A Whiteheadian Approach to the Divide Between Organisms and Machines

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Abstract: The essay takes a critical stance towards the widespread thesis that life is computable or even reproducible on a medium other than a biological body. The insights of some opponents of that thesis were somehow anticipated by Whitehead in his metaphysical works, and the essay is intended to stress the relevance of Whitehead's processual ontology to the debate on artificial life. Some of Whitehead's notions, such as the *mental pole* and the *living person*, help significantly to account for the divide between organisms and machines. Two distinctive characteristics of organisms are especially analyzed by the essay: their ontogenetic development and their mental faculties.

Keywords: Life; Machines; Self-creation; Processual Ontology; Mental Faculties.

1. Introduction

The 1980s were a turning point for biological research, as a new idea has progressively spread since then, namely the idea that life can be artificially created from nothing. The specificity of life has been disregarded by many scholars, and advocates of synthetic biology have claimed to be able to craft a new organism by simply assembling elementary particles or building blocks so as to make up an informational code. This untenable claim is based on the thesis that everything is information[1] circulating through a neutral medium[2]. If a living being were truly a mere amount of information independent of the physicochemical medium, as maintained by many synthetic biologists, nothing would prevent us from transferring those same pieces of information to a medium other than DNA macromolecules and proteins, such as a computer[3]. Even when the creation of artificial life is not the goal, the unbridgeable gap between living beings and machines

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1 See Wiener (1988).
2 See Shannon's theory of information.
3 Benasayag (2020, 31-32).

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is often neglected by contemporary scholars. Organisms are thus regarded as pieces of software that function independently of their own bodies and ecosystems[4], and the mind is considered as separated from the body[5]. Of course, there are significant exceptions to this general trend and not all scholars equate machines and living beings nowadays.

This essay is intended to contribute Whitehead's insights and reflections to the ongoing debate on life. From a philosophical point of view, two issues seem to be particularly relevant: the unpredictability and incalculability of the development of a living being, and the interdependence between the mind of an organism and its body. Accordingly, I shall analyze a few theories that approach these issues without recognizing the divide between organisms and machines, for the purpose of contrasting them with Whitehead's account of life. The first section of the essay will summarize Whitehead's criticism of mechanism and his biological inquiry, the second section will dwell on the development of a living being and the third section will deal with the mind-body problem.

2. Whitehead's Criticism of Mechanism

Scholarship has divided Whitehead's intellectual journey into three phases: the logical-mathematical phase, the epistemological phase, and the metaphysical one. As Vanzago points out, Whitehead's metaphysics is best understood when linked to his logical-mathematical and epistemological investigations, because Whitehead's criticism of mechanistic materialism throughout the various phases of his reflections lays the groundwork for the cosmology of *Process and reality*[6]. I shall concisely recapitulate some key steps of Whitehead's rejection of mechanism.

In "On Mathematical Concepts of the Material World"[7], Whitehead analyzes five alternative mathematical structures, all of which are both logically plausible and suitable for dealing with the axioms of physics. A comparison between the first mathematical structure and the fifth one is particularly relevant here. The first mathematical structure represents the Newtonian mechanistic approach to nature, an approach that postulates the existence of three fundamental kinds of primary entities: a) absolute space; b) absolute time; c) bits of matter subject to external forces. The

[4] Longo (2021, 250).
[5] Finelli (2022, 97-98).
[6] Vanzago (2019, 34).
[7] This work, released in 1906, belongs to the logical-mathematical phase.

Newtonian mechanism holds that the vicissitudes of material entities take place within two containers, namely space and time, existing independently of those material entities. The four other mathematical structures are introduced by Whitehead in order to demonstrate that alternatives to the first structure are possible, and among them the fifth structure is the most innovative one. In the framework of this structure, time keeps its own absoluteness, but space is no longer an absolute entity as it is associated with the matter it contains. Furthermore, all physical phenomena are regarded as arising from just one type of primary entities and the interactions between these congener entities[8].

At the turn of the 1920s, Whitehead starts outlining his own non-mechanistic philosophy in three important works: *An Enquiry concerning the Principles of Natural Knowledge*, *The Concept of Nature*, and *The Principles of Relativity*[9]. The target of his criticism is still the Newtonian approach to nature, according to which space, time and matter exist independently of each other and there is no relation between them. The advocates of this approach regard space as both instantaneous and eternal, so that, according to them, material bodies instantaneously act on each other at a distance. Nevertheless, relativistic physics reveals the existence of a maximum speed which cannot be exceeded, therefore action at a distance cannot take place[10]. Whitehead overcomes the Newtonian approach by elaborating the method of *extensive abstraction*, through which he manages to formalize geometry and physics in terms of *events*.

In The *Concept of Nature*, an event is defined by Whitehead as "the ultimate fact for sense-awareness"[11]. The method of extensive abstraction makes possible the formulation of temporal concepts, such as the *instant*, and of spatial concepts, such as the *point*, from events. Concepts such as the instant and the point are abstractions unsuitable for expressing the true nature of events, but they are necessary for science because events are complex. The relations between two events "form an almost impenetrable maze"[12] that can be considerably simplified by diminishing the spatiotemporal extent of the events at issue. Therefore, introducing the method of extensive abstraction enables Whitehead to relativize the philosophical relevance of spatiotemporal concepts, by showing that they are nothing more

[8] Vanzago (2019, 19-20).
[9] These three books belong to the epistemological phase.
[10] Vanzago (2019, 27).
[11] Whitehead (2004, 15).
[12] Ivi (78).

than abstractions from concrete occurrences, or events, constituting the world.

In *Science and the Modern World*[13], Whitehead starts elaborating his own organicism and his criticism of mechanistic materialism targets the idea of *simple location*, namely the fallacious thesis that a corpuscle or a body can be defined irrespective of its environment and irrespective of the temporal flow[14]. As Weber remarks, Whitehead's approach can be described as the rejection of simple location in favor of *complex dislocation* since Whitehead regards a body as an event dependent on its environment. The contrast between simple location and complex dislocation parallels the one between external relations and internal relations. A relation can either leave the relata unaffected or enter their constitution. In the former case, it is called *external*. In the latter case, it is called *internal*. A collision between two billiard balls instantiates an external relation, because the balls remain exactly the same after the impact. Differently, the organs that make up a living being are internally related because if any of them is removed from the organic body that organ does not survive[15]. The passage from simple location to complex dislocation can thus be considered as the turn from a cosmology based on the notion of external relation to a cosmology based on the notion of internal relation. The importance of internal relatedness for Whitehead's organicism can hardly be overestimated. Whitehead regards a concrete enduring entity as an organism, consisting of various smaller organisms, whose overall plan affects the characters of those subordinate organisms[16].

3. Whitehead's account of life in *Process and Reality*

In *Process and Reality*, Whitehead elaborates a process ontology that opens new ways of approaching life[17]. I shall now highlight the aspects of this ontology that are relevant to biology. For the sake of clarity, I shall not delve

[13] This work, originally published in 1925, lays the foundation for Whitehead's metaphysical masterpiece, namely *Process and Reality*, released for the first time in 1929.

[14] Weber (2006, 101).

[15] *Ibidem*.

[16] Whitehead (1967, 79).

[17] I am emphasizing the processual character of Whitehead's ontology because the concept of process is particularly relevant to my biological inquiry, but it is noteworthy that an even more accurate definition of Whitehead's ontology would be *the philosophy of organism*. See Weber (2006, 105).

too much into the technicalities of Whitehead's metaphysical system, and I shall focus on some of his key insights.

A significant innovation introduced by *Process and Reality* is the rejection of the Aristotelian notion of *substance* in favor of a processual account of nature[18]. According to Whitehead, an individual actual being is not a *first substance* of which a *second substance* can be predicated[19], but a *society*, whose members are *actual occasions*, characterized by the transmission of a "common element of form"[20] from one member to another. An actual occasion is a microscopic event, that does not occupy space and does not last over time but affects all future actual occasions by virtue of its very existence. The world is a process of endless generation and regeneration of actual occasions, and a society of actual occasions occurs when some of these actual occasions share a common element of form over time. As Cobb observes, Whitehead reverses the relation between stable individuals and events because he considers a stable individual being as a society, that is basically made up of microscopic events and seems to have distinctive characteristics just because its microscopic constituents share a common element of form[21].

Therefore, the first step to introducing Whitehead's process ontology should be an analysis of those fundamental constituents of the world, namely the actual occasions. In particular, I shall now focus on how Whitehead describes the process through which an actual occasion comes into being or, more precisely, produces itself. This self-creative process consists of several phases, but one should not assume that these phases follow each other over time because, as a matter of fact, the whole process happens all at once. The actual occasion never exists partially. Either it is done and dusted, or it is not there at all. The self-creative process is called *concrescence* in *Process and Reality*, a term that evokes the idea of becoming concrete[22].

Concrescence is not only a process of self-production but also a process of self-determination. An actual occasion is regarded by Whitehead as a subject that receives the influence of its own environment but, to a greater or lesser extent, "integrates and transforms what it receives"[23] for the purpose of becoming itself. The process can thus be defined as *teleological*, provided that the word *telos* is interpreted as a final state rather than only

18 Koutroufinis (2017, 38).
19 See Aristotle (2001).
20 Whitehead (1979, 34).
21 Cobb (2008, 23).
22 Ivi (59-60).
23 Ivi (62).

as an aim[24]. Counterintuitively, the subject of the concrescence does not preexist the concrescence but arises from it. The accomplished actual occasion does not emerge until the end of the self-creative process. The more an actual occasion transcends environmental influences, the more alive it is. Whitehead's concept of life contradicts common sense on two points: a) there is no sharp distinction between living beings and non-living ones because, according to Whitehead, all that exists is endowed with a minimum degree of purposiveness, self-determination and aliveness; b) life primarily pertains to the microscopic level of actual occasions, and a flower or a horse can be defined as *living* only in a derivative sense because they are societies[25]. In summary, Whitehead thinks that the main difference between a horse and a stone is that the actual occasions making up the latter are not so alive whereas the ones making up the former are decidedly more alive. To be precise, only some of the actual occasions that constitute a society need to be alive for that society to be a living being[26].

An essential detail should be added to my account of the concrescence now. An actual occasion produces itself by means of *prehensions*, a term which Whitehead uses to denote "concrete facts of relatedness"[27]. Prehension is an asymmetric relation, because it affects the constitution of the prehending occasion but not the one of the prehended *datum*. One can also emphasize this asymmetry by saying that prehension is a relation that is internal to the prehending occasion and external to the prehended datum[28]. There are two kinds of prehensions, and they differ as to their datum. If the datum of the prehension involves other actual occasions, the prehension is *physical*[29]. However, Whitehead postulates the existence of another class of entities besides actual occasions, namely the *eternal objects* or "pure potentials for the specific determination of fact"[30]. Accordingly,

[24] Koutroufinis (2017, 38).
[25] Whitehead (1979, 102).
[26] Ivi (103).
[27] Ivi (22).
[28] Cobb (2008, 31).
[29] Whitehead (1979, 23). The physical prehensions relating an actual occasion *A* to other actual occasions establish whether each of these latter occasions lies in the past of *A* or in its future. Let's consider a physical prehension *p*, relating *A* to another occasion *B*. If *A* prehends *B*, the latter lies in the past of the former. If *A* is prehended by *B*, the latter lies in the future of the former. If there is no physical prehension relating the two occasions, *A* and *B* are regarded by Whitehead as contemporary. See Cobb (2008, 77-78).
[30] Whitehead (1979, 22).

in addition to physical prehensions there are also *conceptual prehensions* or "prehensions of eternal objects"[31].

As Cobb points out, Whitehead employs the phrase *pure potentials* to mean that eternal objects could in principle characterize actual occasions but "are in their nature indifferent to whether they do, or ever will, characterize anything actual"[32]. In most cases, an eternal object is something that "can be abstracted from experience"[33] and then recur[34]. For example, mathematical formulae, such as , and perceptible qualities, such as a certain shade of red, are eternal objects[35]. Every actual occasion prehends both eternal objects and other actual occasions, but each of them has its own specific prehensions that differ from the ones of any other occasion as to their data and way of prehending those data. Therefore, integration of novel eternal objects into the concrescence by means of conceptual prehensions does not happen in the same way every time a new occasion comes into being. Sometimes conceptual prehensions provide a significant contribution to the creation of the new occasion, other times they play a marginal role. The more they contribute to the creation of the new occasion, the more alive that occasion is. Whitehead states that a living occasion is marked by "a flash of novelty"[36] among its conceptual prehensions.

As it has been touched upon above, concrescence includes several phases. The first phase is *responsive* as the external world is received by the emerging occasion as a multiplicity of data for its self-creation. The second phase is *supplemental* and marks the transition from "pure reception"[37] of an external world felt as alien to emotional integration of the received data into an emerging subjective unity. The third and last phase is called *satisfaction*, and it consists in the full actualization of the occasion in accordance with its "final-state-directedness"[38]. The two above-mentioned kinds of prehensions play different roles throughout the whole self-creative process. The responsive phase is dominated by physical prehensions, whereas conceptual prehensions come into play in the supplemental phase, along-

31 Ivi (23).
32 Cobb (2008, 24).
33 *Ibidem*.
34 Exceptions to that are eternal objects that either have not yet been actualized, such as a physical formula describing a phenomenon that has not yet occurred, or are not actualizable at all, such as "a seven-dimensional space" (Cobb 2008, 24). However, these eternal objects are not relevant to my inquiry.
35 Cobb (2008, 23-24).
36 Whitehead (1979, 184).
37 Ivi (212).
38 Koutroufinis (2017, 38).

side physical ones, and the more the conceptual activity is significant the more intense the emotion felt by the occasion is. Whitehead defines life as "the capture of intensity, under a large variety of circumstances"[39].

4. Two opposite approaches to the development of a living being

I shall contrast Whitehead's approach to life and a mechanistic one inspired by the Turing machine now. Before introducing this latter approach, I have to specify that Turing questioned that his own machine could ever help us understand life, as he avoids reducing biological phenomena to a *discrete* states machine in his works. In "The Chemical Basis of Morphogenesis"[40], he explains morphogenesis in terms of a *continuous* physical process consisting in waves fluctuating within an unstable chemical system[41]. In spite of Turing's epistemological rigor, many scholars have assumed that biological systems can be described through models abiding by the logic of the Turing machine. As Koutroufinis points out, an ontological approach can be defined as *mechanistic* if it regards systems as real entities whose inner causality "can, in principle, be explained by models obeying the logic of the Turing […] machine"[42].

This mechanistic approach is perfectly instantiated by Von Foerster's concept of *non-trivial machine*[43]. A non-trivial machine receives a series of inputs from the outside, and performs a twofold operation each time a new input is entered at a certain moment : a) it calculates an output , on the basis of the input , its own internal state at that moment , a set of constants and an operator ; b) it calculates, at the same moment , its own future internal state on the basis of the input , its own current internal state , a set of additional constants and an operator . I am using the word *operator* to denote "a transition rule"[44] consisting in a logical-mathematical function. At the moment , both operations will be performed again in response to a new input , so that the machine will calculate both the output and the internal state . Consequently, the output the machine calculates at any moment depends on all the ones that it has calculated previously. Von Foerster calls *non-trivial* its own machine in order to distinguish it from a

[39] Whitehead (1979, 105).
[40] See Turing (1952).
[41] Longo (2021, 242).
[42] Koutroufinis (2017, 35).
[43] See von Foerster (2003).
[44] Koutroufinis (2017, 34).

trivial machine, namely a machine whose calculations do not depend on previous calculations at all[45].

The mechanistic approach turns out to be unsuitable for describing biological phenomena, when it comes to explaining the causal factors that contribute to the development of living beings. In systems biology, two types of causal factors are employed to account for biological phenomena: intrinsic factors and extrinsic ones. An *intrinsic factor* is a factor that is generated by the dynamics of the system itself, and it is a time-dependent variable. An *extrinsic factor* is a factor that contributes to generating intrinsic factors but is not influenced by the dynamics of the system. Extrinsic factors can be either independent variables or parameters[46]. Furthermore, a system can include more than one level of causal factors and, if this is the case, its causal factors are hierarchically ordered. In the framework of a hierarchically ordered system, higher-order factors determine the dynamics of lower-order levels. If the system only has two levels, second-order factors determine the dynamics of the first-order ones. The first level of the hierarchy must include both intrinsic and extrinsic factors, but this is not the case with upper levels so that second-order factors can be all extrinsic or all intrinsic.

A non-trivial machine consists of two hierarchical levels. The first level includes both intrinsic and extrinsic factors, whereas the second level includes only extrinsic factors. At the first level of the machine, there are three sorts of extrinsic factors: a) inputs, that are independent variables; b) constants , that are parameters; c) constants , that are parameters. The internal state of the machine at a certain moment is a first-order intrinsic factor, and the same goes for the output produced on the basis of that internal state. The operators and are second-order extrinsic factors, as they are not influenced by the operations of the machine[47]. Three aspects of the functioning of a non-trivial machine are noteworthy: a) "there is a sharp logical distinction and strict operational segregation between intrinsic and extrinsic causal factors"[48]; b) the overall number of extrinsic factors exceeds the one of intrinsic factors; c) the number of intrinsic factors is fixed, in that the machine cannot generate new kinds of intrinsic factors.

The concept of non-trivial machine proves to be unfit to account for the development of living beings, when one endeavors to describe that development in terms of intrinsic and extrinsic factors. It is noteworthy

[45] Ivi (33-34).
[46] Ivi (30).
[47] Ivi (34).
[48] *Ibidem*.

that the words *intrinsic* and *extrinsic* should not be interpreted as meaning, respectively, *internal* and *external*. As has been pointed out above, *intrinsic* denotes a causal factor that is dependent on the dynamics of the system and *extrinsic* denotes a causal factor that is independent of those dynamics. A living being produces two sorts of first-order intrinsic factors: a) the "material-energetic quantities"[49] that it generates and that affect its ontogeny, such as "the concentration of regulatory proteins, scleroproteins, hormones, ATP molecules etc."[50]; b) environmental conditions that the living being modifies for the purpose of increasing its own survival chances, such as "regulated atmospheric humidity and room temperature"[51]. The first-order extrinsic factors that affect the ontogeny of the living being can be divided into three classes: a) "initial conditions, such as the parental genetic constitution and the environment of a zygote at the time of its fertilization"[52]; b) natural laws constraining physicochemical processes within the living body; c) environmental conditions that cannot be modified by the living being, such as "gravitation, radioactivity, geological processes, solar activity, and the forms and quantities of available energy and matter"[53].

However, living beings are able to adjust the value of many quantities that influence their own development, like for example the concentration of proteins and hormones, so that in a living being the number of first-order intrinsic factors is much bigger than the one of first-order extrinsic factors. Moreover, an essential feature of biological phenomena is the absence of sharp demarcation between first-order intrinsic factors and first-order extrinsic factors. Just to make an example, many extrinsic factors related to environmental conditions have been transformed from first-order extrinsic factors to first-order intrinsic factors in the course of the evolution of human species, as human beings have become capable of fruitfully manipulating their own environment. Finally, the number of first-order intrinsic factors contributing to the development of a living being can increase also because new kinds of molecules are synthesized during many biological processes, such as the growth and regeneration of unicellular beings, growth and regeneration of multicellular beings, and embryogenesis[54]. These three aspects of life, namely numerousness of first-order intrinsic factors, capacity to transform extrinsic factors into intrinsic factors and

[49] Ivi (31).
[50] *Ibidem*.
[51] *Ibidem*.
[52] *Ibidem*.
[53] *Ibidem*.
[54] Ivi (31-32).

creation of new sorts of first-order intrinsic factors, cannot be accounted for by a non-trivial machine because of the above-mentioned characteristics of its functioning. As has been remarked above, three fundamental features characterize a non-trivial machine: a) sharp distinction between intrinsic and extrinsic factors; b) extrinsic factors outnumber intrinsic factors; c) the number of intrinsic factors is fixed.

All that I have said about the difference between living beings and non-trivial machines enables me to stress the main fault of the mechanistic approach to life, namely its way of considering second-order factors. The mechanistic approach ascribes to the system little capacity to influence its own first-level dynamics, because it postulates that all second-order factors are extrinsic. Indeed, first-level dynamics are affected by higher-order factors, so that second-order factors determine how many factors the first level has, whether they are intrinsic or extrinsic, and whether or not the system is able to somehow introduce new first-order intrinsic factors. For example, a non-trivial machine can produce no more than two first-order intrinsic factors, because it converts inputs to first-order intrinsic factors in accordance with logical-mathematical functions expressed by the operators and and it is not able to change those functions. But a living being can create new sorts of first-order intrinsic factors and transform first-order extrinsic factors into first-order intrinsic factors, so that its organization must involve intrinsic, rather than extrinsic, second-order factors. As Koutroufinis observes, the second-order factors that affect the development of a living being "are necessarily intrinsic"[55]. Although Whitehead does not deal with intrinsic and extrinsic factors, his notion of concrescence helps us account for this key difference between living beings and machines. One can draw a parallel between the conceptual activity of an actual occasion and the generation of second-order intrinsic factors taking place within a living body. Just as conceptual prehensions prehend novel "forms of definiteness"[56] or eternal objects, so the first-level dynamics of a living system are endlessly defined and redefined through generation of new second-order intrinsic factors[57].

[55] Ivi (32).
[56] Whitehead (1979, 22).
[57] Koutroufinis (2017, 39).

5. Two opposite approaches to the mind

So far, I have focused on the topic of the development of a living being, and I have contended that Whitehead's processual ontology enables us to understand that living beings are capable of self-determination because their organization differs from the one of a non-trivial machine. However, that ontology helps us account for another fundamental difference between living beings and machines, namely mental faculties. Interestingly, terms like *mental* and *mentality* occur frequently in Whitehead's description of concrescence. Whitehead holds that the conceptual prehensions of an actual occasion contribute to forming its *mental pole*, so that any actual occasion is endowed with a more or less significant mental pole. An actual occasion is dipolar, in that its mental pole arises from its *physical pole*, the latter consisting of the physical prehensions of the occasion[58]. To quote from *Process and Reality*, "the physical inheritance is essentially accompanied by a conceptual reaction partly conformed to it, and partly introductory of a relevant novel contrast, but always introducing emphasis, valuation and purpose"[59]. Now, I shall use Whitehead's notion of *mental pole* in order to reject the thesis that a living mind can be reduced to a machine.

The *computational conception of the mind* is inspired by two of Turing's ideas: a) the Turing machine, which is similar to a non-trivial machine; b) the *imitation game*, as he outlines it in the work "Computing Machinery and Intelligence"[60]. A Turing machine is composed of an "arbitrarily long segmented tape"[61] and a device performing operations upon the tape. Four different operations can be carried out by the device: a) it can make a mark on the tape; b) it can remove a mark from the tape; c) it can move the tape one segment forwards; d) it can move the tape one segment backwards. The states of the tape before and after a series of operations are called, respectively, *input* and *output*. The instructions according to which the device operates make up the *program* of the machine[62]. As regards the imitation game, it is noteworthy that Turing introduces it as a reformulation of the question of whether machines are able to think. He holds that

[58] The set of all actual occasions is a subset of the set of *actual entities*. This latter set is almost identical to the former, as it consists of all actual occasions plus God. Therefore, God is the only actual entity that is not an actual occasion. God differs from an actual occasion in that his physical pole arises from his mental pole. See Cobb (2008, 70).

[59] Whitehead (1979, 108).

[60] See Turing (1950). Hereinafter, I shall refer to the excerpt from this work that was included in Hofstadter & Dennett (1981).

[61] Fetzer (2004, 119).

[62] *Ibidem*.

answering such a question is difficult because, if one proposes to answer it based on the common meaning of the terms *machine* and *think*, the only way to do that is with statistical survey[63]. This is the reason why he substitutes a new problem for the initial one. He asks the reader to imagine that a person of any gender interrogates two other people, a man and woman placed in a separated room, for the purpose of guessing which one of them is the man and which one is the woman. The communications between the interrogator and the two other people have to take place by means of a teleprinter or an intermediary, in order to ensure that the interrogator does not get any clue from those people's tone of voice. The two people who answer the interrogator's questions have different tasks. One of them has to deceive the interrogator, whereas the other has to help the interrogator guess correctly. Let's say for example that the man plays the role of the deceiver. If this is the case, the man will pretend to be a woman by imitating a woman's way of answering questions, whereas the actual woman will do her best to convince the interrogator not to buy into the man's lies. Once he has described the game, Turing wonders what will happen if, at a certain moment, a Turing machine replaces the man as the deceiver. Will the interrogator's failure rate be the same as before[64]?

The fundamental assumption underlying the computational conception of the mind is that a Turing machine that succeeds in misleading a human interrogator, when playing the imitation game, possesses both intelligence and mentality[65]. A criticism may come to mind as soon as this thesis is formulated, namely that unlike actual minds Turing machines are "abstract entities […] incapable of exerting any causal influence upon things in space/time"[66]. As Finelli points out, a program or software is independent of its hardware, the latter consisting in the material components making up the machine[67]. How can one equate a Turing machine with an actual mind? Turing is not directly responsible for this fallacious equalization, since he proposed nothing but an imitation game in the absence of an answer to his initial question of whether machines can think[68]. As a mathematician, his goal was probably other than to philosophically define the mind. Furthermore, he proves to be perfectly aware of the epis-

63 Turing (1981, 53).
64 Ivi (53-54).
65 Fetzer (2004, 120).
66 *Ibidem*.
67 Finelli (2022, 99).
68 Longo (2021, 233).

temological limitations of calculation-based approaches[69] as he states that "the nervous system is certainly not a discrete state machine"[70].

I contend that the computational conception of the mind is far from being a simple generalization of Turing's speculations on future developments of machines. The imitation game does not constitute per se a philosophical theory of the mind, so that the attribution of mentality to "Turing machines manipulating marks"[71] presupposes additional theses on the epistemological reliability of imitation and the mind-body problem. These additional theses are outlined by the cognitive scientist Douglas Hofstadter in his dialogic work "The Turing Test: A Coffeehouse Conversation", which consists in an imaginary conversation on Turing's imitation game between three students taking different points of view on the topic. One of them, Sandy, advocates an interpretation of Turing's game that lays the foundation for the computational conception of the mind. Two of his ideas are relevant here. Firstly, he challenges the widespread idea that there is an unbridgeable gap between a simulation and the concrete phenomenon that it simulates, so that, if an extremely detailed simulation of a hurricane were realized, it would contain simulated people experiencing wind and rain "just as we do when a hurricane hits"[72]. Secondly, he reduces a mental faculty such as thought to an "abstract pattern"[73], that is usually considered as a feature of a living brain but can actually characterize other kinds of brains as well. He holds that the common trait among thinking things is "a similarity of internal structure – not bodily, organic, chemical structure, but organizational structure – software"[74]. According to him, brains that differ from a living brain in their physical composition can still support thought, because physical medium does not matter.

I shall now focus on the first of these ideas, for the purpose of stressing its flaws. The student who advocates a computational approach to the mind postulates that an extremely detailed simulation of a certain phenomenon somehow equates to that phenomenon. Nevertheless, such a simulation is neither realizable nor epistemologically reliable. It cannot be realized because, as Benasayag remarks, concrete phenomena are neither computable nor completely representable[75]. Just as a territory cannot be

[69] Ivi (238).
[70] Turing (1981, 64-65).
[71] Fetzer (2004, 120).
[72] Hofstadter (1981, 74).
[73] Ivi (78).
[74] Ivi (80).
[75] Benasayag (2020, 14).

reduced to a map representing it, so a hurricane or any other phenomenon exceeds any representation of it that one can possibly make. The above-mentioned simulation is not epistemologically relevant either, as it is not a *model* but an *imitation*. The difference between a model and an imitation is explained by Longo, who observes that only the former aims to make phenomena intelligible through mathematical description[76]. As Longo points out, imitation is not intended to describe anything, and its goal is just to look like the imitated phenomenon.

As regards the second idea outlined by Hofstadter in his dialogue, one can consider it as a mere reformulation of the Cartesian dualism of mind and body[77]. Whitehead rejects that dualism, as he contends that physicality and mentality are "two aspects of every occasion"[78] rather than two metaphysically separated types of substance. As has been touched upon, he holds that an actual occasion has both a physical and a mental pole, the latter emerging from the former at a quite advanced stage of the concrescence. The dipolar character of concrescence "provides in the physical pole for the objective side of experience, derivative from an external actual world, and provides in the mental pole for the subjective side of experience, derivative from the subjective conceptual valuations correlate to the physical feelings"[79].

One may wonder how Whitehead's account of a dipolar actual occasion enables us to elaborate a non-dualistic approach to the mind. This point can be clarified, by analyzing how the mental poles of the actual occasions making up a certain living being give rise to the mind of that living being. For the purpose of explaining that, I shall now introduce some notions that Whitehead formulates to define life. According to Whitehead, a living being is a society of actual occasions, just like many other individual beings such as a building or a stone. So far, I have not specified what exactly Whitehead means by the term *society*, because in his terminology the meaning of this term presupposes the notion of *nexus*, namely a set of actual occasions "in the unity of the relatedness constituted by their prehensions of each other"[80]. A society is a nexus that fulfils the following two conditions: a) a common element of form characterizes each of its actual occasions; b) the transmission of this common element of form from one member of the nexus to another takes place because each member pre-

[76] Longo (2021, 15).
[77] Finelli (2022, 99).
[78] Cobb (2008, 40).
[79] Whitehead (1979, 277).
[80] Ivi (24).

hends other members[81]. There are several kinds of societies, which differ from each other in organization. Some societies include other societies and nexuses[82] within a structural pattern, and this is the case of a living being since Whitehead describes living beings as *living structured societies*[83]. The living occasions that make the structured society alive do not belong to any of the societies that it includes, but to some of its nexuses[84].

Not all living structured societies are organized in the same way. In the framework of a simple living being, such as a worm or a jellyfish, the constituent occasions form a democracy, and the parts of the organism continue performing their functions if the organism is cut into halves[85]. The more a living being is complex, the more hierarchical its organization is. Some kind of centralized control can be observed even in insects, although the most significant example of hierarchical organization is of course the human being, whose body sustains several "paths of inheritance"[86] converging towards a central supervisory organ, namely the brain. Whitehead seems to think that what is commonly called *the mind*, a faculty that common language ascribes to living beings rather than to actual occasions, is strictly related to the bodily organization of an organism. He probably holds that only some living beings have a fully-fledged mind, namely the ones whose body is hierarchically organized and endowed with a brain.

In the framework of a hierarchical living body, a complex structure pervading the whole body produces a "presiding occasion"[87] in the brain at every moment. Presiding occasions are continuously generated and regenerated, so that the succession of these presiding occasions gives rise to a special type of nexus, that is called *living person* by Whitehead and is marked by the transmission of conceptual novelty from one presiding occasion to another[88]. Whitehead thus regards the mind as a succession of presiding occasions or a living person, and his account of the mind offers a valuable alternative to Cartesian dualism. To a great extent, a living person "sums up what is taking place in the body and functions for the sake of the well-being of the body"[89]. To quote from *Process and Reality*, "human

81 Ivi (34).
82 Whitehead uses the word *nexūs* to denote the plural of nexus.
83 Whitehead (1979, 99).
84 Ivi (104-105).
85 Ivi (108).
86 Ivi (109).
87 *Ibidem*.
88 Scholarship wonders whether a living person is just a nexus or also a society. See Cobb (2008, 43-44).
89 Cobb (2008, 45).

mentality is partly the outcome of the human body, partly the single directive agency of the body, partly a system of cogitations which have a certain irrelevance to […] the body"[90].

6. Conclusion

The main characteristic of life is not transmission of information but generation of unprecedented novelty through self-creation. This explains why a living being is not only unpredictable but also impossible to craft artificially. One can remark an intriguing convergence between Longo's epistemological insights into the limits of calculability[91] and Whitehead's processual ontology. Both Longo and Whitehead teach us that the development of a living being cannot be described through a non-trivial machine, and the reason why an organism is different from a machine is that the former generates its own second-order factors whereas the latter does not[92]. Just like artificial life, artificial intelligence is also unattainable. The core idea behind AI projects is that the mind can exist independently of the body but, as Benasayag observes, the mental faculties of an animal or a human being depend on brain processes, bodily processes and even environmental processes[93]. The thesis that a Turing machine that is able to win at Turing's imitation game is intelligent is based on an untenable metaphysical dualism, and Whitehead's notion of a *living person* proves to be useful to reject that dualism by accounting for the close interdependence between the mind and the body.

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[90] Whitehead (1979, 108). It is noteworthy that Whitehead introduces a new kind of prehensions, in order to elucidate how conceptual novelty is canalized and intensified in the context of a living person. He calls *hybrid prehension* this new kind of prehensions, and he considers the set of hybrid prehensions as a subset of the set of physical prehensions. See Cobb (2008, 42-43).

[91] Longo (2021, 236-238).

[92] See Koutroufinis (2017).

[93] Benasayag (2020, 8).

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