APOLOGY FOR TECHNICAL DISTANCE BUT BEWARE THE FEEDBACK!

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Philosophy boasts an ancient familiarity with the practice of taking distance, which it tendentially conceives as a human condition (in transcendental or anthropological sense): the human being is par excellence an ek-static being. Arguably, this issue is rooted in the fundamental mode of being of the human body (but not only human), and has also a structural and not adventitious relationship to technology. A classic neuroscientific experiment shows that technical distancing can produce unpredictable neuro-plastic effects, as well as a general reorganization of behavior based on the emergence of a meta-operative agency. The agency thus enhanced, however, may in turn give rise to a genuine dialectical opposition between plastic expansion and self-referential contraction of behavior. Some examples will help shed light on this dialectic and eventually highlights some requirements that are necessary, though not sufficient, to adequately cope with the social distancing imposed by the anti-Covid measures managed by digital technologies, transforming the emergency into opportunities for the future.

ON THE PHILOSOPHICAL NOBILITY OF DISTANCE

Philosophy boasts an ancient familiarity with the practice of taking distance, which it tendentially conceives as a human 'condition' (in transcendental or anthropological sense): the human being is par excellence an 'ek-static' being. By the way, the very philosophical thought spreads from taking distance from the facticity of existence, which thus points out to the possibility of being re-assumed, and potentially requalified also at the stage of praxis, thanks to a reflective comprehension. In order to adequately describe the paradox of 'being-merged-in', which is 'at the same time' a 'taking-distance-from', Emilio Garroni (1986; 2020) elaborated Ludwig Wittgenstein's notion of *durchschauen* into the theoretical figure of 'seeing-through'. According to this elaboration, although we are inside a contingent world, we would be able to wonder what could ever be a 'contingent' world in general —a world that 'touches' us[1]. This is possible thanks to a *durchschauen* favored by particular situations, e.g. art. Friedrich Nietzsche had also used quite a likely expression about art, which he intended as the 'most transparent' (*durchsichtigste*) form of the will to power, i.e. the metaphysical essence of the living being in general. A whole family of concepts of primary importance for modern philosophy can be reduced to this preliminary reflective statement. As we shall see, we can advance the suspicion that this is rooted in the essential mode of being of the human (but not only the human) body.

For instance, the phenomenological tradition remarked that we can feel to 'be' our bodies and, at the same time, having taken a distance from it, to 'have' one. Furthermore, without a preliminary evaluation of the philosophical nobility of distance, we could understand neither the "Copernican turn" Immanuel Kant recognized to his way of thinking, nor the different versions of a thought of the reflective distancing depending, in a way or another, on that turn: from Georg Wilhelm Friedrich Hegel's *Aufhebung* up to the Jacques Derrida's *différance*, maybe passing through Walter Benjamin's *aura*

and Martin Heidegger's discredit of the "detachedlessness" (*das Abstandlose*) as perverted outcome of modern technics. The power of the paradox according to which we can perceive to be 'in touch' with contingence only at the condition of being contextually distanced from it can be extended with no effort also to the concepts of modern philosophy, which have contended against any super-sensible declination of the classical idea of transcendence by reallocating its topological device, that is, the *débrayage* from the *hic et nunc*, as argues semiotics (Greimas & Courtès, 1993) –into the very heart of the sensible and the somatic: from Friedrich Nietzsche's aforementioned "will to power" to Maurice Merleau-Ponty's "flesh", up to Gilles Deleuze's "level of immanence", together with the different forms of "embodied cognition" handled today at the intersection between philosophy and neuroscience (Gallese, 2009).

This being the state of affairs, an apology of distance would be, for a philosopher, the most futile of the exercises if the measure of a 'social distancing', which the pandemic of Covid-19 induced us to introject as an automatized somatic norm (even in the complementary forms of a compulsive refusal), would not invite us to reconsider the phenomenon in new perspectives. First of all, we find the perspective of the 'technological mediations' to which we asked to govern this phenomenon according to the modes of the so-called 'smart working', together with the different forms of meeting at distance of which our experience was made during the last months –and with an animated debate around them.

However, we should firstly ask what we would find between the dominion of technics and the dynamics of distancing. Is this a purely fortuitous relation or rather a much tighter and more significant bond?

In order to start answering these questions, let me begin with a classical neuroscientific experiment, in a clear synthesis provided by Maravita & Iriki (2004): this will allow me to clarify a decisive point.

Fig. 1 Figure from Maravita, A., & Iriki, A. (2004). Tools for the Body (Schema). Trends in Cognitive Sciences. 8 (2). Neural responses are recorded (inset) while monkeys retrieve items of food and observe their actions on a video monitor, as captured by a video camera (Camera 1).
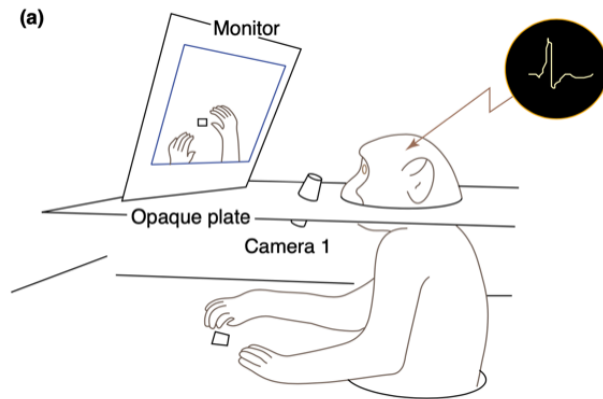
TECHNICAL DISTANCING AND METAOPERATION: THE POWER OF FEEDBACK

The aforementioned experience aims "to observe changes in the behaviour and/or the neural activity of monkeys and humans following the use of simple tools (for example a rake) to extend reaching space". In practice, some Japanese macaques are trained in such a way that "after two weeks of training, when a food pellet was dispensed beyond the reach of the hands, monkeys skillfully used a rake to pull the food closer, where they could reach it with their unaided hand".

During one of these trainings, researchers put the macaques in a post (Figure 1), so that the animal's arms and hands would not be directly visible to itself, but appear on a screen in front of it. After an adequate period of training, not without difficulties, macaques started operating with the representation of their limbs in a fluent and spontaneous way, while the surveys the researchers did on the animals' brains "suggested that the visual image of the hand (and even its 'virtual' equivalent, such as a spot of light) in the monitor was treated by the monkeys as an extension of their own body".

However, this quite notable outcome was not the only one, not even the most important, at least from the
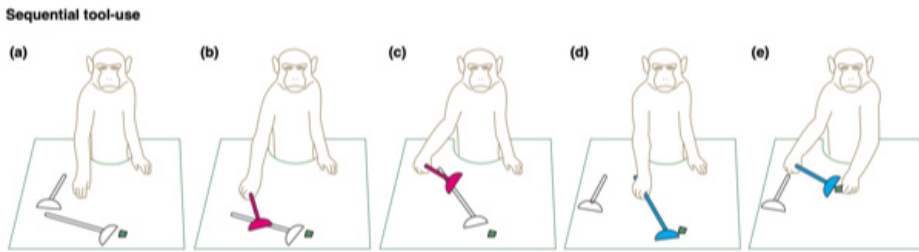
Sequential tool-use

(a)   (b)   (c)   (d)   (e)

Fig. 2 Figure from Maravita, A., & Iriki, A. (2004). Tools for the Body (Schema). Trends in Cognitive Sciences. 8 (2). Experimental setting for the double-rake reaching study in monkeys.

point of view I adopt in the present article. Indeed, the researchers could then note that the macaques trained to operate through a technological mediation –in other words, proceed to a disembodiment of the direct relationship to arms and hands, after which followed a re-embodiment mediated by a technical device– were able to exercise real 'metaoperations' (Garroni, 1977; 2005) like that described in Figure 2. In this Figure the macaque shows to be able to use a short rake, which is insufficient to reach the food, in order to get a longer one, by which the food becomes reachable. The decisive point is not really in the fact that great apes show the ability of operating on operations is doubtlessly ascertained: namely, the ability of conceiving a sequential design in which appears at least one operation not immediately referable to the final goal of the project. Nor is it in the fact that, under certain circumstances, it is possible to train apes to perform this kind of interconnected actions. The decisive point is in the fact that, after having passed through a process of disembodiment and subsequent re-embodiment technically mediated, the macaque was put in the condition of designing a complex operation 'by itself'. A metaoperative element is present, and 'determining', in this operation. In other words, the feedback exercised by the body's technical extension on the animal's behavior had the effect of not only reorganizing its body schema, but also 'spontaneously' introducing the possibility of metaoperative processes into its experiential space. The experiment synthetically reported teaches us two remarkable things. The first one is that, thanks

to a technical mediation, the macaque behaved as somebody who has done the experience of 'having' a body, beside that of 'being' a body. Arguably, in its overall agency, a 'Copernican turn' took place: a technically mediated disembodiment was followed by a re-embodiment, a feedback foreshadowing a very remarkable reorganization of this very agency as a whole.

The second thing we learn is that, by virtue of this feedback, the macaque finds itself in an environment that is radically different from its previous one: in fact, its body can now recognize in it a virtuality before unknown. In this case, the (metaoperative or recursive) opportunity of using the short rake as a tool apt to get another tool, the long rake, which is in turn apt to get the food. This means that, thanks to the complex experience of technical distancing described above, the life environment of the macaque is 'enriched' of new components and virtualities: it eventually becomes a more complex but also more advantageous environment. A new way of being of 'contingency' or 'to be in touch with'.

The moral of the story: if the feedback appeared advantageous, it is because it opened a richer world to the macaque and put the latter in the condition of dwelling in this world with success –and with great 'naturality', as note the researchers who worked at the experiment. "This behaviour was attained very quickly, in remarkable contrast with the initial basic training in using tools, which took at least two weeks". To conclude this section, one could observe that the "more complex world" evoked here is of course the same as before. What changed, however, is the way the macaque perceives its contingencies and interacts with them. And it is a way that increased its 'gradient of plasticity' to a measure that it introduced recursive or metaoperative abilities. It is indeed a sort of 'Copernican revolution'.

But do things always go in this way? To be more precise, does metaoperativity, this refined effect of distancing, always result in an enrichment of the environment-world's contingency?

PLASTICITY, AUTOMATISM, SELF-REFERENCE:
ENVELOPE AND ENVIRONMENT

The unveiling character of the experiment to which I have just referred is surprising in many aspects. Beside its radical *artificiality*, what strucks the more is in fact the 'naturality' of its most spectacular outcome, the metaoperative behavior on which I insisted. Much could be said on this point, making room to an imaginative though fully legitimate storytelling. For instance, the disembodiment experimented by the macaques should have put them on the way toward the emergence of a denotative proto-language (Montani, 2018; 2019; 2020) if the pragmatic conditions were only created to induce a group of them to cooperation. I contain this development and restrict myself to remark its counterfactual nature as for two aspects. First one, what the macaque 'learnt' to do, as well as the extraordinary consequence it drew, is a performance that the embodied imagination of homo genus 'selected' during several hundreds of thousands of years, bringing it to a very significant degree of adaptive efficacy within the species homo sapiens. Second one, this rather peculiar adaptive development, by the way involved in the emergence of language, is not at all "brain-centric" as argues Noam Chomsky's influential theory of language among others. As a matter of fact, it is not only inseparable from the fact of coevolving with a world-environment that, as we have just seen, shows to be as much contingent, plastic and reorganizable as the former; it is also made in such a way to very closely integrate with the marked 'cooperative attitude' of the living being that has drawn the most spectacular adaptive consequences from it (Arbib, 2005; Corballis, 2011; Ferretti, 2010; Gallese & Lakoff, 2005; Liebermann, 2006; Mithen, 2006; Tattersal, 2008; 2016; Tomasello, 2008) : however, their position cannot be always unified. In other words, the phenomenon of technical distancing must be assumed in a perspective that is decisively characterized by its pragmatic feature. By the latter determination, it must be intended that the

metaoperative practices on which I lastly focused would have no value if they were dissociated from their diffused embodiment, as well as from their happening in cooperation with other individuals in a world-environment that is so reorganized and enriched. I would like to rapidly exemplify the last aspect with a reference to artificial intelligence and the machines capable of deep learning.

We must in particular outline that, once the basic inputs received by an operator are instantiated, these machines are able to learn autonomously, thanks to processes that survey the respective universes of reference, e.g. photographic images as objects of recognition. They resort to procedures of sampling and classification, which have nothing in common with those spontaneously implemented by human beings. As showed Melanie Mitchell (2019) with extreme clarity, this makes these machines extremely vulnerable, at least so far. In other words, they can be easily cheated if they are not put in the condition of acting in particularly stable environments, as much immunized as possible from contingency and unpredictability. Games like chess or Go, being entirely manageable with calculation, serve as an example. Adopting a quite perspicuous distinction (Floridi, 2018), we can say that these machines work better when their world of reference is conformed to the model of the 'envelope', i.e. limited, self-referred and rigidly programed environments, rather than in real environments. In order to have a driverless car that offers the maximum of security guarantees, one should produce them for a web of highways especially designed for their performances. It is an envelope, that is, a tendentially close space, immunized from every contingency as much as possible, saturated of previsional automatisms and therefore deprived of any interactive plasticity. In other words, this space is substantially self-referential. Our future smart cities could be projected on the basis of this principle that brings to the extreme consequences a process of 'anaesthetization' typically connected to the securitarian instances inscribed inside technics, that is, the promise of repair against contingency and unpredictability (Montani, 2007).

At this point, we need to observe that the possibility of a 'self-referential drift' constantly and systematically looms over the metaoperative outcome of technical distancing to which I pointed out in second chapter. As such, indeed, metaoperativity may evolve in the sense of either the reorganization and enrichment of the environment or the automatization and self-referential escalation of the envelope. An 'authentic dialectical opposition' emerges here and concerns the processes of interiorization of technologies in general. An unbiased reflection upon the technical remediation of distances should deal with it at a theoretical level and give confirmation through proper empirical investigations.

DIALECTIC OF THE TECHNICAL REMEDIATION. SOME EXAMPLES

In second chapter I suggested that the most wonderful product of the metaoperative performance our embodied imagination is able to perform was the discovery of the articulated, denotative and componential language, which is capable of recursiveness and reflectivity. I do not aim to come back to this issue, which I discusses elsewhere (Montani, 2018, 2019, 2020a, 2020b). I only want to remark that, amid the most significant properties of articulated language, there is exactly that of 'speaking of itself', that is, assuming its own significations as the object of discourse. It is intuitively evident that this property of language can be constituted in a dialectical opposition. In fact, on the one hand, to assume a signification as the object of discourse allows a more attentive survey of the way linguistic signs refer to the world-environment. It is an exploration and requalification of the very modes of reference (Jakobson, 1985; Ricoeur, 1975; Lakoff & Johnson, 1982). Charles Sanders Peirce (1998) thought exactly of a virtually interminable movement of semantic requalification when he spoke of the sign as "firstness, or the representamen" that refers to "secondness, or the object" in such

a way that "thirdness, or the interpretant" makes the device of signification explicit in a more developed way. Therefore, this is in principle conceived as a re-describable and reorganizable device. On the other hand, however, linguistic semiosis proceeds to contextual disengagement of the order of signification from that of reference while it instantiates this very proceeding of expansion. On the contrary, as pointed out Roman Jakobson (1985), the two orders 'must' be able to dissociate and distance each other if semiosis aims to reorganize. In this way emerges the possibility of a tendential ungluing of language from the world of reference in favor of a play of void cross-references amid the significations. Poetry, as pointed out Paul Ricoeur (1975), is exactly a way of recovering this risk (or desire) of void circularity to sense and reference.

In short and so to speak, an 'autistic' polarity, which is always in the condition of assuming dominance, is in action within the powerful device of metaoperativity. If we assume this point of view, we can sketch a very general partition of the digital devices and distinguish between those which patronize such an autistic drift (envelope-devices) and those which contrast it, either directly or indirectly (environment-devices) (Casetti, 2018; Cecchi, Feyles& Montani, 2018). The most obvious example of the first type of device is that of videogames engendering addiction. Much more interesting is the example that I would like to propose for the second type, also because it presents itself as a successful case of exaptation, at least for certain aspects. I think of the ascertained wellness that a videogame like *Pokémon-go* brought to some autistic kids, who discovered that, thanks to the technically re-mediated distance that derived from it, not only they had no more fear of leaving home, but also desired to do that on autism and digital subsidy (Suskind, 2014). More generally, here emerges the question of social robotics (Dumouchel & Damiano, 2019), as well as the interactive (or even coevolutionary) principles to which it is likely to be able to conform in an increasingly clear way. I do not want at all to generalize

the last frame. I only aim to propose it as an example of the criteria which we should perhaps resolve to adopt, in order to correctly handle the dialectic of metaoperations to which digital technologies induce us to make increasing room. I will bring another two examples.

It seems that it might happen soon that it will be possible to equip human brains with embodied proxy. This proxy will significantly enhance some performances, like the rapidity of calculation. This brain mutation will be naturally acquired only by a very small number of individuals who will be able to afford the extremely high costs of implantation and maintenance. These would so form a close oligarchy of elected, capable not only of challenging a computer in chess match, but also of having access to the ideation of hyper-performant strategies, for instance in the quickness of financial transactions or, more generally, in networking with diversified systems of control –from the survey of 'rich data' to the real-time check of one's own health conditions, up to the disintermediated connection with the internet of things, and so on. For the very fact of being realistic enough, this perspective has the merit of outlining at least two instructive lacks. The first one is its 'neurocentrism': in the way I presented it, indeed, the technical performance at stake overrates by far the power and autonomy of brain, as well as its most immaterial product: calculation. In fact, it dissociates brain from body, the former being actually the "modest tenant" of the latter, as argued the paleontologist André Leroi-Gourhan (1993). Without body, no calculation would have ever been originally available to brain (Malafouris, 2013). On the contrary, we can suppose that, outside the presupposition of 'coevolutionary processes' successfully synchronized with the whole body and the parallel transformations in the human forms of life, the mere implantation of elements of Artificial Intelligence in the synaptic web of a single individual would result into an evolutionary flop, together with the certain madness of the holder of this kind of brain (Pennisi, 2018; Carbone, 2020). It immediately follows the second lack of this perspective, which consists in

'solipsism': the success of technical re-embodiment primarily depends indeed on the fact that it is shared. Elon Musk's chip, in short, would fully be part of the class of envelope-devices, those which lower worldly contingency.

We are likely to say then that we must privilege the three aspects of the diffused re-embodiment, not localized in the brain or elsewhere, the cooperation and the end of the self-referential escalation in any diagnosis of the present state in the (fatal) increase of technical mediations at disposal of our bodies and intersubjective relationships. Here it is the second example: while the experiment of *Google Glass*, the 'smart' glasses designed some years ago, has substantially failed (Montani, 2014; 2017; Carbone, 2020), its simplified version destined to sightless people spread and successfully strengthened itself. I mean the app *Be my Eyes*, thanks to which a volunteer interacts with a sightless person and guides its movements within a space the app downloaded on its smartphone can inspect and share, so assuming the function of a de-localized eye, e.g. individuating an object in a room and giving the sightless person instructions to reach it. Evidently, if, unlike *Google Glass*, this device overcame the Darwinian selection in effect inside the web, it happened because it was spontaneously integrated by both users in a sensorimotor activity and constantly shared. From being an envelope close and hostile, the world where the sightless person moves, with the help of the cooperator who sees together with it, has become an environment. A real environment strengthened by a medial device in its actuality and in its contingency.

CONCLUSIONS

What philosophy assumed, often in an undetermined way, as an ability of distancing that in many aspects would be constitutive of human experience in general can be reformulated in a more rigorous and perspicuous way at the very moment when the government of this 'faculty' received a tech-

nological delegation according to a form, which appeared coactive and degrading to many people. The experiments with Japanese macaques conducted by Atsushi Iriki and his team help us actualize this need of rigor and perspicuity. They are indeed 'rigorous' experiments as far as they let us: i. outline in the phenomenon of distancing the emergence of a 'metaoperative' component inside the agency of a body that had not it before; ii. ascertain that this emergence considerably extends not only the control this body has on space, but also the ability of exerting effective and creative strategies. Furthermore, they are 'perspicuous' experiments as far as they highlight a 'non-extrinsic link' between the behavior of an acting integrated body and the intervention of a technological mediation. In particular, it appears that a technical device is able to mediate a process of disembodiment to which follows a feedback capable of implementing a general reorganization of that body's agency within an environment richer in contingency, with which one can come 'in touch'. The conclusions the apology sketched here can draw are significant.

Firstly, we must suppose that, during the evolution, the human being's 'embodied imagination' spontaneously got the metaoperative and recursive competence the macaque produced –spontaneously too: let us not forget this qualifying point– only thanks to a particularly unnatural mediation, which was coercive for its behavioral standards. In this way, the human being's embodied imagination shows of having got huge adaptive advantages from its intrinsic ability of extending into a technology. Thanks to this process the human body has never stopped taking new distances from itself and from the world. This distancing again and again relaunched, belongs to the very 'nature' of the human body. Articulate language, when it emerged, was only the most spectacular of those procedures of distancing.

Secondly, we must outline how far the specific phenomenon of the technical externalization is determining here. It is indeed a process of which we would fail to grasp the essence if we were to intend it according to Chomsky's

model of a competence that is just performed. It is rather true that attention must focus on the 'feedback' that the level of the externalized performance never stops exerting on the mode of being of the competence itself. In this case, it is highlighted by the fact that this feedback can be realized only through the dialectical opposition described in the third and fourth chapters. Thirdly, this allows us to clarify the object of the present apology. The latter is not concerned with merits and deficiencies of distancing –or transcendence, philosophically speaking– 'as such'. It is rather concerned with the ability of 'reorganizing the world of contingency' –the world we are 'in touch' with –when distancing itself is delegated to a technology in a more intensive or even prescriptive way. From this point of view, I indicated three general criteria which can allows us to prevent our environment from reducing its contingency: 1. The diffused –and not localized, in the brain or elsewhere– re-embodiment; 2. The increase and requalification of cooperativity and its forms; 3. The constant critical vigilance over the self-referential directories the feedbacks of the technological extensions always make viable.

NOTES

1 Remark that in Latin 'contigent' means '*quod mihi contingit*': what touches me, what concerns me.

REFERENCES

Arbib, M. (2005). From monkey-like action recognition to human language: An evolutionary framework for neurolinguistics. *Behavioral and brain sciences*, *28*(2),15-24.

Carbone, M. (2020). Da corpi con protesi a corpi come 'quasi protesi'? Ágalma, 40. Retrieved November 20, 2020 from http://www.agalmarivista.org/articoli-uscite/mauro-carbone-da-corpi-con-protesi-a-corpi-come-quasi-protesi/

Casetti, F. (2018). Mediascape. A Decalogue. In S. de Silva, D. Furioso & S. Jaff (Eds.), *Perspecta 51, Medium* (pp. 21-43). Boston, MA: MIT Press.

Cecchi, D., Feyles, M., & Montani, P. (Eds). (2018). *Ambienti mediali*. Milano IT: Meltemi.

Corballis, M. (2011). *The Recursive Mind: The Origins of Human Language, Thought, and Civilization*. Princeton, NJ: Princeton University Press.

Dumouchel, P., & Damiano, L. (2019). *Vivere con i robot*. Milano, IT: Cortina.

Ferretti, F. (2010). *Alle origini del linguaggio*. Roma-Bari, IT: Laterza.

Floridi, L. (2018). What the Near Future of Artificial Intelligence Could Be. *Philosophy & Technology*. doi.org/10.1007/s13347-019-00345-y.

Gallese, V. (2009). Neuroscienze e fenomenologia. In *Treccani. XXI secolo*. Retrieved November 20, 2020 from http://www.treccani.it/enciclopedia/neuroscienze-e-fenomenologia_(XXI-Secolo)/

Gallese, V., & Lakoff, G. (2005). The Brain's Concepts: The Role of the Sensory-Motor System in Reason and Language. *Cognitive Neuropsychology*, 22, 455-479.

Garroni, E. (1977). *Ricognizione della semiotica*. Roma, IT: Officina.

Garroni, E. (1986). *Senso e paradosso*. Roma-Bari, IT: Laterza.

Garroni, E. (2005). *Immagine, linguaggio, figura*. Roma-Bari, IT: Laterza.

Garroni, E. (2020). *Estetica. Uno sguardo-attraverso*. Roma, IT: Castelvecchi.

Greimas, A. J., & Courtès, J. (1993). *Sémiotique. Dictionnaire raisonné de la théorie du langage*. Paris, FR: Hachette.

Jakobson, R. O. (1985). *Poetica e poesia*. Questioni di teoria e analisi testuale. Torino, IT: Einaudi.

Lakoff, G., & Johnson, M. (1982). *Metaphors we Live by*. University of Chicago Press, IL: Chicago.

Leroi-Gourhan, A. (1993). *Gesture and Speech*. Cambridge-London, UK: MIT Press.

Lieberman, P. (2006). *Toward an Evolutionary Biology of Language*. Cambridge, MA: Harvard University Press.

Malafouris, L. (2013). *How Things shape the Mind*. Cambridge, MA: MIT Press.

Maravita, A., & Iriki, A. (2004). Tools for the Body (Schema). *Trends in Cognitive Sciences*, 8(2), 79-86.

Mitchell, M. (2019). *Artificial Intelligence: A Guide for Thinking Humans*. New York, NY: Farrar, Straus and Giroux.

Mithen, S. (2006). *The Singing Neanderthals. The Origins of Music, Language, Mind and Body*. Cambridge, MA: Harvard University Press.

Montani, P. (2007). *Bioestetica*. Roma, IT: Carocci.

Montani, P. (2014). *Tecnologie della sensibilità*. Milano, IT: Cortina.

Montani, P. (2018). Sensibilità, immaginazione, linguaggio. Processi di interiorizzazione e cultura digitale. *Bollettino della Società filosofica Italiana*, 3, 25-41. doi: 10.23816/92265

Montani, P. (2019). Technical Creativity, Material Engagement and the (Controversial) Role of Language. *Aisthesis*, 12(2), 27-37.

Montani, P. (2020a). The Imagination and its Technological Destiny. *Open Philosophy*, 3(1), 187-201.

Montani, P. (2020b). *Emozioni dell'intelligenza. Un percorso nel sensorio digitale*. Milano, IT: Meltemi.

Peirce, C. S. (1998). *Sundry Logical Conceptions*. In *The Essential Peirce. Selected Philosophical Writing* (vol. II, pp. 267-288). Bloomington, IN: Indiana University Press. (Original work published 1893-1913).

Pennisi, A. (2018). *I vincoli bio-evoluzionistici dell'immaginazione interattiva*. In D. Cecchi, M. Feyles, P. Montani (Eds.), *Ambienti mediali* (pp. 69-87). Milano, IT: Meltemi.

Ricoeur, P. (1975). *La métaphore vive*. Paris, FR: Seuil.

Suskind, R. (2014). *Life, Animated: A Story of Sidekicks, Heroes, and Autism*. Los Angeles, CA: Kingswell.

Tattersall, I. (2008). *The World from Beginnings to 4000 BCE*. Oxford, UK: Oxford University Press.

Tattersall, I. (2016). Language Origins: An Evolutionary Framework. *Topoi, 37*, 289-296. doi:10.1007/s11245-016-9368-1

Tomasello, M. (2008). *Origins of Human Communication*. Cambridge, MA: MIT Press.

ADDITIONAL READINGS

Condemi, S., & Savatier, F. (2019). *Noi siamo sapiens*. Torino, IT: Bollati Boringhieri.

Everett, D. (2017). *How Language began. The Story of Humanity's Greatest Invention*. London, UK: Profile Books.

Fitch, W. T. (2010). *The Evolution of Language*. Cambridge, MA: Cambridge University Press.