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Can Algorithms be Embodied? A Phenomenological Perspective on the Relationship Between Algorithimic Thinking and the Life-World

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Abstract
This article investigates the possibility to question the difference between artificial and human intelligence by assuming that the latter can incorporate artificial, external components just as artificial intelligence can simulate human responses, and by exploring human embodiment in its technically and digitally augmented dimension. The idea that digital processes do not merely imply a detachment from the body, a dematerialization or disembodiment, is supported by many researchers, starting already from those who—back in the 1980s—reacted to cyberpunk narratives and their tendency to posit a new mind–body dualism. Yet, here I would like to frame this thesis not within the post-human context but in a phenomenological perspective, and in doing so I will employ specific conceptual tools. I will particularly (1) rely on Katherine Hayles' distinction between incorporating and inscribing practices; (2) refer to Maturana and Varela's notion of structural coupling; (3) analyze algorithmic thinking and its temporal structure.

Keywords Embodiment · Algorithmic Thinking · Phenomenology · AI · Posthuman

1 Introduction

In this article I will address the following main questions: what if we try to overcome the notion of artificial vs. human intelligence by assuming that human intelligence can incorporate artificial, external components just as artificial intelligence can simulate human responses? What if human embodiment can be augmented technically and digitally? These are now classic questions in digital technology studies; however, in order to develop my argument, which I will structure from a phenomenological point of view, I would like to start with a quote from Katherine Hayles' seminal book *How We Became Posthuman* (1999):

You are alone in the room, except for two computer terminals flickering in the dim light. You use the terminals to communicate with two entities in another room, whom you cannot

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see. Relying solely on their responses to your questions, you must decide (…) which is the human, which the machine. (…) Your job is to pose questions that can distinguish verbal performance from embodied reality. If you cannot tell the intelligent machine from the intelligent human, your failure proves, Turing argued, that machines can think. (Hayles, 1999, p. xi).

What does this mental experiment tell us? "Here, at the inaugural moment of the computer age, the erasure of embodiment is performed so that 'intelligence' becomes a property of the formal manipulation of symbols rather than enaction in the human life-world." (Hayles, 1999, p. xi) Thus, at the heart of the Turing test there lies the "erasure of embodiment:" such an erasure has been reinforced by the definition of information provided by Claude Shannon and Norbert Wiener, who have conceptualized information as an entity distinct from the substrates carrying it. "From this formulation, it was a small step to think of information as a kind of bodiless fluid that could flow between different substrates without loss of meaning or form." (Hayles, 1999, p. xi).

The question I pose here is rather simple: what if at the heart of the Turing test there lay not the erasure of embodiment but its transformation through processes of digital *incorporation*? What if we question the difference between artificial and human intelligence by assuming that human intelligence does incorporate artificial, external components just as artificial intelligence can simulate human responses? What becomes of human embodiment in its technically and digitally augmented dimension? This is not a new proposal, of course: the idea that digital processes do not merely imply a detachment from the body, a dematerialization or disembodiment, is supported by many researchers, starting already from those who reacted to cyberpunk narratives and their tendency to posit a new mind–body dualism (Boler, 2007, 2012; De Preester, 2011; Kirby, 1997; Lapage-Richer, 2018; Richardson & Harper, 2001). Yet, here I would like to frame this thesis not within the post-human context (as in Hayles' case) but in a phenomenological perspective, and in doing so I will specifically analyze algorithmic thinking and its temporal structure.

2 The Observer's Role

Let us go back to the Turing test: someone (a human) is *observing* the responses by someone/something else (another human? A machine?). There is an *observer* and someone or something that is *observed*: this poses the problem of reflexivity, already addressed by researchers during the first wave of cybernetics and in the well-known Macy conferences.[1] It is interesting that one of the first attempts to develop the epistemological implications of this problem was made by Heinz von Forster in a way that is reminiscent of the phenomenological theory of empathy, i.e. by resorting to analogy and the imagination: "If I assume that I am the sole reality, it turns out that I am the imagination of somebody else, who in turn assumes that *he* is the sole reality." (von Foerster, 1984–cit. in Hayles, 1999, p. 133) This means that, as Hayles observes, "I use my imagination to conceive of someone else and then of the imagination of that person, in which I find myself reflected." (Hayles, 1999, p. 1333) Although von Foerster himself deemed this argument insufficient to found

[1] The conferences, held at the Josiah Macy Jr. Foundation in New York from 1941 to 1960, were meant to foster interdisciplinary exchanges among scholars on a wide range of topics, including cybernetics.

reflexivity in a rigorous epistemological way, it remains interesting from a phenomenological perspective: it shifts the problem of reflexivity from observation (from the objectivist point of view) to the observer. Humberto Maturana—whose work influenced von Foerster's views after 1969[2]—expressed this point in his 1972 book (co-authored with Francisco Varela) *Autopoiesis and Cognition*, through his well-known maxim: "Everything said is said by an observer." (Maturana & Varela, 1972, p. xxii) The relevant point here is that shifting the attention to the observer also means giving relevance to a body, the observer's body, with its own context and positioning—to a primal and original experience that *is* embodied: this is the phenomenological move I am interested in, i.e. the re-location of intelligence (even when artificially augmented) within lived-experience (what Husserl would call the *Lebenswelt*). Even though Maturana himself retrospectively acknowledged that his (and Jerry Y. Lettvin's) initial attempts (Lettvin et al., 1959) to reformulate the objectivist epistemology of early cybernetics ambiguously assumed an objectivist framework,[3] the emphasis on the observer's role is important, for it allows us to connect symbolic operations to their foundations in experience.

3 Structural Coupling

Among the many features of the observer, as conceived by Maturana and Varela in *Autopoiesis and Cognition*, I will focus on just one, which holds special phenomenological relevance: the structural coupling. In order to continue living, organisms must be structurally coupled to (some elements of) their environments: "humans, for example, have to breathe air, drink water, eat food." (Hayles, 1999, p. 138) Living systems engage in a two-way, mutually triggering interaction with their environment: a change in the environment can trigger effects for the living organism in a way that must be differentiated from causal relationship. Causality is not part of the autopoietic process itself, but rather of the descriptive domain of a human observer who draws inferences from her descriptive position. "Information, coding, and teleology are likewise inferences drawn by an observer (…). In the autopoietic account, there are no messages circulating in feedback loops, nor are there even any genetic codes. These are abstractions invented by the observer to explain what is seen." (Hayles, 1999, p. 139).[4]

From a phenomenological standpoint, we could say that living systems' relationship with their *Umwelt* is essential for them: cognition, as long as it is understood as an autopoietic process, involves structural couplings between the living system and the environment.

[2] The intellectual exchange and mutual influences between Maturana and von Foerster are reconstructed by Hayles (1999, 133 ff.): she mentions von Foerster's invitation for Maturana to speak at a conference held in 1969 at the University of Illinois, where von Foerster was working, and the big intellectual impact that Maturana's talk had on von Foerster's work.

[3] Maturana recalls that "the epistemology that guided our thinking and writing was that of an objective reality independent of the observer." (Maturana & Varela, 1972, p. xiv).

[4] It is for this very reason that Maturana criticizes John von Neumann's attempt to model descriptions and inferences about "what appeared to take place in the cell in terms of information content, program and coding"—all things that do not inherently belong to the autopoietic machine. (Maturana, 1978, p. 59) Varela goes even further in this critique by writing that "information, *strictu* sensu, does not exist. Nor do, by the way, the laws of nature." (Varela, 1981, p. 45) This essay—like other works by Varela published after 1980—marks a departure from the emphasis on autopoiesis (and his collaboration with Maturana) in favor of the notion of "enaction," which privileges the active interaction of the organism with its environment over the process of self-organization).

When we describe these couplings scientifically, we must pay attention – as the Husserl of the *Crisis* (1979) would say – not to confuse the idealized concepts we construct to describe phenomena with the phenomena as such: this is why it is important to return, on one hand, to the things themselves, the phenomena under observation, so as to escape the risk of a mere operational discourse; and, on the other hand, to the observer's position—it is important not to forget that her cognition is embodied, i.e. mediated by "the sensory and cognitive interfaces of embodied researchers." (Hayles, 1999, p. 135).

Clearly, Maturana and Varela's theory is based on the principle of treating "cognition as a biological phenomenon;" (Maturana & Varela, 1972, p. xvi) however, they were fully aware of the fact that even artificial systems can become autopoietic unities: "if living systems were machines, they could be made by man", they declare. (Maturana & Varela, 1972, p. 82) But we could then ask: what if we expand the notion of structural couplings in the current, digital era in order to include those interactions necessary to the every-day life that involve algorithms?

4 Incorporation/Inscription

This is where the notion of "incorporation" becomes useful. Following Hayles (who builds on Paul Connerton's theory (Connerton, 1989)), we can understand by the expression "incorporating practice an action that is encoded in bodily memory by repeated performances until it becomes habitual." (Hayles, 1999, p. 199) Such practices always rely on some kind of medium: "learning to type is an incorporating practice," (Hayles, 1999, p. 199) by means of which we extend our cognitive skills so as to integrate in the extended cognitive system that part of the environment required to perform the action. I think that on these grounds phenomenology can be complemented, to a certain extent, with externalist theories. The term "externalism" refers to a series of theories and positions within the philosophy of mind sharing the idea that the mind depends, in its cognitive functions, not merely on internal bodily conditions, but also—at various levels and to varying degrees—on conditions external to the body. In their landmark 1998 article *The Extended Mind* (Clark & Chalmers, 1998) Andy Clark and David Chalmers propose an "active externalism," which consists in emphasising the active role played by the environment in the definition of cognitive processes. They write: "The external features here are just as causally relevant as typical internal features of the brain." (Clark & Chalmers, 1998, p. 9) In other words, "there is nothing sacred about skull and skin:" (Clark & Chalmers, 1998, p. 14) if external conditions play a role in guiding cognitive processes, then the mind must be seen to extend outside the body, by integrating those environmental components that prove functional to cognition into the extended cognitive system.

Incorporating practices, therefore, involve bodily extension through some type of medium. As such, they must be distinguished from "inscribing practices", which instead involve "inscriptions that abstract the practices into signs." (Hayles, 1999, p. 199) There is, of course, a relation between the two forms of practice: "incorporating practices perform the bodily content; inscribing practices correct and modulate the performance. Thus incorporating and inscribing practices work together to create cultural constructs." Yet, "in contrast to inscription, which can be transported from context to context once it has been performed, incorporation can never be cut entirely from its context." (Hayles, 1999, p. 200) The important aspect to be discussed here is stressed by Hayles with reference to Hubert Dreyfus', 1972 seminal work *What Computers Can't Do* (Dreyfus, 1972): embodiment

cannot be characterized as algorithmic. In his book, Dreyfus relies on Merlau-Ponty's theory of perception as habit in order to argue that human cognition is primarily based on unconscious processes rather than on conscious, symbolic processes that can be formalized in heuristic programs for digital computers. This happens precisely because most human behaviours are embodied: this means we don't need all the rules to be specified in advance, i.e. encoded in the algorithmic, formalized sense. Dreyfus introduces three conditions of embodied learning that are not present in computer programs: "an 'inner horizon' that consists of a partly determined, partly open context of anticipation; the global character of the anticipation, which relates it to other pertinent contexts in fluid, shifting patterns of connection; and the transferability of such anticipation from one sense modality to another." (Hayles, 1999, pp. 201–202) We will see that these conditions can be interpreted phenomenologically: however, I will suggest that this interpretation does not rule out the possibility of digital incorporation. In other words, a phenomenological understanding of algorithmic thinking can help us avoid the opposition between embodied learning and digital coding in Dreyfus' sense by emphasizing the notion of incorporation precisely in its temporal structure. So we now need to delve into the phenomenological theory of temporality, with regard to embodied and algorithmic thinking: our starting point will be the Husserlian notion of "life-world".

5 Temporality and the Life-world

By the term "life-world" (*Lebenswelt*) Husserl describes the everyday non-scientific perspective on our environment and surroundings: the concept refers to the field of intersubjective background beliefs that first makes scientific objectifying knowledge meaningful. The life-world therefore has priority over the scientific interpretation of the world; at the same time, the pre-scientific view and the scientific are connected a priori, i.e. there is a (possible) correspondence between the practices of constitution of meaning in everyday life and in scientific knowledge, between the way things appear subjectively, in perception processes, and the way they are known scientifically (objectively).

This becomes especially clear if we consider the problem of time-constitution: as already shown by Henri Bergson (1990), subjective time-consciousness radically differs from objective time-consciousness, since the former is a qualitative and continuous mode of *perception*, whereas the latter is a quantitative (discrete) mode of *representation*. What we actually perceive is the subjective duration, which we can represent mathematically by means of instruments (such as clocks and watches) that translate subjective time into space and are therefore capable of measuring it (a clock measures the distances/portions of space marked by the hands). What can be measured is—according to Bergson—space and movement, whereas time as such is a continuous flow subjectively experienced by individuals: objective spatialized time is therefore common to a certain culture and equally experienced by many people, while pure duration is subjectively perceived and differs in this very perception from subject to subject.

Even if he does not directly refer to Bergson's theory, Husserl shares this view of an essential difference between subjective and objective time: by objective time Husserl means a pure sequence of now-points (*Jetztpunkte*), which are per se incapable of explaining the connection between the points. When we listen to a melody, what is it that makes us say that we are hearing *a melody* and not a mere sequence of instant sounds? To interpret the melody as a *unity* of meaning, we need something more than the simple, objective

reference to a mere sequence of disjointed sounds as now-points. Indeed, the time we experience in our every-day life, in the life-world before any scientific representation of time, is a subjective and continuous one. It is not divided into fractions; it is a consciousness-flow irreducible to objective measurement. This subjective experience of time has a structure (retention-impression-protention) that holds for all kinds of perception of objects. However, Husserl is much more interested than Bergson in explaining the correspondence between subjective and objective time: his whole lecture series on the constitution of inner time-consciousness (Husserl, 1964) is devoted to this topic.

Through reflection (representation) we build a correspondence between the subjective experience of a certain content and its placement within an objective time-frame, that we can repeat independently of the original experience: for instance, through recollection (which is a form of reflective representation) we can reproduce the melody we heard yesterday, because we can build an analogy between the moments of the original perception and the moments of its reproduction in the present. We know that the reproduced melody is not *really* perceived, but is perceived *as if* it were being heard now; nevertheless, we say that it is precisely *that* melody we heard yesterday that is being reproduced now. This is possible because, thanks to repetition mechanisms based on reflection and secondary (non-retentional) memory, we have progressively objectified subjective time-perception into an objective time-frame: we can therefore "place" each subjective time-perception within this objective frame. As pointed out by Domenico Schneider (2019), "time consciousness is always extended and is given by the protentional and retentional structure of consciousness (Husserl), or the biological time of life in the form of duration or *durée* (Bergson, 2003) is a particular mode of temporalizing. We have to separate this way of temporal structuring from technical time structuring."

To sum up: subjective experience in the life-world and its objective representation in scientific accounts are two different yet at the same time related things. According to Husserl (in his well-known late work *Crisis of the European Sciences and Transcendental Phenomenology*, first published in 1936 - transl. 1970), "the life-world had become occluded under the impact of the norms of naturalistic positive science set down by Galileo and Descartes in the seventeenth century," and this "threatened to fuel the general disaffection from all rational critical inquiry unleashed by fascisms in Europe in the 1930s." (Harrington, 2006, pp. 321–323) The priority of the life-world over scientific interpretation turned into its reverse: the completion of the Positivistic view of the world in Modernity produced an absolutization of the scientistic attitude, meaning a progressive oblivion of the sources of our experience in the life-world. We can see this very clearly in the course of industrialization, "which starts with machines and the steam engine and ends with the development of the assembly line. Certainly these are the main events, which are additionally accompanied by urbanization, electrification and an increased mobilization of our society." (Schneider, 2019) These "events" would have been inconceivable without the fragmentation of subjective time and experience into objective units measurable in terms of work-time and time-wage.

6 Temporality and the Algorithms

Computer technology and the Internet have recently (from the early 1990s) sped up this process. The logic of algorithms is based on the discrete (digital), objective representation of time-processing: this does not mean that it is completely detached from the subjective

experience of time-contents, but that the very connection between algorithmic knowledge and life-world experience has been increasingly lost in the course of IT development. As stated by Schneider, "in introduction books for computer science and algorithm we find: An algorithm is a self-contained step-by-step set of operations to be performed, this step-by-step definition is only related to an objective time flow and in general is determined by mono-causality 'if that then do that', and all steps are isolated from each other." (Schneider, 2019) The very nature of digital processing implies that all steps are distinct and that in the flow of execution there is no creative continuous influence of the individual steps on one another. Let's consider a standard definition of what an algorithm is: "Today, an algorithm is defined as a finite and organized set of instructions, intended to provide the solution to a problem, and which must satisfy certain conditions." (Chabert et al., 1999, p. 455) These include:

1. The algorithm must be capable of being written in a certain language: a language is a set of words written using a defined alphabet.
2. The question that is posed is determined by some given data, called *enter*, for which the algorithm will be executed.
3. The algorithm is a procedure which is carried out step by step.
4. The action at each step is strictly determined by the algorithm, the entry data and the results obtained at previous steps.
5. The answer, called *exit*, is clearly specified.
6. Whatever the entry data, the execution of the algorithm will terminate after a finite number of steps. (Chabert et al., 1999, p. 455)

Given this definition, we could schematize the different modes of cognition within the life-world and the digitized world as follows (here I refer to Schneider's (2019) schematization):

Life-World

- Communication is enriched with affects, emotions and non-designative elements (e.g. intonation, micro gestures etc.).
- Human–environment interaction is always flexible within the flow of interaction → enaction, embodied engagement in the *Umwelt.*
- Humans have consciousness/awareness of *Gestalt* in the flow of experience → *anticipatory* ability for the whole scene. Temporal structure as a flow. (Schneider, 2019).

Digitized Word

- All levels (the electrical layer (hardware), the host layer, and the media layer) only have a clear designation and a clear semantic.
- Computer-environment interaction strongly depends on algorithms (i.e. on data-bases) a *representation* is needed, which is less flexible because data and relations are given: in this sense, the interaction with the environment is not embodied but coded (and this is why computers are generally faster in processing than humans).

- Algorithms basically proceed step-by-step (and this even applies to neuronal networks) → they are able to find basic patterns and have no comprehensive view. (Schneider, 2019).

This should explain in what sense embodiment cannot be understood in algorithmic terms. Yet, as I have anticipated, such a phenomenological interpretation does not rule out the possibility of a certain incorporation of algorithmic, digital processes: again, it is important to distinguish here between incorporation (extension) and inscription.[5] While we can incorporate via embodiment—i.e. through bodily extensions that expand the cognitive system so as to integrate digital devices into the extended cognitive system—we do not "inscribe" the algorithmic logic, since the code (the program, the algorithmic sequence) remains basically unknown to most users and does not need to be known in itself in order to use digital devices. Embodiment is always bi-directional: for it refers not only to the fact that our exchange with the environment is always contextualized and mediated by our body and its sensorimotor activities, but also to the fact that the tools and devices that facilitate our experience of the world are increasingly becoming embodied, i.e. embedded in our bodily and cognitive capacities We are increasingly *technologizing* ourselves and this technologization implies a double-embodiment process: on one hand, we extend ourselves into reality by means of digital devices; on the other, these also become embedded into our bodies, increasingly blurring the lines between the biological dimension and the artificial. Double-embodiment involves the subjective side (embodied experience) as well as the objective side (embodied technologies) of our relationship to the digital world: this means that, just as in Husserl's account, while there is a difference between the logic (and temporality) of subjective experience (embodiment, enaction) and the logic of the objective representation (algorithms, codes), there is also a connection between the two, grounded in the *Lebenswelt*. Through incorporation we indirectly integrate within us something of the algorithmic processes inscribed in the devices we use, but we do not inscribe their logic within ourselves, since this falls outside our embodied and even extended cognition. In conclusion: can algorithms be embodied? I would suggest the following answer (which is of course provisional and to be discussed further): they can be indirectly incorporated, but they cannot be directly inscribed into our cognitive (bodily and intellectual) human system.

7 'Algorithmic Catastrophe'?

Of course, such a conclusion would be far from neutral: it would imply that, as long as they are incorporated, algorithmic processes can have an impact on our own cognition – if only indirectly. The assumption that—at least to this extent—algorithms can be embodied is precisely the reverse of the idea—supported, for instance, by Yuk Hui (2015)—that knowledge and reason can be exteriorized and automatized in what we call "algorithms:" Hui interprets algorithms as the "latest development of reason, totally detached from the thinking brain, and becoming more and more significant in our everyday life due to recent rapid

[5] I do think that, in the case of digital processes and devices, the distinction theorized by Helena De Preester between extension and incorporation can be phenomenologically reduced, as I have tried to show in my 2019 article *Embodiment, Disembodiment and Re-embodiment in the Construction of the Digital Self.* Indeed, I think that processes of incorporation imply some kind of bodily extension and do not represent a totally different mode of experience. (Buongiorno, 2019).

developments in artificial intelligence (AI)." (Hui, 2015, p. 125) Although I share the idea that cognition can be externalized to some extent (see paragraph 3), I am not convinced that the final stage of human reason coincides with algorithms for two reasons: first, as I have tried to show, algorithms can be incorporated but not inscribed into our cognition; second, the very fact of incorporation speaks against a "total detachment from the thinking brain." However, it is true that the latest developments in AI are leading to a notion of algorithms that complicates the idea of a purely linear, discrete and operational structure: "If we define instructions as sequential step-by-step schematizations, and understand them as one pole of the algorithm, then the other pole of the algorithmic spectrum would be recursive and non-linear operations. This spectrum contains different notions of algorithm according to different specific functionalities." (Hui, 2015, p. 134) This brings us back to the issue of temporality and discloses the potential risks in embodied algorithms: Norbert Wiener already noted these risks in his 1960 article "Some Moral and Technical Consequences of Automation." There he criticized "the assumption that machines cannot possess any degree of originality" and that "its operation is at any time open to human interference and to a change in policy." (Wiener, 1960, cit. in Hui, 2015, p. 135) I have already mentioned that the objective temporality of algorithms is usually faster than that of human agents: as Hui has observed, "the automation of machines will be much faster than human intelligence, and hence will lead to a temporal gap in terms of operation. The gap can produce disastrous effects since the human is always too late, and machines won't stop on their own." (Hui, 2015, p. 135) This can lead to what Hui calls "algorithmic catastrophes," and what I would rather call the algorithmic paradox: if, to a certain extent, we can incorporate algorithmic processes, this also means entering into a dialectic relationship between our own subjective, fluid temporality and algorithmic, automatized temporality. It is precisely this dialectic that is leading researchers to question and rethink the ancient, metaphysical problems of contingency and autonomy in the digital era.

8 Conclusion

In this paper I have attempted to outline a phenomenological interpretation of embodiment in the sphere of algorithmic intelligence, developing my argument in the following steps: (i) the distinction between human and artificial intelligence can be overcome by combining the enactive and posthuman perspectives by resorting to the concepts of "structural coupling" (Maturana and Varela) and incorporation (Hayles); (ii) algorithmic and digital temporality can be interpreted as a form of objective temporality, as opposed to the subjective temporality of consciousness, in the sense theorized by Husserl: the distinction, however, is also a relation insofar as objective temporality is grounded in the subjective temporality experienced in the life-world; (iii) it follows from (i) and (ii) that algorithms can be incorporated but not inscribed in our cognition; that is, they can be embodied only indirectly (through technological mediation) and never directly; (iv) from (iii) it follows that a complete detachment of algorithmic intelligence from embodied intelligence is not possible; therefore, a critical margin to avert possible "algorithmic catastrophes" (Hui) is always open to human intervention.

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