to which there is a linguistic module. A module should have just one input, whereas the cortex responsible for language is wired with both auditive and visual inputs; furthermore, according to PIOTROWSKI (2005), there is a superposition of syntactic and semantic processing activity of the different regions of the cortex. In general, with the shift from psychology to neurology, metalanguage seems the same, but there is a change in its meaning. For example, Studying the brain of five patients in persistent vegetative state (PVS) with different imaging techniques, SCHIFF et al. (2002) detected in three cases a correlation between "fragments of behaviour" and metabolic activity in "segregated corthicotalamic networks". Schiff consider this an evidence of <<the modular nature of individual functional networks that underlie conscious brain function>>. Now, a module should represent a specific "mental function". On the contrary, Schiff uses the word "module" like a bridge in order to link what we perceive (fragments of behaviour and metabolic activity) with something on which we have no information: mental activity. This changes the function of the metalanguage. The technical terms of cognitivism are the same, but they are no more used to analyse mental architecture; they link the data provided by different imaging techniques – MRI, PET, Magnetoencephalography (an *expression plan*) to an interpretation in terms of psychological processes (*content plan*). That's what HJELMSLEV (1953) calls a meta-semiotics. The new use of the word *module* lead some authors to distinguish the neurological meaning from the psychologic one. For example, REYNA (2002:56) refers to 'columns', different vertically oriented clusters of connected neurons which perform a specific brain function working in parallel. So, the V2 module is the part of visual cortex that creates stereo - vision; V4 produces colour, and so on. It is important to understand that, as REYNA (2006:57) says, no module is an island: neurological "modules" are not *informationally encapsulated:* on the contrary, there is evidence of significative *feedback* activity

between them – cf. ANGELUCCI – BRESSLOFF (2006). Furthermore, there are evidences of high-specialized cortical regions, which are composed by bimodal neurons. A good example is V6A, a cortical region involved in grasping activities, which elaborates both visual and sensorimotor information – cf. GAMBERINI ET AL. (2011). The new meanings of the word *module* introduce an ambiguity between neurological and psychological architecture. Even if there are advancements in our understanding of the first, we still know really little about the second. After the introduction of hi-resolution imagery techniques, even the meaning of "innate structures" like Chomsky's syntax changes. One argument in favour of innatism is that there are some conceivable syntactical constructions that we can't find in any known language. For example, the operator for negation ("not") could be placed in a fixed position in the sentence (e. g. the fourth place). A language structured that way could work, but empirically it does not exist. Using the new neuroimaging techniques, MORO (2008) discovered that, when humans learn this odd syntactic structure, they use cortical areas previously not associated with language. This raise questions about the neurological meaning of "innate" structures. How these structures are related to cortical specialization? How the possibility of innovating structures is related to brain plasticity?

3. How to choose between different models? An epistemological problem.

Fodor's architecture is not the only proposal. FODOR (2001) is an attempt to criticize a different model proposed by Cosmides and Tooby, according to whom mind is a massively modular architecture without a central system. On the contrary, SHALLICE (1988) proposes an architecture with more than a central system. The same way, Chomsky's model of language faculty is not the only one. Other interesting proposals came from TESNIÈRE (1959), revisited by ANDERSON (1971) or FILLMORE (1968). How to choose between different models if they are all equally "psychologically plausible"? As PUTNAM (1988: 95-96, 121-125) demonstrated, formalist position – the basis of Fodor and Chomsky's models - is under suspicion. In order to simplify his argument, let's imagine a computer that draws the demonstration of Pythagoras's theorem. We can try to imagine the software that it used to do it, and to propose different algorithms. But, if we don't know in how many passages the machine executes its task, every software model producing the demonstration could go. The same way, if we know nothing about the number of "states of mind" required by any "mental function" to perform a task, every formal, computational model of the "mind" (as much as every "mental" faculty like language) is just a suggestive description of certain *behaviour*. And both Fodor's architecture and Chomsky's one and their competitors don't specify a number of states. So, the "psychological plausibility" seems not epistemologically sufficient to decide between different models.

4. The next generation

It is well known that the generation represented by George Lakoff, Eleanore Rosch, Mark Turner, already abandoned the software/hardware metaphor, the formalist framework and the syntactic paradigm in the field of language in order to study the *embodied mind* and to adopt a semantic perspective on language. As CASONATO, CARCIONE, PROCACCI (2001) notice, the "body" is here intended in a duplex perspective: as a phenomenological body, which perceptions are the basis of our

experience and meaning; as a neural body, which environmental interaction and evolution produces particular innate cognitive structures and operations. Still, in this framework there are different "psychologically plausible" contradictory models. Furthermore, these models do not abandon the search for "innate" phenomena, raising the question about their biological basis.

5. Language and space representation

A major change between the two generations of cognitive linguists regards their attitude toward syntax. Roughly speaking, they remind to the traditional distinction between the localist and anti-localist schools – cf. ANDERSON (1971:3-13). The syntax is somehow "pure" and expressing logical relationship for the first generation; the second generation analyses the meaning of morphosyntax in terms of complex spatial relationships *and* as a result of abstractions starting from them. A couple of considerations by Fillmore reveal the conflict between the two perspectives. In a note to FILLMORE (1968) we read:

> The impression is sometimes given that the identification of the etymon of a case affix brings with it an account of the intellectual evolution of the speakers of the language in question. (…) The change, in short, may well have been entirely in the economies in bringing to the surface underlying structural features which themselves underwent no change whatever.

That's surely true: we have to resist to the temptation to see our ancestor as brutes, also because it is a well-known fact that there is no scientific evidence of "primitive" languages – cf. SAPIR (1921). Nevertheless, this is not an argument for neglecting the spatial semantics in the "deep structure" of the case grammar. FILLMORE (1977, 2.7) could not explain how his case-theory could account for the very complicated set of case function in Finnish:

> My answer has to be, of course, that the morphemes in surface case systems encode more than nominal functions, and that therefore an account of the uses of surface-structure cases requires more than a theory of deep cases.

Nevertheless, the second generation of cognitive linguists realized how much Fillmore's model couldn't handle fine spatial distinctions – see TALMY (2003:185).
As we see, a big difference between localist perspectives and the ones based on universal deep grammars is the question about change in languages. From an innatist point of view the question is simply not relevant, a position related with their incapacity of giving clues about the origins of language faculty. On the contrary, localist tradition proposed many reconstructions of the ancient indo-European common oppositional structures (e.g. ablative/allative/instrumental) that originated all the possible cases in different European languages – cf. MARTINET (1986). A good example of the *concreteness* of morphosyntactic relationships comes from the difference between *on* and *above* in English, *sur* and *au dessus de* in French. Both the terms presuppose a reference point which is down, but the first is "in contact" with it, whereas the second is not touching it. Interestingly, the same opposition (in contact/without distinction of contact/not in contact) is present also in temporal adjectives – *next, following vs. successive, consecutive*. As we will see, this analogy between space and time is not a single case. Now, there is a curious not-Cartesian

asymmetry in the way in which language represents space: the preposition *under* does not distinguish between "in contact/not in contact". A similar asymmetry regards in many language the opposition *ahead/in front of//behind* – cf. French *devant*/*en face de//derriere;* Italian *davanti/di fronte//dietro.* Naturally, in many languages this asymmetry is absent; nevertheless the deep category *coherence/incoherence,* which is responsible for the opposition *with/without contact* explains many other surface phenomena – cf. HJELMSLEV (1935). Giving more consideration to spatial relationships, the second generation of cognitive linguists saw in this kind of asymmetries a trace of the link between meaning and experience. WIERZBICKA (1996:58-59) explains the asymmetry starting from child language research:

> The idea of looking for things under the table or under the bed is no doubt more relevant to a small child than that of looking for things "above" something – presumably, partly because of the child's own size and partly because things fall down, rather than rise. (…) It makes a lot of sense to assume that from a child's point of view the likely choice is between interesting objects being *under* the table or *on* the table, rather than *under* the table and *above* the table.

Wierzbicka refers to psychological studies on language acquisition and concludes for a contrast between a purely logical point of view and psychological reality. In these cases, *common experience* is a good explanation for universality of certain linguistic solutions; in other cases – i.e. about the different lexicalization of colours, the *common perceptual basis* gives us another explanation. Finally, when she meets a "primitive term", indefinable, not marking a particular culture – cf. WIERZBICKA (1997) – but simply translatable in every language, she concludes that it is "innate". There is just a passage in which she explains what she means with this word:

> In the theory presented in this book (…) it was expected that the concepts 'someone', 'something', and 'want', which are indefinable in English, would also prove to be indefinable in other languages, and that other languages, too, will have words (or bound morphemes) to express these concepts. This expectation was based on the assumption that fundamental human concepts are innate, in other words that they are part of the human genetic endowment; and that if they are innate, then there is no reason to expect that they should differ from one human group to another – WIERZBICKA (1996:14).

The question about how the evolution of our cortical structures is related to the development of the innate conceptual apparatus and grammar seems excluded from her interests. This is a common problem of all cognitive approaches.

6. Contradictions: does size mean?

What kind of geometry is relevant to language representation of space? Quantitative or qualitative? TALMY (2003:183) considered these sentences:

(1) The bike is near the house
(2) The house is near the bike

He says that (2) sounds really odd, exactly as "the bike and the house are near each other". And this because the object use as a reference entity is usually the larger one.

In this case, “quantity” seems to be relevant to the semantic dimension of language. In other cases - TALMY (2003:224) - quantity seems not relevant:

(3) The ant crawled across my palm;
(4) The man walked across the field;
(5) The bus drove across the country;
Here the range in the size of a Reference Object, from a palm to a country, and the corresponding range in the length of the path travelled, are irrelevant to the choice of schema-specifying preposition. In order to explain the relationships between objects and reference points, Talmy refers directly to the *Gestaltist* distinction between *figure* and *ground.* His work has been used in order to propose mathematical models that links language schematisation with perception – cf. DOURSAT – PETITOT (2005). Talmy prefers a topological model without a metric (Euclidean) space (2003:187), but examples (1.) and (2.) seems in contradiction with his claim. Furthermore, he claims that “more permanently located” reference-objects are better candidates to serve as reference points. I submit to my reader three counter-examples:

(6) The airship approached the mooring mast.
(7) The manhole is under my car.
(8) When I inserted the reverse gear, I didn't notice the lamppost behind my car.

In (6.) the reference object is smaller than the located object; in (7.) something not-mobile is located thanks to a mobile reference point; in (8.), the bigger and not mobile object is located thanks to the smaller one, sadly in movement. Personally, I believe that dimensions and movability are relative to another feature indicated by Talmy (salience). What a model should do is:

a. Indicating criteria for the perceptual salience.
b. Explaining how salience is intercepted by pregnancies of the perceptual apparatus.
c. Discussing the individuation of these pregnancies.

A morphodynamic point of view can help: clues and indication about point (b.) are present in THOM (1989 and 1990).

7. The relationship between space and time.

Prepositions like *after*/*before* are used in English on the purpose of locating something indifferently in space or in time. This is a general feature of Indo-European cases representing spatial determinations – cf. VILLAR (1996); superposition between space and time representation can be found also in the great majority of not-Indo-European languages – cf. HASPELMATH (1997). In the *embodiment* framework, temporal relationships have been considered as spatial metaphors by LAKOFF - JOHNSON (1980). If we focus on morphology, their distinction between space and time is more related to implicit metaphysical beliefs than on the reality of languages: why “we will meet at noon” should be a metaphor whereas “we will meet at the river” is not? It is simpler to state that, even if we psychologically draw a distinction between space and time, our language does not. So, the part of morphology expressing spatial and temporal functions is simply polysemic. This relationship seems really deep-structured. The *coherence category*,

used by HJELMSLEV (1935) in order to analyse different case-grammars in terms of spatial relationships, involves also temporal examples (i.e. *after = ceasing to be in contact*). Furthermore, spatial relationships are often described using temporal expressions: "The village is a two hour walk from the sea"; "*Proxima Centauri* is a red dwarf star about 4.2 light-years distant in the constellation of Centaurus*";* so, the thesis of the authors, according to which we talk about our "abstract" temporal knowledge in terms of spatial concrete experience is not convincing. On the other hand, WIERZBICKA (1996:56 - 60) distinguishes between temporal primitives (*When, Before, After*); spatial primitives (*Where, Under, On*); primitives related to movement. She claims that every language distinguishes between *where* and *when*, but she seems to forget the French adverb *ou.* As much as regards *movement,* it obviously involves both time and space, but this is not a conclusive argument, involving physical considerations more than basing on the reality of language. I'll rather say that there are convergences between movement and positioning in language; e.g. the English preposition *in* and the Italian preposition *a* express both the nuances, depending on the verb which selects them; similarly, in Sanskrit, the *locative* case expresses both the position and movement to a particular place, depending on circumstances - cf. VILLAR (1996). COMRIE (1985:15) traces some distinctions between location in space and in time. For example, he claims that

> Although (…) the expressions used in languages for location in time are often derived etymologically from spatial expressions, there are some crucial distinctions (…). First, as far as space is concerned, not-here defines a continuous area, i.e. everything which is not the location of the speech situation (…). For location in time, however, because of the one-dimensional nature of time, not-now does not define a continuous area, but rather the discontinuous area consisting of past and future, but separated by the present moment.

I disagree with the author. The opposition here/there is analogous to now/then – cf. also the opposition *teraz/kiedyś* in Polish; nevertheless, Comrie says that the opposition between *here/there* has not an analogy in verbal tense. By doing this he jumps from adverbs to verbs without an explicit motivation. I'm afraid the second argument is even less understandable: he says that it is impossible for the speaker and the hearer not to share "the present moment", even if they are in different location. This is not true: when we write a letter, the hearer and the speaker don't share "the present moment". Latin politeness imposes to the writer to conventionally adopt the temporal set of the reader as a reference point for verbal tense. My *present* as a writer becomes the *imperfectum* of the reader; the same happens to adverbs: my *hodie* (today) becomes the *eo die* (that day) of the reader. So, can we identify space and time? Not in every case. For example, LYONS (1968:347) notices an interesting distinction:

	Temporal:	*Locative:*
First order nominals:	*John was yesterday	John was in Central Park
Second order nominals:	The demonstration was yesterday	The demonstration was in Central Park

As we can notice, the difference between locative and temporal expressions is not morphological; it concerns syntax. On this basis, Lyons distinguishes two orders of

nominals: *substantivals*, denoting persons, animals, things, places; *not substantial*, like *event*, *accident*, and derived from verbs. The distinction is also topological:

> (…) first order nominals tend to denote 'entities' (enduring through some time-span, although they may move or be moved from one place to another) and second-order nominals tend to refer to 'events' (with 'punctual' location in space and time – LYONS (1968:348).

This is not the only syntactical difference. TESNIÈRE (1952) distinguishes between *actants* and *circumstants*. *Actants* (§ 32) are persons or things involved in the verbal process, whereas *circumstants* express the circumstances of the process. Temporal and locative specifications are circumstants (§ 35). *They* are expressed in a hierarchical order. All of them follow the first actant (*subject*); circumstants expressing undetermined time precede the second and the third actant (expressing respectively the *object* and the *attributive function*): "I *always* see him everywhere"; determined temporal and locative circumstants follows both the second and the third actant: I gave the book to your sister *yesterday in the Park*. Different syntactic constructions are possible: in that case, the information expressed by the "misplaced" circumstant results *marked*. So, the syntactic construction let us distinguish between temporal and time specifications, whereas the morphology constructs an analogy between the concepts of "place or direction in space and in time". This is not really a problem in morphodynamic framework, because it distinguishes a form of the *expression plan* – which is identical in the two cases – and a form of the *content plan*, which is sensibly different. Temporal specifications and first-order nominals are *allotopes* - "* John was yesterday" - whereas temporal specifications and second-order nominals are *isotopes* - "The demonstration was yesterday" - cf. RASTIER (1999). A morphodynamic point of view will make use of Lyons's topological distinction between an extended and a punctual existence in time, in order to specify the kind of salience of second-order nominals, which lacks in first-order ones and inhibits the pregnance of the morphological items expressing the temporal function.

8. Neural plausibility of innatist and experience-based explanations.

As we said, even the second generation of cognitive linguists tend to consider "innate" all the general linguistic features that they can't explain as cultural phenomena, or as the consequences of learning, or as the results of experience, or as the interaction with the environment through the interface provided by our body. Cognitive psychology grants them that a-priori categories, schemas, and so on, exist in our mind. This way linguistic studies are immediately exportable to other fields; for example, researchers in artificial intelligence – having to program a computer – are really interested in these a-priori structures, in order to provide the machines an *applied ontology*. Now, in my opinion, "cognitive features" should be *neurally plausible.* I suspect the *neural plausibility* of "innate" features. In order to exemplify different threats of such an explanatory process, I'll consider again TALMY (2003). He uses a *source-goal* model – a tradition in cognitive sciences, from FILLMORE (1968) to LAKOFF - JOHNSON (1980) - to distinguish a relation of emanation between two objects. The object that is taken to be more active or determinative of the two is conceptualized as the s*ource* of the emanation (active-determinative principle). He says he remains agnostic on whether the connection is learned or innate:

> If it is learned in the course of development, then each individual's experience of agency leads by steps to the conceptualization of fictive emanation. If it is innate, then something like the same steps may have been traversed by genetically determined neural configurations as these evolved - TALMY (2003:117)

However he propends to the innate explanation:

> (…) Closed-class spatial elements generally characterize the Figure's geometry much more simply than the Ground's geometry. The explanation for this can perhaps be found in our very mode – in large part presumably innate – of conceiving, perceiving, and interacting with the contents of space - TALMY (2003:185).

Notice that the meaning Talmy confers to the word “innate” is “neurobiologically hardwired” and “genetically determined”. I already quoted DONALD (1991): language faculty is relatively recent, and chomskian and fodorian innatism don't explain the morphogenesis of the corresponding cortical areas and seems to conflict with the long period required by brain evolution from a phylogenetic point of view. Paradoxically FODOR (2001) agrees with him, disputing against evolutionary models in cognitive linguistics; however, the alternatives to evolution should be *neurally plausible* too in order to avoid exoteric turns. Another reason for suspecting innate hardwired brain structures is brain plasticity. There are many cases in which patients recovers lost functions after a brain damage. A famous case is reported by NATHAN - SMITH (1950): after the death of an apparently normal man, unexpected gross bilateral abnormalities of the hippocampus and absence of the fornix caused by maldevelopment had been found. These were not associated with abnormalities neither of the olfactory function nor of the emotional control, as one would expect if all these functions would genetically determined to coincide with their cortical regions. In a morphodynamic perspective, our genes allow the development of stabile structures. *Structural stability* is the feature of re-acting to deformations – cf. BRUTER (1981). Naturally, even experience-based cognitive explanations should be neurally plausible. “Experience” is not a magic wand for avoiding problems. For example, when claiming that child's early experience of the world influences languages categories, as both Wierzbicka and Lakoff concede, we cannot pretend that children are not learning a language, thus inheriting all the linguistic categories. An indirect prove is that in some case babies re-interpret them: HARRIS - CAMPBEL (1995:61) call *re-analysis* the process that changes the underlying structure of a syntactic pattern without modifying its surface manifestation. So, language is part of the experience of the world of the baby: at the most, the problem is what happens in our brain when learning languages – cf. MORO (2008). I think that there are linguistic researches that indicate us some methods to reach neural plausibility. One of the oldest is JAKOBSON (1971), which represent a good example of cooperation between neurologists, interested in a functional model of language in order to understand how these functions are implemented in the neural cortex, and linguistic research, which search for new interpretations of semiotic structures in relation to brain architecture – for example, Jakobson interprets the relationships and the differences between language and music in the light of brain lateralisation. PIOTROWSKI (2005) develops this cooperation in a morphodynamic

perspective, studying the interaction between syntactical and semantic language processing using EEG techniques.

9. Optical illusions and top down processing in vision.

In the past, the phenomena of contour completion, multistability, and amodal perception as the ones described by KANIZSA (1979:19), have been considered as arguments in favour of top-down processes – cf. CAVANAGH (1999) – and of modularity of vision – cf. FODOR (1983:66), because they are unconscious, automatic, and we can't avoid them. Now, according to SARTI - CITTI (2011 a and b) this is not the case. On the basis of the neurophysiologic data about the structure of cortical links between neurons in the visual area V1, the authors propose a sophisticated mathematical model, indeterministic and formally equivalent to a quantum field theory in phase space. The goal of the model is reproducing the association fields thanks to which our visual system integrates the contours of objects, empirically described by FIELD, HAYES, HESS (1993). As SARTI - CITTI (2011b : 2) write:

> The plasticity of the brain, i.e. its ability to reorganize neural pathways based on new experiences through learning procedures, guarantees a strong connection between the design of our perceptual systems and the properties of the physical environment in which we live. Hence it is natural to conjecture that the origin of the neurogeometrical structure is deeply adapted to one deduced by statistics of natural images. In order to prove this conjecture, (…) we have computed the co-occurrence probability of edge orientations in a natural image database and compare it with the metric modelled with Lie group invariance. The probability of co-occurrences has been obtained computing a three dimensional histogram where the two first dimensions correspond to the relative position of two edges and the third one to their relative orientation. This probability has been compared with the fundamental solution of the Fokker Plank equation invariant with respect to the group law.

The authors suggests that cortical connectivity modelled by neurogeometry is deeply shaped by the statistical distributions of features *in the environment*. So, it can be explained as an interaction between the embodied subject and the world.

This example suggests us how to make a good use of the criterion of neural plausibility. There is an evident preference shown by our language towards oppositions like up/down or left/right. Thanks to Sarti's and Citti's model we can say that they can be primitives – as Wierzbicka claims – but not innate. Other experience-based explanations based on the gravity force or the geometry of the body, like LYONS (1977:690), HASPELMATH (1997:27), LAKOFF - JOHNSON (1980:56), should be reconsidered too, in the light of the plasticity shown by our visual system in adapting to the environmental features, “learning” them.

10. Other examples of neural plausibility

The criterion of the neural plausibility could explain different observations regarding language. For example, TALMY (2003:130-134) compares linguistic constructions as:

(9) I rode along in the car and looked at the scenery we were passing through.

(10) I sat in the car and watched the backdrop scenery.
(11) I sat in the movie-set car and watched the backdrop scenery rush past me.
(12) *We and the scenery rushed past each other.
(13) The stream flows past my house.
(14) *My house advances alongside the stream.

Talmy's examples presuppose that we can distinguish real movement to the fictive one. According to Talmy, sentences fictively depicting the observer as stationary and the observed as moving are acceptable, whereas sentences fictively depicting the observer as moving and the observed as stationery are not acceptable. The problem seems more complex. Let's consider:

(15) I was walking and looking at the woods I was passing through.
(16) I was walking and the woods rush past me.

If we compare (10) and (16), they seem acceptable, but (16) is a marked construction, a literary one. The neural plausibility criterion pushes us to search a solution in the link between vision, fictive movement of the point of view (the eye), and perception of our body. According to Galletti, in our visual cortex we can find *real-position cells:* their receptive field remains constant in space regardless of eye-movement. These cells can be found in bimodal regions of our visual cortex, that process vision coupled with sensorimotor information – cf. GAMBERINI (2011). It seems that the movement of our body is related in distinguishing the movement of our point of view from the real movements in the environment around us. This could explain the difference between (10) and (16): while sitting in the car, our body doesn't move.

11. Summary

The next table resumes the changes between the cognitive and the morphodynamic point of view on language and meaning:

Cognitive point of view	*Morphodynamic point of view*
Psychological plausibilità	Neural plausibility
Focus on innatism	Focus on learning
Focus on mental universals	Focus on cortical plasticity
Biologic organization as a support of cognitive processes	Centrality of morphogenesis and phylogenesis in our explanations
Nature determines culture	Feedback relations between nature and culture

Respecting the reality of linguistic data is always preferable to the ready-made philosophic and psychological models; furthermore, a criterion of neural plausibility suggests us more reliable hypothesis about phylogenesis and morphogenesis of language and vision. Morphodynamic categories provide a new common framework for different disciplines as biology, psychology, linguistics, semiotics, and anthropology – cf. Boi (2005).

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