

Antonino Pennisi
Alessandra Falzone *Editors*

The Extended Theory of Cognitive Creativity

Interdisciplinary Approaches to
Performativity

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Editors

The Extended Theory of Cognitive Creativity

Interdisciplinary Approaches to
Performativity

 Springer

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Chapter 2

Dimensions of the Bodily Creativity. For an Extended Theory of Performativity



Antonino Pennisi

Abstract In our project the performance is a *product of performativity*. Performativity is the cognitive ability to produce physical or mental actions. Studying performance and studying performativity sets different scientific activities. Studying how to enhance the performances belongs to the behavioral science. On the contrary, studying performativity belongs to a general cognitive procedure that must not be confused with the description of behaviors, requiring a specific theorization in the cognitive sciences instead. The aim of this research project is to focus on the hypothesis that performativity is not a property confined to certain specific human skills, or to certain specific acts of language. Instead, the executive and motor component of cognitive behavior should be considered an intrinsic part of the physiological functioning of the mind and as endowed with self-generative power.

Performativity as a physiological tool of cognitive creativity has precise neural correlates and procedural properties. The firsts are summarized briefly in the central part of the essay. The latter are more widely discussed in the following chapters. From the point of view of procedures, instead, it is argued that performativity is a cognitive property that arises from the absence of an algorithm designed to carry out a given performance. Acting in a non-planned way, learning by trial and error, applying familiar behavioral patterns to new situations: these are just a few examples of what is performativity and of how it works. Thus, performativity is intrinsically creative because its nature is to face situations that cannot be solved by the application of already known algorithms. In a nutshell, performative creativity is a procedural system that is somewhere between what Chomsky called “rule governed creativity” and “rule-changing creativity”. Performativity however bears a peculiar kind of creativity, which is different from the one generated by the competence but still shares some features with the latter: in fact, it is a fully embodied and free-from-rules process that is carried out through trial and error, that is to say it depends on the bodily practice (locomotion, language, perception, etc.) made in everyday experience.

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It is for this reason that Embodied Cognition (EC) should be the theoretical framework to explain the functioning of the performativity. EC indeed is the answer to all those cerebrocentric theories that consider only the computational function of the brain and ignore the role of the body as the main responsible for all the abilities of humans, animals and machines, describing performance just as an executive function. The EC however addresses the issue of performativity from the point of view of the individual rather than from that of the species. From this perspective it makes difficult to incorporate performativity into a general theory of cognition. Its phenomenological instances come into conflict with the naturalism of cognitive sciences. On the contrary, an extended theory of performativity cannot do without ethological and evolutionist perspectives. These perspectives are addressed in the second part of the essay, both from the point of view of the historical reconstruction and from that of the current debate.

In the light of the considerations made in the last part, the final hypothesis that we support is that performativity is not an attribute belonging to some human abilities only, nor to the faculty of language, nor to uniquely creative intelligence of *homo sapiens*. On the contrary, it can be defined as a fundamental element for *any species'* cognitive process. From an evolutionary point of view, performativity probably developed in parallel with the structural and functional transformations occurred in *homo sapiens* that led to the species-specificity of language and let embodied simulation be our model of perception. For what concerns other species, performativity had a different development for any of them and led to other kinds of cognitive abilities.

2.1 Introduction

This volume presents the results of the research PRIN project (Projects of significant national interest) “Perception, performativity, and cognitive sciences”, which has been financed by MIUR (Ministry of Education University and Research) over the 3 years period 2016–2019 and carried out by a team of academics that I have the honor to coordinate: these academics are Vittorio Gallese (University of Parma), Ruggero Eugeni (Catholic University of the «Sacred Heart» of Milan), Claudio Paolucci (University of Bologna), Pietro Montani (the «Sapienza» University of Rome), Marco Mazzone (University of Catania), Franco Lo Piparo (University of Palermo), Guglielmo Tamburrini (University of Naples «Federico II»). During 2017 Nunzio Allocca has joined the roman unity, while Marco Carapezza joined the unity of Palermo. All the news about the state of research and the scientific initiatives involving our research group are available on the web ([https:// sites.google.com/view/perception-performativity/project](https://sites.google.com/view/perception-performativity/project)) and described in 1/2018 of “Reti Saperi Linguaggi. Italian Journal of Cognitive Sciences” (Pennisi 2018a).

An early debate on the subjects of the research took place on 1 March 2016, during a conference that was held at the Sapienza University of Rome. One year after the project was started, another convention on such matters was held: the tenth

edition of the CoDiSco International Conference, named “Performative Dimensions in Cognitive Sciences” (see Pennisi, G. 2017), which took place from 27 to 30 September 2017 in Noto, at the premises of CUMO (Consorzio Universitario del Mediterraneo Occidentale). This conference led to a lot of theoretical reflections that you can read about on this volume. Most of all, it has enlightened the inexhaustible strength of the methodology of cognitive sciences: a strength represented by its interdisciplinarity, a lot of approaches and philosophies being focused on one particular problem. The problem we discuss is to make up an exhaustive theory of performativity and its relationship with cognitive creativity.

2.2 What Is the Performativity: Performances vs. Performativity

We need to start from the difference between Performances and Performativity.

The term *performativity* doesn't even exist in philosophical English. In philosophy of language, the founder of the term – J.L. Austin – never spoke about “performativity”, but spoke about “performative utterances” (1962): classes of verbs, nouns and expressions that replace the action. This definition of the word *performativity* gained a foothold in linguistics and pragmatic semantics (Searle 1979, Lakoff and Johnson 1980), but has completely disappeared from the dictionary of contemporary philosophies like phenomenological philosophy of mind (Gallagher and Zahavi 2008; Gallagher 2017a, b; Gallagher 2018- cfr. Pennisi, G. 2018, 2019), enactivism (Noë 2004, 2009, 2015; Menary 2006, 2010; Hutto and Myin 2013) and every other philosophy inspired by Embodied, Extended or Embedded Cognition (Varela et al. 1991; Gibbs 2005, 2008; Anderson 2015; Chemero 2009; Rowlands 2003, 2006, 2010; Shapiro 2004, 2011, 2014; Clark 2008a, b, 2016).

Of course we can attribute this “negationism” to linguistic issues even if I don't think this is the case. The term “performativity” is not officially approved in English, French, Spanish, German and Italian but is currently used in philosophical literature, and also in England it is widely employed in social sciences. We are not dealing with a grammatical or lexical problem but rather with a theoretical one.

In social sciences (anthropology, gender sociology, economics, law) the term “performativity” is theoretically essential and has an exclusively externalist value. The term has the specific function to show the great power of language to influence political, economic, legal, social and gender relations. In these sciences, the category of “performativity” or “performative power” is irreplaceable.

Special considerations apply instead to the study of arts and media marked by the “performative turning” (Robert Wilson, Jerzy Grotowski, Marina Abramovic, Richard Schechner, Neil Harbisson, Stelarc – or Stelios Arkadiou), which led to the establishment of performances studies, a theoretical approach all focused on the performative challenge of what bodies can do. In this case, the externalist approach (the effect of the performances on the enjoyers) is complemented by a more

embodied aspect that would affect the structural possibilities of the bodies: today this is a topic dear to the heart of Evo-Devo. However, this range of performative practices is rarely included in scientific dimensions.

What unifies all these primarily social meanings of performativity, putting them in contrast with cognitive sciences, is that the firsts focus primarily on external conditions (environment, society, culture, prosthesis, technologies, etc.), while the latter are always tormented by the centrality of the internalist perspectives (mind, conscience, psychic states, etc.). In the internalist perspectives there is no space for the major aim of our project: to consider performativity a specific cognitive ability. This is what I will try to show in the following pages.

In our project the performance is a *product of performativity*. Performativity is the cognitive ability to produce physical or mental actions. Studying performance and studying performativity sets different observational or scientific activities.

For example a performance is:

1. An action that can be inhibited, favored, induced, etc. (ex: athletic performance, cognitive performance, etc.);
2. An executive plan of a project (performing a musical score, performing a theatrical screenplay, etc.);
3. A mental procedure that allows the execution of algorithmic behavior (reciting a poem, counting, executing a multiplication, etc.)
4. An action that executes a project.

Studying how to enhance these performances belongs to the behavioral science. On the contrary, studying performativity belongs to a general cognitive procedure that must not be confused with the description of behaviors, requiring a specific theorization in the cognitive sciences instead.

The hypothesis we want to put forward is that performativity is a cognitive property that arises from the absence of an algorithm designed to carry out a performance. Acting in a non-planned way, learning by trial and error, applying familiar behavioral patterns to new situations: these are just a few examples of what is performativity and of how it works.

I.e. walking is for children a merely performative activity which is necessary due to the lack of a genetic algorithm regulating the bipedal locomotion. A child will never be able to prove to himself he can walk until his musculoskeletal system will be fully developed. The neuromotor control needed for walking can be exercised in a physiologically mature body; however, the outcome of such process is not obvious. The predisposition and the development of a genetic structure apt to bipedalism do not guarantee the function to be triggered. The same is true for the control of the vocal tract of children between 18 and 24 months of age. No child is able to articulate his voice correctly until his musculoskeletal structure is not fully mature. Nonetheless, even when the development of the latter is complete, there is no program that makes the child aware of how to move his vocal tract to produce the vocalisms typical of human language. Our considerations on bipedalism and on the production of articulated sounds are proven by the statistics on the infants

sauvages: among them, the 71% is quadruped, the 46% does not show any kind of vocal articulation and only the 3% articulates properly (Pennisi 2006).

The abilities to walk and to produce articulated sounds depend on something more than just the genetic makeup and the algorithms determined by it. More specifically, every man needs to live along with a group of conspecifics to learn how to move and talk. Above all, man needs the cognitive ability to carry out operations in absence of a set of instructions, a performative activity which depend on many factors: the observation of others' target-behaviors, the effort to imitate the conspecifics, the use of well-known strategy to solve new problems, the physiological interaction between little used body parts and neuromotor stimuli, direct and indirect dialogue, etc.

All the aforementioned activities are not the result of random attempts, but the outcome of processes which are analogous to the ones that occur in other cognitive tasks and that are adapted to new situations and environments. Thus, performativity is intrinsically creative because its nature is to face situations that cannot be solved by the application of algorithms. In a nutshell, performative creativity is a procedural system that is somewhere between what Chomsky, in 1964, called "rule governed creativity" and "rule-changing creativity" (1964:22).

The first kind of creativity has a syntactical-formal nature. It arises from the possibility of using recursive procedures for any reasoning and/or behavior, that is to say it depends on rules that can recall themselves within an algorithmic or a simply combinatory structure. This is the kind of creativity that allows to make an "infinite use of finite means", paving the way for the research of an unlimited number of possible solutions for a problem (Chomsky 1965, 1966). Such creativity is part of the "Competence"; it can raise some "issues", but it should never become a "mystery" (Chomsky 1982). On the other hand, the "rule-changing creativity" is a mystery to Chomsky, something outside the ordinary cognitive procedures: it is, in fact, "an aspect of the 'use of language' (i.e., performance), which is 'not to be confused' with competence" (id.:430).

It's then in the field of cognitive sciences that performativity gets downgraded to *performànce*. This downgrade has been realized for the first time from Chomsky, who established the dicotomy between *Competence* and *Performànce*. According to Chomsky, *competence* is the perfectly internalized knowledge of all rules that determine the accuracy of movements and actions, while *performànce* is what constantly spoils the perfection of this mental project. Thus, *performànce* is a reflection of embodiment's limits, while *competence* is purely free-from-body project.

Performativity bears a peculiar kind of creativity, which is different from the one generated by the competence but still shares some features with the latter: in fact, it is a fully embodied and free-from-rules process that is carried out through trial and error, that is to say it depends on the bodily practice (locomotion, language, perception, etc.) made in everyday experience.

It is for this reason that Embodied Cognition should be the theoretical framework of the elective theoretical framework to explain the functioning of the performativ-

ity. Embodied Cognition indeed is the answer to all those essays and theories (like Chomsky's) that consider only the computational function of the brain and ignore the role of the body as the main responsible for all the abilities of humans, animals and machines, describing performance just as an executive function.

Susan Hurley (2001) exemplifies this idea using the metaphor of "the sandwich model": in traditional cognitive models mind is considered the "highest" function, because of its role in elaborating informations, while perception just carries inputs and action transforms them into exhibition. In philosophy of language, Chomsky exasperated this position by describing morphological and semantic aspects of language as "externalization device" (2005: 10) that are independent from it. Recently, Chomsky said that we should think "the externalization of narrow syntax like the printer attached to a computer, rather than the computer's CPU" (Berwick and Chomsky 2016:35, cfr. 72 e 108). Lawrence Shapiro (2004: 165) named "separability thesis" the main hypothesis of cognitive neuroscience, according to which "from knowledge of mental properties it is impossible to predict properties of the body. Therefore, a human like mind could very well exist in a nonhumanlike body" (cfr. p. 167): this is the opposite of what happens in evolution, and it's a position too close to Putnam's idea of "the brain in a vat" (1981).

In contrast to this cerebrocentric vision of the first cognitive science and in partial analogy with the opposite one of the Embodied Cognition, the hypothesis that we would like to propose here is that the performativity constitutes a specific cognitive tool of the bodily creativity, in the bio-cognitive and evolutionist sense of the term. The hypothesis we are advancing here is that performativity is not an attribute belonging to some human abilities only, nor to the faculty of language, nor to uniquely creative intelligence of homo sapiens. On the contrary, it can be defined as a fundamental element for *any species'* cognitive process. Performativity is an attribute of every mind's physiological functioning, and has its own generative power. From an evolutionary point of view, performativity probably developed in parallel with the structural and functional transformations occurred to homo sapiens that led to the species-specificity of language and let embodied simulation be our model of perception. For what concerns other species, performativity had a different development for any of them and led to other kinds of cognitive abilities.

Performativity as a "physiological tool" of cognitive creativity has precise neural correlates and procedural properties. The latter differ according to the many fields of application of performativity: language (syntactical and semantic properties), images (kinetic and visual properties), performing arts etc. The neural correlates of performativity depend on the role of the different brain areas. The neural mapping of the performative function of such areas was the core of many researches carried out within the context of neurolinguistics.

A large amount of neurolinguistic literature has been devoted to the aforementioned mapping process, carried out through both brain imaging (Monchi et al. 2001, 2006; Nagano-Saito et al. 2008) and the study of the biochemical reactions involved in the plasticity of synaptic processes (Thivierge et al. 2007; Ko et al. 2013). Such researches have demonstrated "that the caudate nucleus and the putamen are particularly important, respectively, in the planning and the execution of a self-

generated novel action, whereas the subthalamic nucleus may be required when a new motor program is solicited independently of the choice of strategy” (Monchi et al. 2006, 257). Examining the biolinguistic aspects of these discoveries in depth, Lieberman and his team have shown that the neural circuits connecting different brain parts during human speech exploit the putamen for neuromotor control, changing “on the run” – that is, during verbal action performance – “the direction of our thought processes based on new stimuli such as the understanding of meaning conveyed by the syntax of language” (Lieberman and McCarthy 2007, 16).

Furthermore, a similar activation of brain motor components is registered when language data are processed in the absence of grammatically well-tested algorithms, such as when a second language is learned (Klein et al. 1994), or when a subject switches from listening to informal speech to a more formal one (Abutalebi et al. 2007).

In short, the management of neurocerebral performative strategies seems to be responsible for the most dynamic processes of linguistic behavior. This kind of behavior needs an attempt, or an active effort, that cannot be accomplished only through the mechanical application of already known and stabilized rules because it requires “the execution of a self-generated action among competitive alternatives” (Lieberman 2013, 80): an activity that is prolonged virtually forever, after the first acquisition step of ontogenetic speech, moving from mechanical physiology to the physiology of thought.

This overall framework also explains why the paths of speech often follow the hesitational phenomena of breaking up, recomposition, reunion, syncretism, propositional chiselling, semantic and lexical refinement: that is, all that is stigmatized by Chomsky’s idea of performance as the deposit of cognitive junk produced by externalization devices (to repeat his words: “numerous false starts, deviations from rules, changes of plan in mid course, and so on”, 1960: 530). On the contrary, the most advanced neurolinguistic research reveals the close interconnection between motor performativity and the continuous reorganization of propositional and abstract thinking: “the cortico-striatal regions that regulate language comprehension also regulate many aspects of behavior such as motor control and abstract reasoning” (Simard et al. 2010, 1092). Evolutionarily, in fact, the performative motricity of thought could have been decisive for understanding the subsequent development of human language, “because it indicates that our modern brains may actually have been shaped by an enhanced capacity for speech motor control that evolved in our ancestors” (Lieberman and McCarthy 2007, 16).

2.3 From Cerebrocentrism to Embodied Cognition

Embodied Cognition played a major role both in contrasting all the theory based on the centrality of the brain and in fighting against the dualism competence-performance. This dualism is the reason why no one ever managed to make up an extended theory of performativity. Now we know that the first axiom of this theory is

that performativity can't be separated from all the cognitive processes that realize it; on the opposite, we know performativity *is* a cognitive process, irreplaceable both for human and not human animals thanks to its involvement in easing the natural selection of ethological and cultural behaviors' creative aspects.

More than any other theoretical approach, EC suggested that no natural intelligence can be conceived as a brain in a vat. The principles EC is based on are nowadays considered as cornerstones of the debate involving new cognitive sciences.

These principles can be summarized as follows:

1. Today it's impossible for cognitive sciences to ignore the involvement of body structures in cognitive processes (Rowlands 2010; Shapiro 2011). This is the end of the dualistic idea of the functional independence of the brain from its physical substructure.
2. Different body structures correspond to different cognitive systems (Shapiro 2004). The ethological comparison of cognitive systems acquires a structural value.
3. Cognitive processes are not limited to internal operations of the brain but include large body structures and interaction with the environment (Lakoff and Johnson 1999; Noë 2004; Clark 2008a, b; Chemero 2009). Embracing an evolutionary and evolutionist perspective is essential to understand this aspect.

The embodied perspective is articulated and fragmented in different, often extreme positions. Shaun Gallagher and Mark Rowlands coined the term "4E cognitions": embedded, embodied, enacted, extended. The ambiguity of the embodied perspectives produced some relevant problems.

The first problem is the potential danger of returning to behavioral epistemologies. For example, in the most extreme enactivist theses such as the dynamic approach to cognition of Chemero (2009) or the post-artificialist models of R. Brooks (1991 and 2002) the danger of returning to behavioral epistemologies manifests itself in the hypothesis according to which self-organization of systems in continuous dynamic interaction can explain the entire cognitive process. What is important is not our nature but *the way we act*.

The second potential danger is the overcoming of every form of representationalism by assuming that cognition does not require internal semantic states. Gibson (1977), for example, denies any cognitive function of symbolic processing by attributing to perceptive systems the ability to capture the affordances directly from objects.

The third huge problem is what I would like to name "emotionalism", that considers physicality a form of "lower cognition" or "minimal cognition" (Calvo and Keijzer 2009, Chemero 2009, Stewart 2010, Di Paolo et al. 2010): it not body against mind but that parts of the brain that concern computational functions against the ones that operate perceptive, motor and emotional functions. Many have talked about this topic, like Antonio Damasio (1994, 1999, 2004) and Joseph LeDoux (1998, 2003).

Shaun Gallagher talks about this issues is his last work, adding new topics to discuss about.

- The so called fallacy of casual constitution (C-C-Fallacy), that concerns the hypothesis of the extended mind. According to Aizawa (2010 and 2014), the person who extends the space of cognition to devices, protheses and environmental influences, make an unjustified inference from causal dependence to a constitutive dependence. For instance, the use of a notebook or a smartphone as a support for memory can help cognitive process but it is not the cognitive process itself. It is essential to make up a “plausible theory of what distinguishes cognitive processes from non-cognitive processes” (2010:332).
- The primacy of the function in the distributed cognition is supported by the extended-mind perspective and denied by enactivism. The hypothesis of the extended-mind accepts the existence of a certain space for representation since it supports the idea that specific differences in body and shape can be “neutralized” and transformed into similar representations, instead of enactivism, that denies this possibility. According to enactivism, the biological aspects of body, including its regulatory emotional process, have a permanent effect on cognition, just like the sensorimotor matching processes between organism and environment.
- Tests conducted by Libet prove that brain receives a signal 800 milliseconds before every physical movement and that it needs 350 millisecond to make a person conscious of his decisions and movements. Thus, the brain of a person is already working before the movement even starts. In conclusion, “conscious acts are enacted by unconscious processes” (Libet 2004, 529).

All these problems are a huge price to pay for the EC perspective in Cognitive Science since they aren’t in line with the fundamental principle of Cognitive Science itself: a theory does not have to describe behaviors and their rules but has to test analytic models in order to falsify them through experimentation (Chomsky vs. Skinner 1959).

It is no accident that Gallagher wonders if it still makes sense to accept the idea of enactivism as a science of mind. Enactivism is not a scientific research program but it is a “philosophy of nature” (Gallagher 2017a:21; Godfrey-Smith 2001), a sort of “comment about the overall image of the natural world made by scientific and non-scientific research” (Godfrey-Smith 2001: 284) that, as “a form of naturalism, does not endorse the mechanistic definition of nature” (Gallagher 2017a: 23).

It is clear that we are therefore faced with a situation of strong theoretical weakening, if not a true epistemological collapse. As Aizawa writes:

one cannot argue that cognition is embodied and extended, by observing that behavior is embodied or extended. And, one cannot show that not all cognition involves representation by providing instances of behavior that do not involve representation. (Aizawa 2014: 40).

2.4 What Is a Body

I believe that the main cause of the contradictions and the issues intrinsic to contemporary EC is the ideological confusion over the notion of “body”. I call it “ideological” because I want to stress that no theory on the embodied mind can afford to omit or forget that the brain – unlike the mind – is a part of the body. What Embodied Cognition really fights against is the cognitive neuroscience’s key principle, that is the brain’s dominance over the other bodily organs. Such belief is the result of the influence of the dualism that still underpins some mentalist theories, but that was strongly rejected by the cognitive-oriented naturalistic philosophies. One of the latter is neo-phenomenological enactivism, which however struggled to “rethink the mind” (Gallagher 2017a) due to the lack of a precise hierarchy among the levels of its analysis.

Every time someone tries to face the philosophical issue of the body, the framework becomes fuzzy and unclear.

Is the brain a part of the body? Does the perceptual properties belong to the nervous system? Does nerves, muscles, bones and soft tissue have a role in cognitive processes? Moreover, what body we are talking about? A social animal’s or a solitary species’ individual’s one? Bee’s or octopus’, horse’s, bonobo’s or sapiens’ one? Are we talking about Shaun’s, Mark’s, Franco’s or Pietro’s body, about the young sprinter’s or the old man’s, Kant’s or an Alzheimer patient’s one? Are we talking about the body of a mathematically gifted child or about the child with autism’s one, about the body of who wears a prothesis or the one of who uses tools that might extend cognition, such as smartphones or notebooks?

I could go on forever. The first thing I want to emphasize is that bodies are highly variable phenotypes. Such variability is enhanced by the individual development and by the natural and cultural environment in which people live. Culture and learning can take individual and collective differences to the extreme. However, one thing is for sure: when people die, all the environmental and cultural differences disappear. The heirs of a writer might be illiterate, the son of a racer might never learn how to walk. A woman who knows how to use a smartphone or a tablet will not automatically give birth to a person with good technological or digital skills.

As we have seen, similar arguments were used by Gallagher to remedy shortcomings in the extended mind hypothesis, such as the “Coupling-Constitution fallacy”. An example of such fallacy is the mistaken belief that the artificial protheses have a constitutive role in the cognitive processes: technological tools are, in fact, the cause of the empowerment of mental processes, not the processes themselves (Aizawa 2010 and 2014).

I think we have to be even more precise. In order to establish what a body can or cannot do regardless of its development, we need to look at the embryogenesis of the brain-body system. Such level of analysis corresponds to the philosophical concept of “Körper” developed by Husserl, that is the body considered as an object with physical and measurable properties (height, weight, biochemical activity, the

functioning of the nervous, cardiovascular and respiratory systems etc.). Basically, we need to look only at the properties that are heritable by the genotype.

The physical bodies, however, experience the world in different and subjective ways. Such level of analysis is the one of “Leib”, Merleau-Ponty’s and phenomenological tradition “object veçu”, that is the body as it is lived and used within the environment by the individual. Here is where we need to apply the theories on body and its performativity in order to shift from the epistemological level of the individual to the one of the species.

Whoever wants to deal with EC while remaining within the frame of Cognitive Science needs to address the relationship between *Körper* and *Leib*. Where does *Körper* meet *Leib*? Can Cognitive Science put the study of bodily structures together with the description of the subjective experience people make through their body, or do physics and biology have to remain separated from psychology and philosophy? In the first case, Cognitive Science would finally achieve the aim of the Embodied Cognition and enter a new phase; in the latter, the scientific research is likely to remain stuck in the cartesian dualism for a long time.

The idea I’d like to put forward is that we need to incorporate a theory of performativity in the framework of Cognitive Science; in order to do that, we have to:

1. Investigate the body through an ethological approach.
2. Establish an evolutionary framework.
3. Put (a) together with (b) in order to develop a theory of performativity.

In the following pages we will try to deal with these points following an approach that, starting from some naturalistic reference points of the past, reaches the theoretical developments of contemporary problems and their possible solutions.

2.4.1 Body Ethology: From the History of Ideas to Cognitive Ethology

Two great precursors of the modern idea of embodied cognition were certainly Aristotle and Spinoza (Pennisi 2016, 2017a, b, 2018b, 2019; Pennisi and Falzone 2016).

Aristotle, as a true biologist and coherent monist, does not separate different substances but thinks that the visible and invisible elements of the same body are inextricably intertwined. In *De Anima*, he identifies the body and mind as a single mass of wax stamped by patterns: the wax and its imprint cannot be conceived separately in the same way in which the function of seeing cannot be separated from the organ of the eye. Each function is inseparable from what makes it possible. This view, compatible with any modern epistemological conception, greatly complicates the work of the scientist. One must no longer describe speculative assumptions that exclusively deal with their own philosophical needs, but we must reconstruct

with utmost precision the way in which the visible and the invisible, structures and functions, connect in the concrete observable behavior. These rigorous scientific ethics can, of course, result in errors, since they are virtually unfalsifiable. Aristotle, who has provided an unparalleled description of the physiology of animals and explained the operation of a great quantity of organs in detail, now needs to explain how these are connected in a unitary body, which is more than the whole of its parts. And since this link cannot be vague and indistinct, but must be placed in the visible body, he locates it in the only network present in animal bodies known before the dissection of corpses, which is the network of blood vessels with a single afferent and efferent centre: the heart. This is why, on the basis of empirical evidence, it is pretty reasonable for Aristotle to arrive at the cardiocentric fatal error.

This fatal error renders Aristotelian physiology of higher functions useless for the purpose of contemporary reconstruction. In fact, it reveals a surprising novelty. The analysis of the bodily technology of language is independent from the super-power of the invasive brain. In this way, however, it is reconstructed for the best in its most analytical ethological and comparative dimension. It is in this way that the most species-specific biological functions of the most constraining parts of the language faculty can emerge and be described in a manner still unsurpassed. In particular, we can consider the role of linguistic articulation as a function taking input from the hardware of the auditory-phonetic systems to reach the logico-semantic-syntactic compositionality of more sophisticated mental procedures of human cognition. Such a role no longer relegates vocal articulation to the auxiliary position given to it by the hegemony of cerebrocentrism in contemporary cognitive science.

In terms of modern philosophy, Spinoza's conception of the mind as "*idea corporis*" means that the union of *Körper* – the bodily extension – and *Leib* – the subjective experience of the body – is the foundation of the only existing human "*natura naturata*" (1663-DCPP: II, 9, 267 – CW:202). Such unity also encompasses God: "extension is an attribute of God; i.e., God is an extended thing" (1677-EOGD: II, II, 87 – CW:245).

The separation between *Körper* and *Leib*, thus, doesn't fall within the interest of naturalist philosophers and, today, of cognitive scientists. Among all the naturalist approaches to the body, ethology is the one which is the most aware of the importance to overcome the dichotomy between *Körper* and *Leib*. Ethology doesn't take into account the individual bodily differences, but rather the differences among the bodies of the many animal species. According to ethology, the development of all the species-specific cognitive structures depends on the species-specific bodily structures. In such monistic theoretical framework, all the aforementioned inconsistencies of the Embodied Cognition disappear.

But how does Spinoza get to this point?

The *pars destruens* of his hypothesis is the deconstruction of cartesian mentalism, that is the position embraced by those who are strongly "convinced that at the mere bidding of the mind the body can now be set in motion, now be brought to rest, and can perform any number of actions which depend solely on the will of the mind and the exercise of thought" (1677-EOGD: III, II, 142 – CW:279). In mentalists' view, the body doesn't have any knowledge ability. They claim that "unless the mind is in

a fit state to exercise thought, the body remains inert. (...) that it is solely within the power of the mind both to speak and to keep silent, and to do many other things which we therefore believe to depend on mental decision" (1677-EOGD: III, II, 143 – CW:280).

Conversely, according to Spinoza: "if the body is inert, the mind likewise is not capable of thinking" (ib.), in the same way it's impossible to speak words if the brain cannot recall them from the memory (Op. 1325).

This happens because even the brain is a part of the body and belongs to the *res extensa*, not to the *res cogitans*. In contrast to Descartes' opinion, Spinoza claims that we should conceive the *res cogitans* as *res extensa*, since the cerebral and sensorimotor operations are brought forth by the body and correspond to measurable cognitive effects. As Thomas Cook says, "I think that he was committed to the view that there is at least a token-token identity between any functionally described bodily state and a state described in purely fine-structure physical terms" (1991:86). This is possible for Spinoza since he believes that "the order and connection of ideas is the same as the order and connection of things" (1677-EOGD: II, VII, 89 – CW:247) and that body and thought are a single substance.

Let's come to the *pars costruens*.

According to Spinoza, not only philosophy is "thinking action, acting that is one with the idea that generated it" (Sangiaco 2010a:7), but even thought is movement that brings joy: "as the mind is more active, so is the feeling more perfect" (1661-KV: II, 19n – CW:89); even God is conceived as an enactive entity, as pure action: "he does what he does, and omits not to do it" (1661-KV: I, 5, 39 – CW:53).

Spinoza's God-Nature is performatively creative: rather than preserving things, He "continues to create them" (1663-CM, II, 11, 274 – CW:207). He doesn't alter the quantity and the movement of the matter, but "in a sense it can be said that something new is added to it" (ib). Conversely, action always depends on the body. Even when action seems not to be goal-oriented, it is always "subordinate to other ends which another has in view, who is above them, and lets them act thus as parts of Nature" (1661-KV: II, 24, 105 – CW:97). Thus, enaction is always bound to the biological structural constraints, even if it manifests itself through different emotional and perceptual acts, and through complex processes such as reasoning and language.

Spinoza often addressed the issue of the variability of language and opinions. Topics such as the imperfection of language, the *abus des mots* etc. were very common among Bacon's, Hobbes', Locke's and Port-Royal Logic's philosophies. In Vico's thought, the acceptance of the imperfections of human language might give life to a new metaphysics: "metaphysicam humana imbecillitate dignam" (Vico 1710:131).

Spinoza shares Vico's position. Human language follows "other laws which are quite different from the laws of the intellect (...). [The words] are merely symbols of things as they are in the imagination, not in the intellect" (1656-TIE, 86–89, 33 – CW:24). Even the acts of denying and affirming are profoundly imperfect: "we affirm and deny many things because it is the nature of words to admit those

affirmations and negations, not the nature of things; therefore ignoring the latter, we will easily take the false truth” (ib.).

The difference between Spinoza’s and his contemporaries’ thought lies in the above assertion. It doesn’t matter if the nature of words is different from the nature of things: the only true wisdom is the scientific knowledge about the bodily structures, which remain constant over time and do not depend on human affects, passions and language.

Men can express themselves only through language: “how else, I ask, can we show the idea of some thing than by giving its definition and explaining its attributes?” (1663-DCPP: I, 6, 161 – CW:134); however, there are some knowledge abilities that are close to natural omniscience, like the scientific understanding (more *geometrico*) of the functioning of the bodies and of their interactions, what we may call the bio-physics of bodily technology.

Let’s be clear: we can’t do without words. Man is ethologically marked by the need of representing, even if the purpose of the representation is not to achieve the perfect understanding of the mind-body unified structure. The language as a biological constrain – which is part of our *natura naturata* – is something different than the scientific knowledge of the bodies, which corresponds to the overlapping between divine thought and Spinoza’s *naturante* thought.

my purpose is to explain not the meaning of words but the nature of things, and to assign to things terms whose common meaning is not very far away from the meaning I decide to give them (1677-EOGD: III, def.20, 195 – CW:314)

However, Spinoza is not a philosopher of language; if anything, he is a philosopher of mind. Spinoza, in fact, is particularly interested in the functioning of the cognitive system – the propositional-linguistic representation – that forces us to think in a certain way, but doesn’t conceive it as a substance, and in doing so he gives new insights to the EC.

However, there is an unsolved issue. Like Della Rocca claims, “for Spinoza, the representation of a thing is intimately connected to that thing’s essence”. (Della Rocca 2008:92)”. How can any philosopher get to the essence of a representation that is only contingency?

What I find very innovative in Spinoza’s thought is that he detected the exact link between *Korper* and *Leib*, that is the level where we can determine what a body can do, regardless of how we subjectively experience it or we describe it through language. Such level is the ethological one, and is intrinsically evolutionary. Contrary to what the traditional philosophy of mind taught, in fact, the phenotypical differences between the individuals cannot account for the differences between the bodies: “the mind is more capable of perceiving more things adequately in proportion as its body has more things in common with other bodies” (1677-EOGD: II, 39, 120 – CW:266), since it “dwells among individuals who are in harmony with man’s nature” (1677-EOGD: IV, Ap7, 269 – CW:359).

Against this background, we can claim that the bodily possibilities are bound by the intrinsic species-specific constitution:

I say that there pertains to the essence of a thing that which, when granted, the thing is necessarily posited, and by the annulling of which the thing is necessarily annulled; or that without which the thing can neither be nor be conceived, and, vice versa, that which cannot be or be conceived without the thing. (1677-EOGD: II, D2, 85 – CW:244).

Whatever can be taken away from a thing without impairing its integrity does not constitute the thing's essence (1663-DCPP: II, Das2, 184 – CW:149)

to produce, in “substantial” thought, such an idea, knowledge, mode of thought as ours now is, what is required is, not anybody you please (then it would have to be known differently from what is it), but just such a body having this proportion of motion and rest, and no other (1661-KV: II, Pn11, 53 – CW:61)

to determine the difference between the human mind and others and in what way it surpasses them, we have to know the nature of its object (...), that is, the nature of the human body (1677-EOGD: II, 13, 97 – CW:252)

we shall presuppose (...) that extension contains no other modes than motion and rest, and that every particular material thing is nothing else than a certain proportion of motion and rest (...): the human body, therefore, is nothing else than a certain proportion of motion and rest. Now the “objective essence” of this actual ratio of motion and rest which is in the thinking attribute, this (we say) is the mind of the body (1661-KV: II, A2, 121 – CW:106).

Therefore, bodies cannot be defined by comparison: we should not wonder what a body can do, but what a body cannot do. Such bodily constrains, rather than being determined by individual, cultural, technological, social or environmental factors – these are domains characterized by the limitlessness of uses, which has a historical-cultural nature – have an ethological ontology, that is to say they do not depend on the history of the interactions, but on the biology of the latter. The difference between historical and biological interactions is that the latter remain constant despite the changes that occur over time, while the firsts are destined to an ephemeral existence. Bodily possibilities and impossibilities concern the species, not the individuals; whereas the genotypes are persistent, the phenotypes disappear with death. The topic of the persistence in the existence (in *existendo perseverantia*) is one of the most recurrent in Spinoza's work. According to the philosopher, permanence is the ability to incorporate changes while retaining the ethological nature unaltered:

as soon, then, as a body has and retains this proportion [which our body has], say e.g., of 1 to 3, then that mind and that body will be like ours now are, being indeed constantly subject to change, but to none so great that it will exceed the limits of 1 to 3; though as much as it changes, so much also does the mind always change. (...) But when other bodies act so violently upon ours that the proportion of motion [to rest] cannot remain 1 to 3, that means death, and the annihilation of the mind, since this is only an idea, knowledge, etc. of this body having this proportion of motion and rest (1661-KV: II, P, 53 nn.12-14 – CW:61).

Therefore by life we for our part understand the force through which things persevere in their own being (1663-DCPP: II, 6, 261 – CW:197)

The distinction between human and animal mind, rather than being ontological, is evolutionary: it depends on a different degree of complexity and specificity that the human body has in comparison to the animal one (cfr. Jaquet 2004; Sangiacomo 2010b, 2011):

“the emotions of animals (...) differ from the emotions of men as much as their nature differs from human nature. Horse and man are indeed carried away by lust to procreate, but the former by equine lust, the latter by human lust. So too the lusts and appetites of insects, fishes, and birds are bound to be of various different kinds. So although each individual lives content with the nature wherewith he is endowed and rejoices in it, that life wherewith each is content and that joy are nothing other than the idea or soul of the said individual, and so the joy of the one differs from the joy of another as much as the essence of the one differs from the essence of the other” (1677-EOGD: III, 57, 187 – CW:309)

when I say that somebody passes from a state of less perfection to a state of greater perfection, and vice versa, I do not mean that he changes from one essence or form to another (for example, a horse is as completely destroyed if it changes into a man as it would be if it were to change into an insect), but that we conceive his power of activity, insofar as this is understood through his nature, to be increased or diminished (1677-EOGD: IV, Pref. – CW:322)

no individual thing can be said to be more perfect on the grounds that it has continued in existence over a greater period of time. The duration of things cannot be determined from their essence, for the essence of things involves no fixed and determinate period of time. But any thing whatsoever, whether it be more perfect or less perfect, will always be able to persist in existing with that same force whereby it begins to exist, so that in this respect all things are equal (1677-EOGD: IV, Pref. – CW:322)

We cannot assume that Spinoza’s thought had a direct impact on the field of contemporary cognitive studies. There’s no doubt, however, that, from a philosophical point of view, Aristotle’ and Spinoza’s ideas are the only ones which provide EC with a natural-scientific validity, allowing it to be embraced by a biologically and evolutionarily oriented Cognitive Science.

The ethological perspective is the main responsible for the transformation of the mind-body problem. Ethology – and, more specifically, cognitive ethology – showed better than any other scientific approach that the study of bodily properties is relevant only if the body of the species, rather than the body of the individual, is taken into account.

Only by studying the species-specific universal properties of the bodies we can understand the actual relation between bodily technologies and cognitive states. The body has a direct effect on cognition. I.e. the “olfactory” cognition of dogs or the “visual” one of eagles are one with the animals’ nervous systems and with their highly specialized cortexes. In the human animal, the most distinctive cognitive abilities are language and bipedal locomotion, which in turn are made possible due to the presence of a vocal tract that allows to articulate distinct and combinable sounds and to a musculoskeletal structure that doesn’t prevent the torso from lifting. It is no coincidence that the most developed areas of the motor cortex are the ones of tongue and hand.

The human language would therefore be a biological form of embodied species-specific intelligence based on the evolution of the overall body structure of *Homo sapiens*.

The brain is a fundamental part of these structures and, in order to develop articulated language, has allowed human evolution to perform a complete rewiring of respiratory, muscular and nervous physiology. It has monitored fine control of

articulatory features and has functionalized them to new cognitive tasks (semantic categorization, syntax and logical representation of the world) and radical transformations of social behaviour (hyperextension and articulation of cooperation between conspecifics, pragmatic adaptability, moral normativity and aesthetics). Of all the different corporeal structures of *Homo sapiens*, the brain, however, constitutes the biologically less constrained part. In conjunction with certain trends of thought matured in the Evo-Devo, we must consider, in fact, the specific constraints of Bauplan, the “constraining” character of the shape of the body, which is much less flexible than the brain structure and is plastically the most adaptable organ of the whole living machine.

Yet such power and freedom has a price: the brain that can adapt and coordinate, synchronize and schedule everything, which can infuse intentionality and finalize it, cannot “invent” the lowly bodily organs, its suburbs. Indeed, in a sense, from an evolutionary point of view, it is completely dependent on them. If unusual genetic mutations of the body, conforming to the laws of development and form, should in time be beneficial for the fitness of the species, the brain will certainly be able, in a short evolutionary time, to exploit and tame the possibilities, cabling with extraordinary precision, and operating procedures. But without the slow and continuous transformation of those forms, change (that particular change) would never take place. The most important evolutionary transformations always start from modifications of the structures: the functions will follow, as well as their performative algorithms. The adaptation and control principles – specific to the brain – are opposed to those of autonomy and generation – and are typical of other structures. And this, among other things, explains what to Michael Tomasello seemed to be the biggest mystery of human evolution: the discrepancy between the cumulative cultural evolution speed, and its inexorably slow character of “normal processes of biological evolution involving genetic variation and natural selection” (1999, 2).

2.4.2 The Evolutionary Framework for an Extended Theory of Performativity

In functional terms, hence, the brain is a powerful biological instrument permitting continuous reorganization of the activity of organisms. An incessant activity of biological agents that move and act, that perceive and explore the world around them through a network of sensors and nerves, whose complexity of articulation is directly dependent on the species-specific structure. This activity relentlessly stimulates the rewiring of sensorimotor networks and remodeling of cognitive interactions. Our mind is the result of this close cooperation between the performative competence triggered by sensory-motor systems and the readjustment of the computational procedures of our deep brain to allow the survival and growth in the fitness of individuals and the entire species within environmental variation.

In the functional reconstruction we have so far tried to propose, performative competence describes the individual and collective behaviors that seem geared to different procedures from those originally considered by cognitive sciences. Incoming stimuli are not processed by a set of internal computing mechanisms, i.e. autonomous rules that are entirely intrinsic to innate mechanisms of thought, which always produce calculable output, except for errors or alterations of the machine procedure. Conversely, the performative inputs redetermine the rules and their countless combinations implemented by the “black box” create unexpected behaviors. This behavior should be tested in more or less extended temporal spaces by generating adaptation and fitness for the organisms. On the one hand, this mechanism starts from the “flaw” of performative competence, and proceeds in the absence of algorithms which have already been formalized and are available for application. On the other hand, it highlights the possibility of producing innovative types of behaviour: in fact, these unexpected cases “oblige” the central structure by reincorporating them within our knowledge, in new and broader coordination and control systems, creating new algorithms that could automatically produce (but it is not obvious that this will occur) new knowledge gained from exploratory activities. Essentially, it is the motor activity of our bodies that generates innovations that are ruled by our plastic brains. Change is always triggered by the bodily organs; the brain intervenes functionally later supporting the organism to free it from the anguish of uncertainty, from the horror vacui of the inapplicability.

Of course, the brain is also part of our body, as well as the mind generated by this continuous cooperative processing. If we didn't think so, we would remain fatally trapped in the dualistic residues and the Platonism typical of the first phase of cognitive sciences. However, it is the biological status, the specific type of constraints which the brain obeys, that makes it functionally different in nature from other parts of organisms:

our brains are set in gray matter, not in stone; their parts are predisposed but not absolutely preset for particular functions. They are built of general-purpose bioprocessors that, after being formed, become specialized in response to their inputs and outputs – not of preevolved, rigidly specialized processors. There may be a protomap specifying which is to happen, yet this is easily rubbed out. Thus, neural abilities may be fated, but they are not determined (Skoyles and Sagan 2002, 26).

The structural plastic difference in cytological nature, between that part of the body we call the “brain” and all the other parts (muscular, skeletal, ligament, respiratory, digestive, integumentary system, etc.) that in symbiotic interaction determine the survival and adaptability of organisms, plays a biological decisive importance not only, as we have seen, in functional terms, but also, and perhaps most importantly, under an evolutionary profile. If the brain and, more generally, the nervous system, have to be subjected to the same slow, progressive modification of the mechanical components, organisms could not survive.

The brain's development is so fast because its loop of continuous monitoring of sensorimotor events does not allow individual strips of behaviour to be negatively

affected for a long time by performing indeterminacy, to suffer the pain of insecurity or the danger of extinction without the intervention of a specific adaptation to the kind of stress that comes from activation of the modified body (by endogenous or environmentally induced mutations). The neural rewiring timing modification and the structural evolutionary modification are immeasurably different. Any slight body modification can take millions of years, it can go through thousands of intermediate stages, and it can mark a variety of overt or silent evolutionary events. But meanwhile, at every stage, it will be constantly assisted by the plasticity of the nervous systems that do not function for even a moment without continually reformatting the cognitive systems as a whole.

The birth of a new species can be thought of as a discrete state of this continuous process, a stage marked by the achievement of a new and stable order of bodily and cognitive ergonomics technology. This state is not inscribed in any predictable historical process. Natural selection and random populational variation may have been modelled, for a significant time, by the mechanical components of organizations, assisted by new functions of the neurocerebral systems. Only when these structures, shaped by time and the environment, and by individual and socialized use, have reached a certain random or historically unpredictable combination, only when a series of organic gears, levers, wheels, cams, pistons, lubricants and whatever can support the living mechanics, will these be fitted together in a structure that allows organisms to have different interactions with the world thanks to the evolutionary plasticity of the nervous systems, then and only then an unedited species-specific cognition will enter into competition with other species.

Considering the plasticity of neurocerebral systems to be a permanent support to the evolutionary continuum of structures until they achieve the discrete stage (i.e. speciation) that constitutes a ratchet in the life of biological organisms is a truly Darwinian theoretical starting point, since it would cover all animal species, regardless of the complexity of their cognitive systems. Similarly, it may also serve to explain the specificity, if not the functional uniqueness, of all species, not just the human one. In other words, brain plasticity could minimize what the previous articulated theories split into inefficient and consistent dichotomies (structures/functions; nature/culture; gradualism/saltation; continuous properties/emergent properties, etc.).

However, a significant price is paid for these advantages in a new philosophy of biology that is no longer based on cerebrocentric models, such as those now demanding the priority of cognitive neuroscience in the cognitivist galaxy. In fact, the brain (the nervous system, more generally) fully takes responsibility in supporting the relentless evolution of bio-mechanical structures, but, accordingly, it cannot determine the directions of development, nor be the original cause of the functions they control. Brains do not cause developmental changes but allow the establishment of them. The body-brain always comes after the body-structure.

2.4.2.1 The Brain and the Chrono-Logical Causalism

This sort of principle of chrono-logical causalism has always been the core of Darwinism. Darwin, in the first note of the fourth edition of *The Origin of Species*, admitted that he had learned it from Aristotle, even if he objected that the philosopher did not understand the role of natural selection. Actually Aristotle seems to substitute the matter's intrinsic finalism with the logical causalism of succession: that is, the evolutionary causalism of "before and after", the irrefutably chronological sequence of states of biological life. This eradicates any possible eschatology: it is not at all certain what will evolve in a certain way, predictable because designed or functionally inevitable.

However, a certain functional outcome would not simply exist if its antecedent did not exist: in this sense the cause of a given state of affairs is always its previous state: "where a series has a completion, all the preceding steps are for the sake of that" (Aristotle PH, II B, 8, 199a, 8–10 – ed. Ross, 647) in fact "artificial products are for the sake of an end, so clearly also are natural products. The relation of the later to the earlier terms of the series is the same in both" – (Aristotle PH, II B, 8, 199a, 18–9 – ed. Ross, 648). So there would be no saw for cutting if there was no iron to make it, or there are no houses where one can live if there are no bricks and stones to build them (Aristotle PH, II B, 8, 200a, 10–25). Similarly, in nature, the roots of the plants grow down because there exists before them "Mother Earth" that is rich in nutrients. And so, in order to define a human being, it is essential to assume the continuity of its states which, once occurred, we can only reconstruct by describing how they are embedded within each other: "if man is this, then these; if these, then those" (Aristotle PH, II B, 8, 200b, 3–4 – ed. Ross, 651).

In naturalistic thinking, both scientific and philosophical, the principle of chronological causalism has always been a fixed point, the firm anchoring of man to his animal roots. In *De Rerum Natura*, by Lucretius – opposing the finality of the Stoics – it is claimed that functional facilities are unpredictable:

since nothing was born in the body that we might use it, but that which is born begets for itself a use : thus seeing did not exist before the eyes were born, nor the employment of speech ere the tongue was made; but rather the birth of the tongue was long anterior to language and the ears were made long before sound was heard, and all the limbs, I trow, existed before there was any employment for them : they could not therefore have grown for the purpose of being used (DRN IV, 822–857, ed. Munro, 190).

This anti-Lamarckian ante litteram profession is backed up by a tight logical and biological argument that is still very current. The sharpness of the eye vision is not the result of an intelligent design, nor the locomotor apparatus, nor the human organization in the lower limbs and upper limbs respectively used to move and to produce tools, but owes something to the generosity of a God dominating nature and conditioning it: "other explanations of like sort which men give, omnia perversa praepostera sunt ratione, one and all put effect for cause through wrongheaded reasoning" (DRN IV, 822–857 – ed. Munro, 190).

The correct relationship between the before and after, between the chrono-logical causality and unpredictable outcomes of social uses of the possible functions

determines the direction of evolutionary history. As in any naturalistic philosophy, this causality is beyond the control of individual subjects and exclusively relies on the adaptation that only can avoid extinction in a regenerating alternation of life and death. In the same way, our brains can only control and direct the bodily apparatus but cannot prevent the apotheosis or the collapse of the species.

Perhaps, the philosophical voice that insisted most on these brain limitations is that of Henri Bergson, many centuries after Greek-Latin classicism. We assume that his idea about the neurocerebral apparatus is much more mechanistic than his spiritualist vitalism. In *Matière et mémoire*, the brain is considered “a kind of central telephonic exchange”, (Bergson 1896, 10) that takes care of dispatching notices, inhibiting them, fostering them, making them wait. It “adds nothing to what it receives” (10): it coordinates the stimulus and decentralizes the answers; it connects through cord and peripheral nerve excitations with central mechanisms; it directs and chooses the motor pathways. In short “the brain appears to us to be an instrument of analysis with regard to the movement received, and an instrument of selection with regard to the movement executed” (10), but in no case it can be considered an organ designed to prepare or explain a representation. Similar judgments have been confirmed, even in later writings. It is treated as a “crossroads” of vibration, a “switch” that addresses possible actions (Bergson 1911), and as an “organ of pantomime” of mental life (Bergson 1912, 58 and 1913, 92).

Despite these limitations, its continuous supervision work of motor activity and, above all, its selective role with respect to the virtual possibilities offered by the rest of the body, transform the brain into an organ of survival and adaptation. So at the same time, the brain becomes “the organ of attention of thought to life” (Bergson 1913, 93) and the organ of “racial [species] attention” (Bergson 1913, 95 and 1908, 178). Attention to life, for Bergson, is the ultimate subordination of mental life to practical activities, to the selective primary needs: the most important cognitive function for self-preservation. Therefore, at the same time, thanks to its ability to select only what is essential for survival contextualized in a precise moment of time, space, and psychological and social environment, and its capability of “masking”, and ignoring everything that is extraneous to pragmatic contingency, the brain locates the existence of individuals and species, it locates them in action and focuses on behavioural opportunities.

We can find few developments in the area of philosophical speculation. For example, one of the pioneers of current neuroscience, Ramachandran, translates the brain’s “negative” capacity, first identified by Bergson, to obscure that which is not essential to the pragmatic behavior of selection, in a precise neurophysiological pattern. According to Ramachandran, many bizarre types of behaviour such as synaesthesia, the manifestations of hysteria, phantom limbs, blind vision, spatial neglect, the extensive catalogue of expressions of autism spectrum disorders, result from the fact that the brain is not capable of overlapping its modules: “here is a bottleneck of attention. You can only allocate your attentional resources to one thing at a time” (Ramachandran 2003, 76).

The principle that “less is more” allows our brain to focus entirely on what it needs to survive. This “principle of modular isolation” (Ramachandran 2003, 55)

would explain, at the same time, the ability to enable some autistic subjects to excel in design, numerical computation, or other modular specializations, and the logic of evolutionary selection that circumscribes and improves the behavior of the species by solely optimizing the behaviors best suited to survival, for example, protection from predators, hunting prey, foraging in general and reproduction. In either case, it is never a choice. In diseases we are forced to divert optimization towards the modules of intact behaviors because (probably) some parts of our neurocerebral system, which are normally used to control those behaviors, are somehow compromised or neutralized. In selective logic we are constrained by neurocerebral systems that are in constant contact with the environmental sensors and that hierarchize the answers on the basis of context requests. It would be a serious evolutionary disorder that would make animal brains indifferent to “attention to life”.

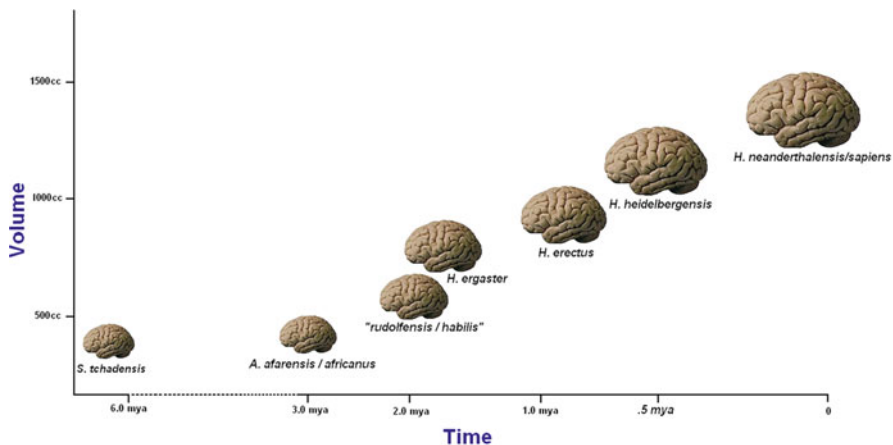
In carrying out this essential monitoring attentional work, under both functional and evolutionary profiles, the neurocerebral system is facing not only external enemies but also, and perhaps above all, inside antagonists: the rest of the body where “he lives”.

The relationship between the bodily technology of a species and its cognitive ergonomics, that monitor and regulate it, is at the origin of all manifestation of genotypic (before) and phenotypic (after) plasticity; then it always prioritizes the relationship between the species and its cognitive ergonomics. According to Ramachandran (2003): “in the biological sphere, opportunistically abduction of a structure to induce it to perform a different function from that it was originally evolved to carry out is not the exception, but the rule”.

2.4.2.2 The Brain Tenant of the Body

This effective expression was formulated by the founder of modern evolutionary paleoanthropology, Leroi-Gourhan (1964, 37 and 47; 1983, 25). To understand the meaning of the term, it should be noted that its creator was the first scholar to propose the idea that human lithic technology, the art of artificially modifying the matter, and more generally cognitive evolution, is the result of a complex transformation not only of the brain but of the body as a whole. Often, Leroi-Gohuran formulated provocative paradoxes to highlight the importance of these scientific issues, as illustrated by one of his mottos: “human evolution did not begin with the brain but with the feet” (Leroi-Gourhan 1964, 229).

Leroi-Gourhan wanted to prove that many philosophical or religious theories of evolution – starting from those of the theologian Teilhard de Chardin – had started to proceed, often unintentionally, to finalistic paths with little critical spirit, and embraced the idea that evolution was characterized by a gradual increase in the size of the brain that caused an automatic development of increasingly complex cognitive faculties.



According to this hypothesis – that still exists today, see the picture taken from a recent essay by Chomsky and collaborators (Bolhuis et al. 2014) – evolution manifests itself firstly in the improvement of brain functional dispositions, and secondly in the resulting adaptation of mechanical dispositions: “the relations between the contained and the container” (Leroi-Gourhan 1964, 59). According to Leroi-Gourhan’s reconstruction, the flaw in this degeneration of evolutionary thought is due to the excesses of finalism, a convenient but very risky shortcut that only a rigorous analysis of the species’ mechanical consistency can avoid to derail by scientifically acceptable paths. In fact, the evolution of the neurocerebral system follows the constraints imposed by the evolution of the mechanical parts. We can image a carnivore skull with a brain the size of a nut and the rest of the skull being filled with bone crests and muscles, or a skull with the same shape and size as the first skull but filled with cluttered grey matter to the roof of the cranial vault. This allows us to understand the case of the evolution of hominids who can share the same bodies but not the same brain development (Leroi-Gourhan 1964, 31 et seq.).

Therefore, the teleological assumption that, as brains get bigger then cognitive abilities increase, must be subjected to a comprehensive review, as one must take into account the inseparable relationship between the structural morphology of the mechanical organs, and the specific morphology of the brain and the nervous system and that of the functional adaptations that enable the survival of the species.

It is here that the chrono-logical causalism that had secretly permeated the history of evolutionary thought, and that we have discussed above, plays an important role. This involves the renunciation of ruling cerebrocentrism: “the ‘cerebral’ view of evolution now appears mistaken, and there would seem to be sufficient documentation to demonstrate that the brain was not the cause of developments in locomotory adaptation but their beneficiary” (Leroi-Gourhan 1964, 26). As in the Aristotelian game of “before and after”, according to Leroi-Gourhan, brain development can never be the cause of the development of the rest of the body:

although this has been at least implicitly supposed in the past, the expansive force of the brain cannot have acted as the motive force in the evolution of the skull. The number of nerve cells cannot increase before the edifice has been enlarged. Even we regard cerebral expansion and spatial improvement of the skull as a single phenomenon, we have to acknowledge that the brain ‘followed’ the general movement but did not generate it (Leroi-Gourhan 1964, 81).

From one point of view, such a clear position seems to be illustrated by Columbus’ egg. The mechanism of every evolutionary change has to be sought in the history of the changes of the mechanical structures of the body: primarily bones, muscles and all that regulates their growth and metabolic functioning. The genetic mutations that can cause these variations will be filtered by populational selection, of course, and those that will survive throughout the course of many generations will have determined a new stable genotype and, at the conclusion of a complete morphogenetic restructuring, a new species.

In the case of the human species, this complex process is pivotal to the achievement of the upright position. In fact, it causes a double “catastrophe”: firstly it frees the upper limbs establishing a new special relationship between them and the brain, and secondly, it allows the increase in skull size with subsequent development of the cortical fan. Recent studies have reported that this structural transformation also favoured the lowering of the larynx and the formation of a supralaryngeal vocal tract with two curved portions with a 1:1 length ratio (Ghazanfar and Rendall 2008). Then, starting from the feet and cascading upwards, the rest of the body was developed including the brain. However, when one considers the role of structure and brain function, there is no doubt that, under the principle of chrono-logical causality, without the revolution in bone structure, cognitive revolution would never have existed.

Therefore, far from being mere externalizing devices of computational algorithms that belong to a predestined mind, the mechanical components – but more broadly all body structures – determine the cognitive opportunities that the neurocerebral system has to manage in the best way possible.

Therefore, in relation to the randomness of chronological evolution, the brain evolves after the rest of the body, i.e. the brain must follow the body and be recruited for its survival. For this reason, the brain is the “tenant” of the body:

the brain, whose role as coordinator is obviously a primordial one but which functionally appears the ‘tenant’ of the rest of the body. This situation of the brain, which could be described as subordinate to the edifice as a whole, has been noted and recorded many times without its significance being wholly clarified (Leroi-Gourhan 1964, 37).

the brain, modest ‘tenant’ of the cranial cavity, plays a mechanically passive role. The apparatus that it will presently animate is there at its disposal, but its role in the evolution of forms is not immediate or direct, making itself no doubt felt in the Darwinian selection of the fittest forms but not, so far as we can see, providing any mechanical impetus. It is in this sense that I regard the development of the brain as an element incidental to evolution in general. This in no way detracts from the well-established truth of the nervous system’s evolution toward increasingly complex structures. Between the evolution of the brain and that of the body there has been a dialogue from which both sides have benefited. Evolution can of course be viewed as the triumph of the brain, but it is a triumph subordinated to

certain overriding mechanical realities. In the progression of the brain and the body, at every stage the former is but a chapter in the story of the latter's advances (Leroi-Gourhan 1964, 47).

The thinking behind this reverse order (compared to the evolutionary thought of that time) in chronological randomness is not limited to the problem of priorities of the bone structures in determining brain shape. Since the bipedal revolution and liberation of the hands, an extraordinary series of unexpected visual, postural and sensory-motor possibilities have been derived with the brain guiding a new machine capable of unexpected cognitive ability. Man's vertical position caused revolutions in "terms of neuropsychological development; the development of the human brain was something other than just an increase in volume" (Leroi-Gourhan 1964, 19).

Take, for example, the change for hominids in their front horizontal field of view compared to that of quadrupeds, that are limited in this regard by the horizontal position of the trunk relative to the head, by the insertion of the neck muscles and by the inability to have a wide rotation of the visual axis. Or consider the changes in bodily technology applicable to extracorporeal technologies: hands capable to beat, cut, make autonomous and micrometrically controlled movements thanks to increasingly sophisticated sensorimotor rewiring: hands that can dismantle bombs, clocks, precision devices and that can use large, small and very small tools with an unthinkable accuracy. And finally, new specialized structures dedicated firstly to breathing and then to vocal production which provide greater and better control of articulated vocalizations (which we will see in detail in the following chapter).

Therefore, functions are completely redefined by the brain based on the opportunities provided by the new structure and induced by the body's live mechanics (*the Mécanique vivant*, 1983). In fact, during the evolutionary processes of any species "we observe a gradual enhancement of the brain and an improvement of the mechanical apparatus by a series of adaptations in which the brain obviously plays a role, but as a determinant of advantages in the natural selection of solutions rather than as a factor directly orienting physical adaptation" (Leroi-Gourhan 1964, 60).

Another essential aspect of the evolution of the brain is cortical structure. This is not directly dependent on the brain size but it is linked to the ability to determine behavioural functions and, therefore, functional mapping, which is better understood now than during Leroi-Gourhan's time. From the work of Penfield and Rasmussen (1950) on the mapping of the neocortex, he concludes a very pertinent fact with his assumption of interdependence between the nervous system and the musculoskeletal system. If in human primates much of the cortical surface is occupied by the areas controlling manual skills and linguistic articulation, it is evident that the bipedal revolution and the consequent settling of the entire body structure have fostered a development of the nervous system functional to technologies and word use (hence the title of his whole book *Gesture and speech*). In fact most recent research has constructed a species-specific map of the human laryngeal phonation area (the larynx-phonation area) which has been derived from

a migration from the homologous primate (zone 4 of the premotor cortex) to the specific human one (zone 6 of the premotor cortex).

Once this interdependence between the nervous system and other parts of the body causing evolutionary change is recognized, it is clear that increased brain size, in addition to its more complex internal structure (gyrification of the cerebral cortex, increased connectivity between functional areas of the cortex, enhanced interneurons in modulating functional connectivity, lateralization), although inherited and modified over time, represents a huge indirect step forwards in the history of hominization (Rakic 2009, García-Moreno et al. 2011, Clowry 2014). Species with “liberated” hands are the same species in which the skull is capable of containing the largest brain: “manual liberation and the reduction of stresses exerted upon the cranial dome are two terms of the same mechanical equation” (Leroi-Gourhan 1964, 60).

In general terms, the human situation is a special case of a universal law. For each species, in fact, “a cycle is established between its technical ability (its body) and its ability to organize itself (its brain)” (60), the outcome of which opens the way to an ever more effective and selective adaptation. It is then true that a quantitatively more developed brain, thanks to a bodily device which has allowed it to expand, ends up being able to develop neural and mental functions, and therefore more elaborate and complex functions, but always in relation to the limits that the type of species-specific body structure establishes. In this way – Leroi-Gourhan concludes – “the brain does control evolution, but it remains ineluctably dependent upon the possible range of selective adaptation of the body” (60).

2.5 Conclusion: Evolution and Performativity

I have tried to prove that a theory of *performativity*, rather than a theory of *performance*, should be combined with a strongly naturalistic cognitive hypothesis on the bodily and, consequently, cognitive constraints of the animal species, man included. The theory of performativity explains how every species’ cognitive ability creatively carries out the adaptation processes within the environment. We must therefore ignore what the body of a single individual can do: an extended theory of performativity should deal with the genotype, not the phenotype.

At the same time, I have pointed out that performativity is a universal faculty which shapes not only the structure of the *Körper*, but even its relationship with the *Leib* within every species-specific niche. The way in which we cognitively experience the world is one with its internal structure. There is no state of consciousness or mental procedure that allows us to experience the world in a non-species-specific cognitive way. Every life is *ethologically unique*, even if different individuals might share some features that their offspring will not inherit.

Lastly, I have highlighted that such theory of performativity must be framed within an evolutionary context useful for assessing its extension and potentialities. I believe it’s undeniable that any transformation process of the bodies and of the

cognitive systems that adapt to them occur via genotype, that is to say that the slow mutation of the bodily structures, at some point, gives life to new species through the cerebral embodiment of the performative experience of the bodies. No novelty is possible without the performative exploration and a complete cerebral refunctionalization of the bodies. This is the reason why, in order to understand the nature of the performative processes, we need to get the real meaning of creativity: it is an evolutionary force which generates new arrangements through the combination of unpredictable bodily transformations and an equally unpredictable conjunction of cognitive systems.

It's important to stress that the theory of performativity we have discussed must not be confused with the description of different kinds of performance. In this respect, we believe that Chomsky was right when he claimed that the study of performance is an end in itself. The literature on the empowerment of performance, despite being interesting, is a product of the pre-cognitive behavioral psychology. We believe that the confusion between performativity and performance is the main cause of the inaccuracy of the embodied and enactive hypotheses we have discussed here.

The aim of the theory I put forward is to provide the Embodied Cognition with a naturalistic and evolutionary background which might ease its framing within Cognitive Sciences. A methodology based on such approach should be an experimental and intensive study on the algorithms-free procedures used by the cognitive systems to face new situations or to solve problems. The purpose of a future ETCP (Extended Theory of Creative Performativity) might be to analyze:

1. Intraspecific procedures of *problem solving*, namely the cognitive abilities used by the biological organisms to get from a given condition to a desired one, with a particular interest in the intraspecific sub-procedures of:
 - (i) *problem finding* (the identification of the problematic situation, which starts from the decision to stop and solve it).
 - (ii) *problem shaping/framing* (overcoming the vagueness of the problem in order to solve it).
 - (iii) *Performative solution of problems* (analysis of previous experiences, trial and error method, the use of analogies and comparisons, the calibration of any action on the basis of the effects on the environment, etc.)
2. Intraspecific procedures of cognitive learning in relation to the development, the formation and the control of the species-specific structures of the peripheral and central sensorimotor systems, with a particular interest in:
 - (i) *neural relational systems* (procedures of recognition of the conspecifics; impact of the limbic system on the control of feelings, affects and emotions; effects of the mirror neuron system and of other species-specific neural structures for social control; etc.)
 - (ii) *locomotor and kinetic-proxemic systems* (control of the balance of the body; coordination of motor actions and of the bodily technologies used to carry them out)

- (iii) *communication and semiotic systems* (control of the executive activity related to the use and the development of linguistic, semiotic and communication systems; adaptation of the organs to the species-specificity of communication, whether it is vocal, visual, olfactory etc.; progressive adjustment of cognitive controls)

Furthermore, the ECTP should encompass a hypothesis on the functioning of a *Universal Device for the Enactive Cognition* (UDEC), that is a generator of non-random solutions for any kind of problem that cannot be solved through algorithms.

Methodologically, the UDEC should aim at unifying the computational methods based on evolutionary algorithms by using them to establish intraspecific performative heuristics useful for simplifying the creative procedures: evolutionary algorithms are a class of randomized heuristics inspired by natural evolution. They are applied in many contexts, in particular in the optimization and in the analysis of the algorithms responsible for the evolutionary success of a species (cfr. Jansen 2013). I am talking about a *multi-objective evolutionary algorithm design* (Coello et al. 2007), which might help to frame the differences caused by the vague nature of the performative heuristics of the animal cognition within the context of the universal performative properties of the biological systems. To this end, “the use of evolutionary algorithms for mining pattern enables the computation capacity to be reduced, providing sufficiently good solutions” (Ventura and Luna 2016).

From an evolutionary point of view, the UDEC is intended to enable switching from a logical-mathematical based computational cognition to a naturalistic cognition based on the performative embodiment. The aim of the UDEC is to explain how the biological systems use the bodily technologies to creatively find a way to survive. The UDEC, in fact, is what is generated by the species-specific bodily experience and by the ability to reuse the neuro-cerebral inputs to create structures devoted to the cognitive, pragmatic and social refunctionalization. In a nutshell, the UDEC should explain how we get from the “rule changing creativity” to the “rule governed creativity”, which is exactly what Chomsky was worried about.

Lastly, from a philosophical point of view, an extended theory of performativity might be useful for erasing the dangerous dichotomies intrinsic to modern naturalism. If we’d read the distinction between *Körper* and *Leib* through the lens of Spinoza’s performativity we could easily understand why there shouldn’t be any gap between mind and body, brain and nervous system, creative and executive functions of the cognitive systems, culture and nature. The biological evolution tells us that the cognitive refunctionalization always depends on the alteration of the bodily structures following random genetic mutations: thus, the history of cognitive evolution proves that the creativity of the ideas is conditional upon the performative creativity of the bodies that generate them.

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