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THE RESISTIBLE RISE OF COGNITIVE SCIENCE

How was Cognitive Science born? Or the cognitive sciences in plural? And what role does Artificial Intelligence play exactly in this beam of disciplines that want to remain at the same time separate (in methods) and united (in purpose)? Philosophy cannot and should not avoid these questions.
First of all because Cognitive Science is considered and is considered the "scientific" heir of Philosophy, as if two millennia of history of philosophy were simply a prehistory finally accessing the adult status thanks to contemporary methods of scientific research. And secondly, because it is from within the very bosom of Cognitive Science that a line of thought has arisen, the "Philosophy of Mind", that many may confuse with authentic Philosophy because of a simple assonance in words, despite the distance that separates them.
We shall soon dedicate to the Philosophy of Mind a specific study, as it is important in our opinion to clearly define whether and how much it can be considered part of Philosophy. In this paper, for the time being, one will find an examination as exhaustive as possible of the birth of Cognitive Science. The objective, as always, is not to assert our more or less contiguity with the authors we name, since such a statement would be as arbitrary as its opposite and fundamentally sterile. Our goal is simply to show the direction that certain debates have taken and the effects this has had on the research in Artificial Intelligence. If the latter is seen as a mere technology, in fact, it will never independently generate its own work plans or ontological bases, and will not be able to free itself from the laces of Cognitive Science, and will therefore not as it deserves be a part of Philosophy. Without this liberation even its technological successes will never be recognized as such.

The "philosophical" potential of Artificial Intelligence, which we have extensively discussed in a previous book,[1] has actually operated very deeply. Since its appearance AI has changed the foundational approaches of the debate, and indeed it can be affirmed that it is only thanks to this "philosophical" potential that the idea of a Cognitive Science has taken shape. Nor could it be otherwise, if we accept that Artificial Intelligence is first and foremost "philosophy by other means", and not simply a wonderful technology.[2]

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[1] GIOVANNI LANDI, "*Intelligenza Artificiale come Filosofia"*, Trento, Tangram Edizioni Scientifiche, 2020
[2] Ibid. p. 19

So let's start with some academic quotes to retrace the birth of Cognitive Science:

"*Cognitive science is the interdisciplinary study of mind and intelligence, embracing philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology..... Attempts to understand the mind and its operation go back at least to the Ancient Greeks, when philosophers such as Plato and Aristotle tried to explain the nature of human knowledge. The study of mind remained the province of philosophy until the nineteenth century, when experimental psychology developed. Wilhelm Wundt and his students initiated laboratory methods for studying mental operations more systematically. Within a few decades, however, experimental psychology became dominated by behaviorism property, a view that virtually denied the existence of mind. According to behaviorists such as J.B. Watson, psychology should restrict itself to examining the relation between observable stimuli and observable behavioral responses. Talk of consciousness and mental representations was banished from respectable scientific discussion. Especially in North America, behaviorism dominated the psychological scene through the 1950s. Around 1956, the intellectual landscape began to change dramatically. George Miller summarized numerous studies that showed that the capacity of human thinking is limited, with short-term memory, for example, limited to around seven items. He proposed that memory limitations can be overcome by recoding information into chunks, mental representations that require mental procedures for encoding and decoding the information. At this time, primitive computers had been around for only a few years, but pioneers such as John McCarthy, Marvin Minsky, Allen Newell, and Herbert Simon were founding the field of artificial intelligence. In addition, Noam Chomsky rejected behaviorist assumptions about language as a learned habit and proposed instead to explain language comprehension in terms of mental grammars consisting of rules. The six thinkers mentioned in this paragraph can be viewed as the founders of cognitive science*."[3]

In a few lines there is the whole canonical history of Cognitive Science. The year that changed everything was 1956 (incidentally the same year of the famous Dartmouth conference), and of the six thinkers who "*can be viewed as the founders of cognitive science*" four are also founding fathers of Artificial Intelligence. The link between AI and Cognitive Science is therefore explicitly recognized and adequately evaluated. But let's continue:

[3] THAGARD, PAUL, Cognitive Science, *The Stanford Encyclopedia of Philosophy* (Spring 2019 Edition), Edward No. Zalta River (ed.),
URL = <https://plato.stanford.edu/archives/spr2019/entries/cognitive-science/>.

"The historical and theoretical assumptions for the birth of Cognitive Science can already be identified in the famous test devised by A.M. Turing, who, starting from the assumption that it is impossible to distinguish, in appropriate experimental circumstances, between the cognitive performance of a machine and those of a human being, suggested the affinity, if not the identity, between human intelligence and artificial intelligence (AI). Another historical source is cognitive psychology, which is based on the paradigm of the mind as an information processing system and has been largely influenced by AA research and computer science. Finally, there is the impact of N. Chomsky's linguistic theories which, extended to the psycholinguistic field, had hypothesized the existence of authentic innate mental abilities, developed and refined in the relationship with the environment."[4]

Here again the link is clear and explicit: it's Turing's question "can a machine think?" that lies under the very possibility of Cognitive Science. If Artificial Intelligence were merely a technology, all this would be quite strange; only by recognizing the authentically "philosophical" potential of Turing's question, beyond technology, we can explain how a complex discipline such as Cognitive Science has emerged from it.
To fully appreciate the scope of this thesis we must return to the founding texts of Cognitive Science. One of the thinkers who has made the most efforts to unify the sense and direction of cognitive science researches is Daniel Dennett, director of the Center for Cognitive Studies at Tufts University. Although he later specialized in the study of consciousness (and on these aspects we will have to return) Dennett's early work was clearly centered on a need for unification:

"Books attempting to tell the whole story of the mind have become rarer in recent years for good reason. No one can hope to master the details.....In the face of staggering complexity, prudence had dictated to the student of mind that he must specialize..... This retreat from generality has been productive, but has left certain fundamental and pressing questions virtually untouched. What is the relationship between a man's mental life and the events in his brain? How are our commonplace observations about thinking, believing, seeing, feeling pain to be mapped on the discoveries or cybernetics or neurophysiology? These questions are important..... In examining these broad questions of mind and body I do not try in this book to tell the whole story, but to set out the conceptual background against which the whole story must be told...." [5]

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[4] ANTONIO RAINONE, "*Italian Encyclopedia (6th Appendix)*", Rome, Treccani Institute Editore, 2000
[5] DANIEL DENNETT, *Content and Consciousness (Preface 1st Edition)*, Routledge, 1968, p. XIII-XIV -

The call for unity here is obvious and understandable. Interdisciplinarity is acceptable if and only if everything is based on a minimally coherent and undisputed ontological view of the world; otherwise the very term Cognitive Science would be impossible to justify. Unfortunately, Dennett tells us, philosophy has been going on for centuries discussing all this without coming to any result, and therefore another solution must be found; the monism/dualism debate is fundamentally sterile and useless. Dennett's solution is to change the approach of the question: no more questioning about the existence or otherwise of mental entities (is there only the material substance or also a Cartesian "mental" substance?), but a decision to define as intentional all linguistic expressions not referable to physically identifiable objects. That is, the realm of the mental, everything we commonly find difficult to associate with a direct physical presence, is somehow subsumed under the term "Intentionality".[6] Dennett can thus not reduce these intentionalities to physical phenomena, a classic monist but theoretically unsustainable solution); and at the same time he avoids the dualist alternative. How? Here's the key text:

"Fortunately, however, once the problem of Intentionality is clearly expressed, it points to its own solution. There is a loophole. The weak place of the argument is the open-endedness of the arguments that no extensional reduction of Intentional sentences is possible..... Could there be a system of internal states or events, the extensional description of which could be upgraded into an Intentional description? The answer to this question is not at all obvious, but there are some promising hints that the answer is yes. ***The task of avoiding the dilemma of Intentionality is the task of somehow getting from motion and matter to content and purpose – and back. If it could be established that there were conceptually trustworthy formulations roughly of the form 'physical state S has the significance (or means, or has the content) that p' one would well be on the way to the solution of the problem. But if that's all it takes, the answer may seem obvious. Computers, we are told, 'understand' directions, 'send' each other messages, store the information 'that p' and so forth, and do not these claims imply that some physical states of computers have content in the requisite sense?"***[7]

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[6] *Dennett's argument is long and articulated, and it freely handpicks concepts from illustrious psychologists and philosophers. A detailed examination of this argument is not important here, as our aim is only to show how at some point it is Artificial Intelligence that solves Dennett's dilemma.*

[7] DANIEL DENNETT, *Content and Consciousness*, London, Routledge, 1968, p. 39-40 (we underline)

Dennett wants at all costs to escape unnecessary and sterile debates about what really exists or not, especially because among cognitive scientists of different schools these would endanger the unity of the discipline. To give his fellow researchers a commonbasis they all can use to define "existence" he uses intentional content (meanings) present in extensive physical states. That is, he has recourse to the statement that for some physical (external) states it is possible to identify an internal (intentional) correlate that in turn it is possible to externalize.
Is such externalization possible? Is it possible to "*somehow switch from movement and matter to content and purpose – and back*"? Dennett does not make the affirmation, "*but there are some promising hints that the answer is yes*", and these indications come from those who are building computers claiming that sooner or later the software will somehow contains content, meaning, and consciousness. Thanks to what the founders of Artificial Intelligence were preaching in the 1960s the methodological unity of Cognitive Science is thus founded. What better proof of the deep "being Philosophy" of Artificial Intelligence?

We bring a final example to support the thesis that Artificial Intelligence (understood as a "Philosophy in the making" and not as a technology) was the essential ingredient in the birth of Cognitive Science. It is a 1993 volume (with many later re-editions) entitled "*Foundations of Cognitive Science*", published by MIT Press; in short, another canonical text, the result of the collaboration by a large number of scientists on various aspects of this science (here declared as unified despite interdisciplinary differences). It is a monumental text, which of course we cannot analyze in detail, but whose introductory chapters are quite explicit in the interpretation of what Artificial Intelligence has done for Cognitive Science:

"In this volume cognitive science deals with the nature of intelligence from the perspective of computation....The ability to manipulate symbols has allowed inanimate physical systems to solve problems and perform functions previously performed only by human beings. The conception of the mind as a symbol processor implies an architecture of cognition that has been and is currently of great influence on the field." [8]

This is just the preface, where computation, that is, the theory that human thought is essentially reducible to the manipulation of symbols, is explicitly named as the point of view from which intelligence (whether human or not) is studied.

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[8] MICHAEL I. POSNER (edited by), "*Foundations of cognitive science*", Cambridge Massachusetts, The MIT Press, 1993, Preface p. xi

"Cognitive science is the study of intelligence and intelligent systems, with particular reference to intelligent behavior as computation....Today it is quite common to attribute intelligence to both human and non-human systems, and in particular to programmed computers. ***Not everyone accepts this usage, but we call intelligent programs if they exhibit behavior that would be considered as intelligent if they were exhibited by human beings****. We define cognitive science as the study of intelligence and its computational processes in humans, animals, computer and in the abstract. It will be instructive to see how the commonality among these three topics came to be recognized and how that recognition let to the birth of the discipline of cognitive science."* [9]

It is the acceptance of a particular definition of "intelligent" that undersea the whole scaffolding of Cognitive Science. ***And this definition*** ("*behavior that would be considered as intelligent if they were exhibited by human beings*") ***is the first postulate of Artificial Intelligence***. Only if you accept it, that is, if you accept the possibility of "Artificial" intelligence, does Cognitive Science make sense as a science.[10]
"*Foundations of Cognitive Science*" is as mentioned a voluminous and very technical text, which aims to be a complete overview of the state of the art of this discipline. Each chapter has a different author, but it is impressive to see that in most of the first lines a homage is paid to the computer as the essential tool for research. Here is a list of some of them, reminding the reader that these are statements by different authors but taken from the same book:

"Nobody doubts that computers have a profound influence on the study of human cognition. The very existence of a discipline called cognitive science is a tribute to this influence. One of the principal characteristics that distinguishes cognitive science from more traditional studies of cognition within psychology is the extent to which it has been influenced by the ideas and techniques of computing." [11]

And again:

"Cognitive science has a long-standing and important relationship to the computer. The computer has provided a tool whereby we have been able to express our theories of mental activity; it has been a valuable source of

[9] Ibid, p. 1-2
[10] We reiterate once again that our purpose here is not to argue for or against the possibility of Artificial Intelligence, but only to show the direct filiation of Cognitive Science from the postulates of AI. As for the definition of "intelligent program", we refer to what we have already written in "*Intelligenza Artificiale come Filosofia*".
[11] Ibid, p. 51

metaphors through which we have come to understand and appreciate how mental activities might arise out of the operations of simple-component processing elements." [12]

But the text edited by Posner goes beyond "metaphors" and "influences". Since Cognitive Science is intended to be interdisciplinary, the Introduction also devotes space to the other sciences (psychology, linguistics) that one would want to somehow enlist in the common effort. And here too we find Artificial Intelligence at every corner:

"Until recently, it (the study of language) had only a tenuous relations with psychology, and today it is represented in cognitive science mainly under the labels of "computational linguistics"….Computational linguistics, as its name implies, is concerned with the use of computers to process language…..As we shall see, it takes rather careful inspection to verify that the group focusing on problem-solving and the one focusing on language are both interested in the same process: human thinking. When linguistics is approached from a computational standpoint, the relation between the two becomes clearer." [13]

Linguistics, in short, also becomes part of Cognitive Science only when it converts to the use of computers and becomes "computational linguistics"; indeed, only with this approach can language analysis really be conceptually approached to the analysis of thought. And the same applies to psychology:

"From its beginning the discipline of psychology has been concerned with intelligence..... The shift came with the so-called information-processing revolution of the fifties and sixties, which viewed thinking as a symbol-manipulating process and used computer simulation as a way to build theories of thinking." [14]

That psychology has been interested in intelligence since its inception is questionable to say the least; in any case, here it is again reiterated that even in psychology change has come with the definition of thought as symbolic manipulation (a thesis of Artificial Intelligence) and above all with the possibility offered by computers to test various theories on how thought works. Here for the first time the status that Cognitive Science assigns to Artificial Intelligence appears, an engineering application with experimental purposes status. The oblivion of Artificial Intelligence as a foundational source for Cognitive Science (i.e. the emptying of its "philosophical" potential) comes together with this "handmaid" role, similar to that which St. Thomas assigned

[12] Ibid, p. 132
[13] Ibid, p. 5
[14] Ibid, p. 3

to metaphysics vis-à-vis faith. This reduction of Artificial Intelligence, or rather of its role, will not be the last; indeed the evolution of Cognitive Science will coincide with further reductions as we will see.

FROM COMPUTATIONAL COGNITIVE SCIENCE TO NEURAL COGNITIVE SCIENCE

In the mid-1980s Artificial Intelligence went through a period of crisis called "the AI Winter". Funding stopped, the disappointment with the results was great considering the promises made, and many doubts rose on the analogy between mind and brain on the one hand, and software and hardware on the other. The purely semantic approach had to deal with the blows of various scholars (John Searle's Chinese Room just to name one), and it became increasingly difficult to argue that somehow a computer can really "think".
This situation could not have no impact on Cognitive Science, precisely because of the filiation we have described above. And it is precisely at that time that the theory of computation begins to decline, while neuroscience emerges as a new paradigm.

"There are two cognitive sciences, computational cognitive science and neural cognitive science. Both meet the three requirements listed above (both are interdisciplinary, both call into question the computer, and both oppose behaviorism), but the two cognitive sciences give very different answers to really important questions..... In the last 15-20 years computational cognitive science has weakened for three reasons. The first is that the biological sciences and in particular neuroscience are progressing in ever faster ways and therefore it becomes less and less plausible to study the mind by ignoring the brain and more generally the body. It is true that once you have constructed a purely "information processing" model of some capacity or behavior, you can look for the related ones in the brain of the structures, representations, mechanisms and mental processes postulated in the model. That's what a lot of neuropsychologists are trying to do. ***But the question is whether it makes sense first to explain behavior with mentalistic patterns and then translate these models into terms of a physical system like the brain, instead of looking from the beginning for explanations in terms of processes where physico-chemical causes produce physico-chemical effects."****."*[15]

"As for the place of the computer in the new neural cognitive science, ***the computer is no longer a model of the mind but is just a practical tool for doing simulations."****[16]*

[15] DOMENICO PARISI, "*The two cognitive sciences*", in "Speeches and Thoughts. Scritti in onore di Giuseppe Mosconi", Bologna, Il Mulino, 2001, p. 217-224 (we underline)
[16] Ibid (we underline)

Obviously the computer remains the main tool for research, but there is no trace of a "philosophical" background anymore. It all boils down to the physicality of neurons (and the corresponding simulation with neural networks), which interact with each other but without any rationality to be found in these interactions. Software is no longer independent from hardware, only the study of the physical states underlying the mental can – in the case of humans – reveal the functioning of Thought. In the only chapter of "*Foundations of Cognitive Science*" dedicated to this new research perspective, this change is clearly indicated:

"A framework for a theory of levels articulated by Marr (1982) provided an important and influential background for thinking about levels in the context of computation by nervous structures. This framework drew on the concept of level in computer science, and accordingly Marr characterized three levels: (1) the computational level of abstract problem analysis, decomposing the task; (2) the level of the algorithm, specifying a formal procedure to perform the task....;(3) the level of physical implementation, constructing a working device using a particular technology...
... an important element in Marr's view is that a higher level was largely independent of the levels below it, and hence computational problems of the highest level could be analyzed independently of understanding the algorithm that performs the computation.....it is important to see that the purely formal point cannot speak to the issue of how best to discover the algorithm in fact used by a given machine , nor how best arrive at the neurobiologically adequate task analysis. Certainly, 19 it cannot tell us that the discovery of the algorithm relevant to cognitive functions will be independent of a detailed understanding of the nervous system."[17]

This step will have enormous consequences for Artificial Intelligence. As soon as the execution of the program depends on implementation, that is, on its physical substrate, the door is open for the nightmare of an Artificial Intelligence that can improve man, that is, that he not simulate him but be better. Where the classical vision wanted to emulate man and his mental functions, neuroscience-inspired AI begins to dream of improving him by improving the material basis of the program. Moreover, despite the declaration of fidelity to the computational theory of this new trend, its epistemological positioning changes substantially:

[17] MICHAEL I. POSNER (edited by), "Foundations of cognitive science", Cambridge Massachusetts, 1993: The MIT Press, p. 302-303

"Structure at every level in the nervous system – molecules, synapses, neurons, networks, layers, maps and systems – is separable conceptually but not detachable physically. What is picked out as a level is actually a boundary imposed on the structure that depends on the techniques available to understand the phenomenon at hand. In the brain, they are all part of one integrated, unified biological machine....Accordingly, which structures really constitute a level of organization in the nervous system is an empirical, not an a priori matter. We cannot tell in advance of studying the nervous system how many levels there are nor what is the nature of the structural and functional features of any given level." [18]

This new tendency renounces Popper's falsifiability and returns to an epistemological model where the law is constructed by inference, that is, by empirical observations. Levels depend on observation techniques and can therefore change whenever new experimental techniques become available. This paves the way for a myriad of empirical experiments that have no claim of scientific certainty, that add nothing to the knowledge of the mind, and perhaps not even of the brain. There has been no shortage of authors who have clearly become aware of these new trends:

"But neural cognitive science is different from computational science even in the general spirit that animates it and in the cultural frame of reference it is inspired by. Computational cognitive science is still culturally linked to modernity, rationality, the primacy of the intellect over emotions and the mind over the body, a conception of reality as a simple system in which a cause predictably produces an effect, a vision of science as an ability to predict and control and as the only or better way of knowing reality. Neural cognitive science simply makes the opposite choices: it is, for what these terms are worth, post-modern, considers rationality only as the "tip of the iceberg" of human beings, does not recognize any primacy to the intellect over emotions and to the mind over the body, it conceives reality as a complex system in which many causes produce many effects in largely unpredictable ways, it clearly sees the limits of the ability to predict and control science and does not consider science as the only or better way of knowing reality."[19]

In short, the oblivion of the "philosophical" potential of Artificial Intelligence even takes away the value of science from Cognitive Science, indeed takes away from science the role of *"the only or better way of knowing reality*."
We will find this radical conclusion in the contradictions that accompanied the theoretical reflections on Cognitive Science, and which took the unfortunate

[18] Ibid, p. 304
[19] DOMENICO PARISI, "*The two cognitive sciences*", in "Speeches and Thoughts. Scritti in onore di Giuseppe Mosconi", Bologna, Il Mulino, 2001, p. 217-224

name of "Philosophy of Mind." We will see in a next article where the abandonment, the indifference and in some cases the simple ignorance of what Philosophy really is has brought us.

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