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Bodies in Place

Enactive cognition as development of ecological norms

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Résumé

Les partisans de l'approche énactive soutiennent que la cognition se constitue à travers l'histoire des différentes formes d'interaction (biologique, sensorimotrice, intercorporelle, linguistique, etc.) entre un vivant et son environnement. Ces interactions ne sont pas aléatoires, mais des activités obéissant à certaines normes que les énactivistes appellent *sense-making*. La cognition est, de ce point de vue, une forme de *sense-making*. Malgré les avantages indéniables que confère une telle perspective pour étudier la cognition, la présente thèse développe un point de vue critique par rapport à l'approche énactive et soutient qu'il est nécessaire d'approfondir notre compréhension de la dimension écologique du *sense-making*. Le but principal de la thèse est en conséquence de montrer que l'environnement joue un rôle encore plus important que l'approche énactive ne lui attribue habituellement. En m'engageant de manière critique dans le répertoire conceptuel de la cognition énactive, de la phénoménologie et des approches écologiques de la cognition, l'objectif de cette thèse consiste à poser les bases conceptuelles d'une approche énactive-écologique de la cognition. Pour ce faire, la thèse s'attèle à mettre de l'avant trois idées principales. La première consiste à redéfinir le concept du *sense-making* : contrairement à la conception qui s'est traditionnellement imposée dans le mouvement énactif, nous allons démontrer qu'il s'agit d'un phénomène de *développement* (et non de création) de normes. La rencontre du corps et du monde est toujours ancrée dans un champ normatif prédéfini, de sorte que nous devons réévaluer le rôle que joue l'environnement dans les processus de *sense-making*. En effet, si les agents se retrouvent toujours-déjà plongés dans un champ normatif (et non dans un environnement purement causal et physique), il faut alors reconnaître que l'environnement joue un rôle *actif* dans la constitution et l'auto-transformation des normes de *sense-making*. La deuxième idée poursuit dans cette veine et porte sur cette nouvelle conception de l'environnement, qui est ici défini comme un champ normatif actif, incarnant une tension entre le passé habituel du système agent-environnement et les contingences incessantes des événements du monde qui poussent le système vers leur auto-transformation et développement. La troisième idée principale de cette thèse consiste en une description holistique du champ d'action des agents (un lieu énactif) et des normes édictées (*enacted*) par des processus de *sense-making* sur le terrain (normes de lieu). Une esquisse générale du lieu énactif montre que les activités de *sense-making* sont liées à des processus écologiques qui enchevêtrent de multiples agents et localités matérielles dans un réseau écologique local. Ces réseaux écologiques forment une unité systémique et résiliente qui se déploie dans le temps avec les habitants du lieu, et fonctionne comme un champ normatif qui contraint et motive l'auto-transformation de chaque système agent-environnement.

Mots-clés : Approche énactive, Phénoménologie, Psychologie écologique, Énaction, Sense-making, Autonomie, Niveaux spatiaux, Merleau-Ponty, Affordances, Lieu.

Abstract

Supporters of *autonomist enactivism* or the *enactive approach* claim that cognition is a phenomenon constituted by the historical development of different forms of interaction (biological, sensorimotor, intercorporeal, and linguistic) between living bodies and their environments. For autonomist enactivists, the nature of these interactions is not entirely predetermined by general laws of causation but by norms enacted in the historical path of the agent-environment system, and thanks to processes of *sense-making*. Cognition is, from the enactivist standpoint, a form of sense-making. While there are multiple advantages in holding such perspective to study mind and cognition, this thesis develops a critical point of view and argues that it is necessary to deepen our understanding of the *ecological* dimension of sense-making. Specifically, the thesis aims to show that the environment plays a more critical role than autonomist enactivism usually attributes to it. By drawing on and critically engaging with the conceptual repertoire of enactive cognition, phenomenology, and ecological approaches to cognition, my objective is to set the conceptual foundations for an *enactive-ecological* approach to cognition. For this task, I propose three interrelated ideas. The first redefines sense-making as a phenomenon of *norm development*. The most common descriptions of sense-making involve the emergence of meaning from raw physical matter thanks to the activity of living organisms. As norm development, by contrast, sense-making refers to a constant enactment and re-enactment of norms of interaction from other pregiven norms, previously enacted in the past of the agent-environment system. I argue that the encounter of the body and the world is permanently embedded in a pregiven normative field and never in an abstract void where raw physical interactions occur. From this standpoint, we need, however, to re-evaluate the role that the environment plays in sense-making processes. If agents find themselves immersed in normative fields and not in raw physical landscapes, then the environment has a more active role for the constitution and self-transformation of sense-making norms than autonomist enactivists have acknowledged. In this vein, the second main idea of this thesis concerns *the environment as an active normative field* that incarnates a tension between the habitual past of the agent-environment system and the ongoing contingencies of worldly events that push the system to their self-transformation and development. The third main idea of this thesis consists of a holistic description of the field of action of agents (*enactive place*) and the norms enacted by processes of sense-making in the field (*place-norms*). A general sketch of enactive place shows that sense-making is tied to processes that entangle multiple agents and material localities into a local ecological web. An enactive place constitutes a systemic and resilient unity that unfolds in time altogether with its inhabitants, working as a normative field that constrains and motivates the self-transformation of each agent-environment system. Bodies are therefore part of wider unities of historical development: places.

Keywords: Enactive approach, Phenomenology, Ecological psychology, Enaction, Sense-making, Autonomy, Spatial levels, Merleau-Ponty, Affordances, Place.

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Abbreviations for Frequently Cited Works

EcApVsPr: Gibson, James J. 2015. *The Ecological Approach to Visual Perception*. New York, NY: Psychology Press. 1979.

EcEvAf: Rietveld, Erik, Damiaan Denys, and Maarten Van Westen. 2018. "Ecological-Enactive Cognition as Engaging with a Field of Relevant Affordances." In *The Oxford handbook of 4E cognition*, edited by Albert Newen, Leon De Bruin and Shaun Gallagher, 41-70. Oxford, UK: Oxford University Press.

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LngBod: Di Paolo, Ezequiel A., Elena Cuffari, and Hanne De Jaegher. 2018. *Linguistic Bodies: The Continuity between Life and Language*. Cambridge, MA: MIT Press.

MndLf: Thompson, Evan. 2007. *Mind in Life: Biology, Phenomenology, and the Sciences of Mind*. Cambridge, MA: Harvard University Press.

PhP: Merleau-Ponty, Maurice. 2012. *Phenomenology of Perception*. Translated by Donald Landes. New York, NY: Routledge. 1945.

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À Gina

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Introduction

Bodies in Place is about the roles the body and the environment play in the constitution of cognitive phenomena, especially in perception and motor action. The thesis I defend follows the path traced by *the enactive approach* to cognition (*EmMnd*; Di Paolo and Thompson 2014), sometimes named *autonomist enactivism* (Barandiaran 2017, 413).[1] The core idea of this enactive approach is that cognition is rooted in the dynamic constitution of living, sentient, and affective bodies, and the material, sensorimotor, intersubjective, and linguistic interactions these bodies maintain with the environment and with others (*MndLf*; *LngBod*). While there is much to retain from this approach, the thesis develops a critical point of view and argues that it is necessary to deepen our understanding of the *ecological* dimension of enactive cognition. Specifically, the thesis shows that the environment plays a more critical role than autonomist enactivism usually attributes to it. The entanglement of the body and the world in cognition is more profound and thicker than this or any other form of cognitive science has acknowledged. Bringing this entanglement to light will help us see cognition as an ecologically situated phenomenon. By drawing on and critically engaging with the conceptual repertoire of enactive cognition, phenomenology, and ecological approaches to cognition, my objective is to see more clearly into this issue and set the conceptual foundations for an *enactive-ecological* approach to cognition.

Enactive cognition is a cognitive science research program that rejects the main assumptions of the predominant view within cognitive science today. We can call this view *brain-centred cognitive science* (1.1) because it locates the relevant causal processes underlying human cognition solely in the brain (Anderson 2007; e.g., Adams and Aizawa 2008; Metzinger 2009). This idea is usually supported by the claim that cognition is a computational function of information processing since

[1] This approach is more commonly known as "autopoietic enactivism" (see e.g., *RadEn*). I do not use this label because it has been explicitly rejected by its supporters (e.g., Thompson 2018). The label "autopoietic" is confusing and misleading, since *the theory of autopoiesis* (Maturana and Varela 1980, 1994) inspires but does not exhaust the conception of life and mind described by the enactive approach (see Di Paolo and Thompson 2014). The theory of biological *autonomy*, by contrast, defines more properly the theoretical core of this approach (cf. Barandiaran 2017 see also 2.4).

it is possible to model many cognitive and brain processes computationally, and find significant correlations between the two (Piccinini and Bahar 2013; Rescorla 2017). This view is, however, problematic both for science (1.2) and philosophy (1.3, see also 2.1), and that is why enactivists propose alternative theories to conceive, explain, and study cognitive phenomena (1.4), based on the idea that cognition is essentially a form of enaction (*EmMnd*; *RadEn*; *EnInt*).

The standard definition of enaction in cognitive science rests on two essential claims (2.2). The first holds that cognition originates in the establishment of regular patterns of sensorimotor interaction between cognitive agents and their surroundings (2.3), while the second argues that any form of cognition is always grounded in these sensorimotor patterns (see, e.g., *EnMnd*; *MndLf*; *EnInt*; *EvoEn*). Defenders of the most original and radical form of enactivism – autonomist enactivism– go even further, claiming that cognition is a form of *sense-making* (2.4) and attributing the origins of sense-making to the biological autonomy of cognitive agents (*MndLf*).

The theory of biological autonomy in autonomist enactivism defines living systems as dynamical systems (2.4). However, the physical constitution and behaviour of living systems cannot be entirely determined by causes external to its own dynamical constitution, as with other dynamical systems (*MndLf*). Instead, living systems constitute a network of interdependent processes that make them autonomous or partially independent of causal processes that occur topologically outside the network (Di Paolo and Thompson 2014). To maintain this network, however, living systems need to interact with the environment, but they do so according to what is relevant for their organizational states and developmental constitution (*MndLf*). Therefore, we can say that, for autonomist enactivism, living beings are autonomous systems that behave and develop according to norms enacted by their own developmental and behavioural histories (cf. Di Paolo and Thompson 2014).

The autonomy of living organisms makes them sensitive to specific aspects of their surroundings, whose relevance is determined by the states of organizational equilibrium of the body and the norms of environmental interactions that this body undertakes to maintain the viability of this equilibrium. Therefore, the environment is disclosed as a realm of possibilities for actions that can potentially transform (for good or for ill) an organism's organizational bodily states (Di Paolo

2005). Autonomist enactivists call this disclosure of the environment, according to norms enacted by autonomous systems, *sense-making* (Di Paolo and Thompson 2014).

At the biological level, metabolism is the most basic form of sense-making (*MndLf*). This is because all organisms normatively select and interact with features of the environment that are good or bad for the metabolic activity of their bodies. It is at the basic levels of sensorimotor interactions, however, that cognition begins (Barandiaran 2017).

In sensorimotor interactions, the body self-organizes to interact with the environment to perform different sorts of activities (Thompson 2005; *MndLf*). These activities can be based on purely biological needs (e.g., looking for food or shelter), or they may be rooted in the goals and interests of sociocultural practices (e.g., making pottery or playing piano). Although the sensorimotor self-organization of living organisms always depends on their biological self-organization, the former is not reducible to nor entirely determined by the latter. The autonomy and sensitivity of life are necessary to modulate the sensorimotor interactions of living agents, and consequently, the norms of life always constrain sensorimotor norms (3.2). However, the self-organization of the sensorimotor body is based on a new level of autonomy that emerges from the acquisition of bodily habits (Egbert and Barandiaran 2014; *SmLf*). The sedimentation of regular patterns of sensorimotor interactions both in the body and in the environment constitutes a sensorimotor identity and a sensorimotor environment for living agents that diverges from a purely biological nature (Di Paolo 2009; Thompson and Stapleton 2009). This sensorimotor level constitutes the most basic forms of cognition as cycles of action and perception (*SmLf*). Sensorimotor interactions with the environment also include interactions with other agents. These interactions can produce emergent self-organization processes between two or more organisms, thereby establishing new levels of autonomy and normativity for the participants of an intercorporeal coordination (De Jaegher and Di Paolo 2007; Froese and Di Paolo 2009). This intercorporeality is the basis of human sociocultural bodily and linguistic practices (Cuffari, Di Paolo, and De Jaegher 2015; *LngBod*) and enables the development of more complex and abstract forms of cognition (Di Paolo 2016; *SmLf*; *LngBod*).

Therefore, as for any other sort of enactivism, autonomist enactivism supports the claim that all forms of cognition are grounded in sensorimotor activity, but in contrast to other enactivisms, this approach founds the constitution of sensorimotor activity in the autonomy of life (2.4). For autonomist enactivism, there is thus a deep continuity between mind and life (*MndLf*; Froese and Di Paolo 2009).

The descriptions of biological autonomy and sense-making imply that living beings are sentient and affective beings (Thompson 2004; Colombetti and Thompson 2008; Colombetti 2014). This means that what affects or what matters to a living organism produces a response according to its own bodily states and skills. We may not know for sure about the kind of experience that simple organisms like cells and bacteria have, or if they have any sort of experience at all. We can observe nonetheless that organisms do not respond like any mechanical system we know (Juarrero 1999; Froese and Stewart 2010).

The most impressive form of artificial intelligence developed thus far responds to the world with rules of behaviour that can be either preprogrammed or learned from interactions with its surroundings (Froese and Ziemke 2009). These responses are increasingly astonishing and may deceive us about the nature of these artificial systems. Still, as Sophia, the humanoid robot of Hanson robotics, declared about itself, it has no motivations, emotions, or values on its own. All these features of Sophia instead mirror the values and interests of its creators (cf. Robbins 2020). By contrast, even the simplest form of life, with a repertoire of behaviours and responses that seems insignificant from our perspective, is guided by affectivity and motivations that emerge from its autonomous organization and its concrete and individual existential concerns (Jonas 1966; Weber and Varela 2002).

If cognition is rooted in the autonomy of life and its primary forms of sense-making, then, on this view, the intrinsic sentience of living organisms entails that a cognitive agent has a minimal form of subjective experience (Thompson 2004; *MndLf*). For this reason, autonomist enactivists have held that our scientific study of cognition must be complemented by a careful and methodological analysis of subjective experience (*EmMnd*). One of the key pillars supporting such an analysis has been the philosophical tradition of phenomenology (2.1).

Phenomenology has influenced autonomist enactivism and the whole field of enactive cognition in many ways (Gallagher and Zahavi 2007; Gallagher and Schmicking 2010). The most radical aspect of phenomenology is how it questions through a systematic analysis of our conscious experiences the belief that the world is in itself as it appears to us in such experiences (see, e.g., Husserl 1999, 1982). For instance, when scientists and philosophers conceive the world as constituted by solid objects that interact causally to produce all sorts of events in the world, including our own experience of this world. This is, for phenomenologists, a theoretical prejudice that Merleau-Ponty (*PhP*, 5) called *the prejudice of the ready-made world* (*le préjugé du monde*). This prejudice has prompted scientists and philosophers to understand their work as simply explaining how this ready-made world works (e.g., Hacking 1983). Such assumptions about the external world were established by modern traditions of Western philosophy (Cartesianism and empiricism remarkably) and have been uncritically accepted by most scholars of brain-centred cognitive science (Wheeler 2005; Rowlands 2010). Unfortunately, such assumptions have caused significant philosophical and empirical problems explaining mental phenomena in all sciences of mind, including cognitive science (Dreyfus and Dreyfus 2000; Dennett 1991).

Phenomenology has questioned many of the unwarranted presuppositions of these modern philosophical traditions (2.1, see also 3.3) and has done so based on a systematic examination of consciousness and experience (Husserl 1982). The phenomenological analysis of consciousness has motivated the claim of autonomist enactivists that science, as a cognitive practice, is always bodily and cultural (Husserl 1970; Merleau-Ponty 1964a, 1964b). For this reason, science always shows phenomena according to the embodied and enculturated experience of its practitioners, and never simply as the world is in itself (2.1). This claim does not deny the possibility of scientific knowledge; it instead recognizes the limits and contingencies of science and provides us with conceptual and methodological tools for studying cognition empirically (Thompson 2016).

Conceptually, phenomenology has provided a network of concepts and phenomenological analyses (e.g., time-consciousness, the body schema, motor intentionality, empathy, etc.) that have helped enactivists to construct their own conceptual repertoire for defining cognition as a bodily process that takes place in highly contingent environments (Gallagher and Zahavi 2007). In addition, the phenomenological method has guided the development of new experimental conditions, where systematic accounts of subjective experiences contribute to the corroboration, refutation, and refinement of theoretical hypotheses (e.g., Varela 1999b).

Perhaps the most crucial contribution of phenomenology to cognitive science lies in the holistic and contextualized studies of cognitive phenomena in the field. On this score, phenomenologists stand in sharp contrast with mainstream philosophers and scientists of the mind, who usually enclose these phenomena in highly controlled environments (cf. *SpPlc*). Although this methodology is helpful for sciences such as physics, chemistry, and molecular biology, there are no guarantees that the same methods can also be successfully applied to study specific aspects of cognition. For example, the engineer Rodney A. Brooks (1991, 1999) and the cognitive anthropologist Erwin Hutchins (1995) have shown how the study of cognition in the lab conceals the many contingencies sensorimotor agents face in real environments and, in the case of humans at least, the deep entanglement of brain, bodily, environmental, and social processes. Phenomenology has proved to be very successful in advancing our understanding of this. One reason for this is that phenomenology analyses cognitive phenomena as they happen *in the world* rather than in the poor experimental environments of the labs. As worldly phenomena, cognitive events are permanently embedded in structures of meaning (horizons) that are constituted historically (e.g., Heidegger 1962) and at multiple temporal scales (*EnInt*). Without considering these horizons, it would be impossible to understand our experience of specific objects and events (Husserl 2001a; *PhP*).

Building on the holistic perspective developed by phenomenology, autonomist enactivism offers one of the richest and most accurate scientific accounts of cognition. One of the most relevant and distinctive contributions of autonomist enactivism is the scientific support it provides for the claim that there is no ready-made world over and above our bodily and cultural experience of it (*EmMnd*). The theory of biological autonomy and the definition of cognition as a form of sense-making recognize that only what is significant or relevant for our bodily and cultural history is part of our cognitive world (*MndLf*). Therefore, any claim we make of the world is necessarily entangled within this history (Thompson 2016), which seems to be highly contingent and cannot be understood in advance to its own unfolding (*EmMnd*).

From this standpoint, the challenge for constructing a robust enactive cognitive science lies in the proper recognition and description of all the constitutive aspects of cognition that result from the body and world entanglement. While autonomist enactivism constitutes, in my view, one of the most advanced approaches in the study of cognitive phenomena, the critique to the effect that this approach tends to neglect the role of the environment is by and large justified (e.g., McGann 2014b). However, the critique is not fatal; somewhat, autonomist enactivism suffers these shortcomings due to an imprecise definition of sense-making (3.1). One of the goals of the present thesis is to correct this flaw and propose an alternative conception.

According to the standard description, sense-making is the activity of living beings who "chang[e] the psychochemical environment into an environment of significance and valence" for them (*MndLf*, 147). In so doing, they "establish[e] a perspective from which interactions with the world acquire a normative status" (Di Paolo and Thompson 2014, 73). The problem I see with such descriptions is that they suggest the pre-existence of a (ready-made) world. This world is value-neutral and purely physical, but that nevertheless acquires meaning, form, and value thanks to the autonomous actions of living beings (cf. De Jesus 2018). A paradigmatic example of this interpretation is supplied by E. Coli bacteria, which swim towards glucose. These bacteria are said to find a (neutral value) chemical compound that *becomes* a nutrient (significant or value-laden) for these same bacteria only through these metabolic and behavioural interactions (*MndLf*; Di Paolo, Rohde, and De Jaegher 2010).

Defining sense-making as the transformation of a purely physical and lawful world into a significant and normative one has prompted both misunderstandings and criticisms of autonomist enactivism. The most common criticisms see autonomist enactivism as a new form of either idealism (Kiverstein and Rietveld 2018), constructivism (De Jesus 2018), or internalism (Wheeler 2010). Therefore, the first central aim of this thesis is to show that typical definitions of sense-making by autonomist enactivists are misleading (3.1).

For practical purposes, we can sometimes claim that the physical environment constrains the development and behaviour of cognitive agents. But as I will argue, sense-making entails that the enactment of norms constrained by a pregiven field is also normative and does not proceed directly from a meaningless physical world (3.2). Thus, the environment that cognitive agents encounter is not the raw physical environment described by physics and chemistry, but a field constituted by normative constraints enacted in agents' ontogenetic and phylogenetic past. If this is so, then sense-making is a process of development of norms incarnated in the temporal unfolding of the agent-environment system, and not the constitution of a normative domain proceeding from a purely physicochemical one.

My second aim is to show that the environment, from an enactivist standpoint, should not be seen as a mere set of physical constraints (4.1), but more as a normative field of constraints that limits but also motivates the emergence of new forms of sense-making (4.2). The deep entanglement of the body and the world that we may read in the definition of the environment as a normative field makes the role of the environment even more important and more active than autonomist enactivists usually recognize. From this new perspective, the environment has more coincidences with the accounts given by followers of the ecological approaches to cognition, starting with Gibson's ecological psychology (4.3).

Like enactive cognition, Gibson (*EcApVsPr*) rejected the assumptions of brain-centred cognitive science, especially those supporting its typical explanations of visual perception. For brain-centred cognitive science, perception is a function that simply recreates in the mind the external features of the environment from the stimuli provided by sensorial organs (cf. Marr 1982). In vision, for instance, our brains need to create a rich visual representation of the environment from the two retinal images in our eyes, caused by the chemical reaction of photosensors to different frequencies of wavelength (Gordon 2004). Internal representations are used to explain how our visual systems obtain necessary information about the environment from sensory information that appears flawed and disarticulated in sensorial organs (e.g., retinal images). Scholars of brain-centred cognitive science believe that computational processes at different scales of organization are required to construct accurate representations of the world (e.g., Marr 1982).

For Gibson (1966; *EcApVsPr*), the representational model of perception is incorrect because stimuli provide no visual information at all. Consequently, Gibson holds that our head does not need to recreate the outside world from these stimuli. Instead, for Gibson, information is already available in the environment, and perceivers only need to pick it up. For example, light as such is not an informational source. Only when it is spread out in mediums and reflected on surfaces does light becomes informational. The reflected light has a particular structure due to the characteristics of the environment it illuminates, not because of the intrinsic properties of light. Subjects can access this information only if they can move back and forth, thereby uncovering the variant and invariant features of reflected light (*EcApVsSPr*). Thus, *ecological information* in vision is a *relational* aspect of the environment, one that correlates the locomotion of perceivers with the variant-invariant structure of an illuminated environment.

Ecological information thus constitutes the first layer of the perceptual field and allows agents to disclose a second ecological layer: *affordances* or possibilities for action. Affordances are defined by Gibson (*EcApVsPr*) as what the environment affords for good or for ill for an organism. For example, a hole in the ground affords shelter for one animal and a dangerous trap for another. There are, therefore, affordances of shelter-ability and trap-ability in the hole. These affordances are not properties of the hole as such, but are relational aspects of the hole for the actions of animals. For Gibson, perception of affordances depends on the existence of ecological information, that is, on a relational field of the animal-environment system that works as a pre-given field for the perception of affordances.

While Gibson's concepts of ecological information and affordances were perhaps too odd and ambiguous for the scientific frameworks of his time, what he termed ecological information is now better understood. It means, roughly, sensorimotor correlations, and it is possible to show with statistical evidence that these correlations exist (i.e., as a reliable prediction) independently of the actual presence of an animal (e.g., Turvey et al. 1981; Bruineberg, Chemero, and Rietveld 2018).

Defining affordances more specifically than possibilities for action has also been challenging for ecological psychologists because the relational character of affordances makes the task of situating them in the categories of our traditional ontologies somewhat complicated (Sanders 1997). Some of Gibson's followers have defined affordances as properties that exist as *dispositions* of the animal-environment system (Turvey 1992; see also Heras-Escribano 2017). Others define affordances as *emergent properties* of this system (Stoffregen 2003). For many ecological psychologists, affordances were considered instead as relations between solid things (the animal's body and physical objects, e.g., Michaels and Carello 1981; Warren 1984). For Anthony Chemero (2003; *RadEmCS*), affordances are also *relations* but between the bodily skills of an animal and the situational features of its environment. That is, affordances, in this latter definition, appear only for animals with the required skills to exploit them in the proper context of action (cf. *RadEmCS*, 139-140). This definition is promising, for it understands affordances as dynamical aspects of the animal-environment relational system. Since the conditions of the environment and the bodily skills of animals are subject to continuous change, the layers of affordances in the environment also change. Chemero thus brings Gibson's ecological school closer to the claims of autonomist enactivism (4.4). If affordances are perceived only by animals with the required bodily skills, then affordances are a matter of an animal's development. Rather than being pre-given in the environment, affordances might thus be seen as significances enacted in the developmental history of animals, that is, as the result of processes of sense-making (cf. *MndLf*).

Recent work on the skilled intentionality framework, carried out by followers of the ecological approach, has updated Chemero's dynamical account of affordances and has made two important distinctions (5.2). The first makes explicit the difference between relevant affordances or *solicitations* (affordances soliciting the action of perceivers in a specific context) and bare affordances (the whole set of possibilities for action perceivable in the environment for a particular type of agents). The second distinction classifies affordances between sociocultural and natural affordances. The first type of these affordances is useful to satisfy the norms of action of a sociocultural practice. The second set of affordances helps agents to perform actions that meet the biological requirements or the personal interests of individuals (i.e., natural affordances) (Rietveld and Kiverstein 2014; see also Ramstead, Veissière, and Kirmayer 2016). These two distinctions are crucial, for they mark out the ongoing differences between ecological approaches and autonomist enactivism.

Solicitations are closer to Chemero's definition of affordances because they are context-relative, and this context involves both the perceiver's development and the variable conditions of the environment. For the skilled intentionality framework, only those perceivers who are affectively attuned to the affordances in the environment are sensitive to relevant affordances (Bruineberg and Rietveld 2014). By contrast, affordances as such are best understood as relations that exist independently of these contingencies. As long as we can recognize correlations between patterns of action and specific aspects of the environment in a cultural or natural group, these affordances become part of the landscape or the niche of the group (*EcEvAf*). Consequently, all individuals of the group can, in principle, access the same affordances. By this account, affordances are therefore subject-independent, and it is only the perception of affordances that is contingent.

From the skilled intentionality framework perspective, we see that affordances and the origin of these affordances are subject-independent. The most typical description of the skilled intentionality framework is based on social norms of action and perception. These norms determine the proper accomplishment of actions, and consequently, the correct perception of the affordances needed to perform them. For the skilled intentionality framework scholars, the constitution of these norms depends on explicit or implicit public agreements that individuals simply follow (Rietveld and Kiverstein 2014). Learning these norms attunes the body to the relevant affordances of the social practice (Bruineberg and Rietveld 2014). Unfortunately, the origin of natural affordances is not yet sufficiently explained by the supporters of the skilled intentionality framework. Still, recent studies suggest that processes of natural selection are the underlying causes of the relational landscape of natural affordances, following Reed's proposal for an evolutionary explanation of affordances (see, e.g., Rietveld and Kiverstein 2014; Bruineberg, Chemero, and Rietveld 2018).

As we can see from this brief overview, ecological approaches seem to offer richer accounts of the environment than those provided by autonomist enactivism. Ecological approaches understand the environment not as a raw physicochemical domain, but as a constituted relational field of sensorimotor structures and/or practical meanings or affordances. Situating agents in a relational field implies a deeper entanglement of the body and the world than the one indicated by the encounter of an autonomous system and a bare physicochemical environment. However, ecological approaches fail to acknowledge the importance of development for the constitution of the relational, ecological field (5.2).

Although the phylogenetic past of agents is undoubtedly crucial for determining the relations possible between an organism and its environment, their development and autonomous behaviour are also fundamental for recreating and renovating the ecological field (cf. Walsh 2018). Organisms deal with contingencies in the environment and must adapt their bodies and behaviours to new environmental circumstances in the course of their development (Griffiths and Gray 1994). Their interaction with other agents can enlarge the number of constraints and enable the appearance of new affordances (see, e.g., Reed 1996, 107-110).

If affordances are indeed dynamical and contingent, it could be more proper to say that agents enact the meaning of affordances, instead of becoming attuned to a pre-established set of relations. This does not deny that we may find statistical correlations between patterns of behaviour and features of ecological niches, thereby studying affordances as though they were subject-independent features of the world. However, if the emergence of affordances and our corresponding perception is dynamic and contingent and dependent on individuals' developmental and autonomous processes, we need a better understanding of their processes of constitution and transformation. This analysis needs to occur at a "deeper level" of the body-world entanglement. At this deeper level, we stop presupposing the relation of the body and the world as an attunement of two separated entities. Instead, we see the body and the world as always coupled or entangled in the same historical path; *what we rather seek after is the process of transformation and constant reconstitution of this entanglement*.

The transformation of this body-world entanglement from the enactive perspective I propose here consists of the transformation of norms enacted by processes of sense-making. As I understand the term, sense-making is enacting new norms from pre-given norms (3.2). According to this definition, the environment appears as an active normative field (4.2), like the one described by ecological approaches (4.3), not as a passive (i.e., merely physical) landscape as autonomists have it. The main goal of this thesis is to shed light on the dialectical process that transforms the body-world entanglement. Merleau-Ponty's phenomenology, and particularly his phenomenological account of levels (3.3), is central to describe this process of transformation, which is a process of *norm development* (3.4).

The concept of *levels* (*niveaux*) in Merleau-Ponty's *Phenomenology of Perception* (*PhP*; see also 2011) describes the already established norms that gear our bodies to the surrounding world (Talero 2005). The attunement of our bodies and the environment is usually observed in our interactions with specific items of the environment, such as things and affordances. Levels, however, refer to more primary structures of the world that work as anchorage points for our bodies and enable our recognition of affordances. Thus, levels are close to the descriptions of ecological information in Gibson's work (cf. Casey 1991; see also Morris 2004). However, for Merleau-Ponty, and in contrast to Gibson, levels are not relations constituted independently of the developmental history of the body and the world, nor do they arise solely from the affective subjectivity of the body (Marratto

2012). Levels are indeed contingent and labile, and their constitution depends on the concrete history of the body-world entanglement (4.4).

Changes in the body or the environment lead to a shift of levels (Talero 2005). For example, the acquisition of a bodily skill, like playing the piano, brings forth a new level and a new spatial dimension (i.e., musical space) in the keyboard (*PhP*). Likewise, incorporating an artifact can shift our habitual modes of inhabiting the world, adjusting its configuration (Stratton 1897), or creating new forms of interaction and space (Bach-y-Rita and Kercel 2003). Damages to our bodies, by contrast, can make us lose levels and reconfigure the body-world entanglement as a new whole (cf. *PhP*; Jacobson 2017).

However, levels and shifts of levels, although constrained by the body's materiality and the world, are not determined by their simple physicality. The attunement of the body and the environment is better explained by the normative development of the body-world entanglement. For this reason, material changes in the body or the world do not lead to an immediate shift of the normative body-world attunement. This can be seen, for example, in cases of phantom limbs (*PhP*) and spatial neglect (Jacobson 2017). It takes time to reconfigure the dynamical interactions of the body and the world (and its corresponding lived experiences) to reach a new attunement. This new attunement is nonetheless based on the previously established levels (*PhP*). Levels thus reveal the lability of norms of bodily interaction and disclose that new norms are constrained by the historical past of the body-world entanglement.

Levels, in the terminology of contemporary cognitive science, are enactive and ecological. They are enactive because they result from concrete processes of interaction between an agent and the environment. They are ecological because they entail the normative relation or, as Merleau-Ponty called it, the pact between the body and the world, and although the meaning lived by agents is partially determined by their own activity, this meaning is located and constituted in the environment itself and not in the purely subjective domain of individuals. Levels are therefore best understood as enactive-ecological norms, or as what I shall call *place-norms*. Understanding sense-making as the enactment of place-norms is the final goal of this thesis.

Places are the more concrete regions of space we inhabit in our everyday lives (5.1). From a phenomenological perspective, they are more original or primary than the general notions of space given in science and philosophy (Casey 1998). Places, I will argue, are constituted by different levels of enactive situated normativity that I will call place-norms. Sense-making as norm development consists precisely of the enactment of place-norms (5.3).

The normative domain of place is, however, multidimensional. Temporally, place-norms are always preceded by other norms that enable and constrain the emergence of new norms. Thus, existing norms function as both scaffoldings and constraints for the enactment of new norms. Place-norms have different temporal scales of constitution, from behavioural to developmental, historical, and phylogenetical scales. The body-world interactions possess biological, sensorimotor, intersubjective, and linguistic dimensions of interaction. In the intercorporeal dimension, there are natural and cultural, local or general norms of interactions (5.1).

I will not pretend to describe the tremendous complexity of place in this thesis but offer only a brief sketch of an enactive account of place. I will begin this work by roughing out some of its general features and show how cognitive agents are always situated in place, and why this account is critical to any explanation of the norms of sense-making. On this basis, I will argue that the original aim of autonomist enactivism—that of embodying the mind (*EmMnd*)— must be complemented. It must emplace bodies in their local environments to construct a more robust enactivist account of cognition. This task is challenging, but I think that it is possible to set out the basic lineaments for the constitution of a truly enactive-ecological perspective.

Before we start, let me very briefly outline the structure of the work ahead. The first part of the thesis is dedicated to showing why, for autonomist enactivism, we think of cognition as an embodied phenomenon. In the first chapter, I will examine the problematic assumptions of brain-centred cognitive science and offer a brief review of the alternative proposals of embodied cognition. Chapter two exposes and analyzes the peculiarities of enactive cognition and argues that due to its theory of biological autonomy and definition of cognition as sense-making, autonomist enactivism has advantages over other enactivist accounts. The second part of my thesis begins in the third chapter, where I propose to define sense-making as a process of norm development and abandon the standard definition of sense-making as a process that simply adds significance and form to a meaningless world of pure matter. Chapter four will argue that autonomist enactivism must recognize the environment as a normative field of forces and not as a purely physical domain from the perspective of sense-making as norm development. Doing so means acknowledging that the environment plays a more active role than the scholars of this approach have admitted. Finally, I will integrate accounts of norm development and the active environment in the fifth chapter and sketch an enactive account of place in some detail. This account will conclude that sense-making consists of enacting place-norms and that our minds are not only embodied, but also emplaced.

Chapter 1 – Worlds Apart: Are We Really Enclosed Inside Our Heads?

Cognitive science is a multidisciplinary field that looks for natural explanations of human activities such as perception, motor action, memory, imagination, planning, and reasoning. These activities are called cognition because they procure knowledge about the conditions of the environment and make the completion of intelligent actions possible.

There are two main types of approaches to cognition in contemporary cognitive science: *brain-centred cognitive science* and *embodied cognition*. While the first approach locates all the *relevant* causes of cognition in brain processes, the second approach maintains that bodily and environmental processes are also fundamental for the constitution of cognitive activities.

The neurocentric stand of brain-centred cognitive science is interconnected to another predominant belief in this field: cognition operates like a computational function of information processing. I name this belief *computationalism*. This chapter argues that the synthesis of neurocentrism and computationalism has been highly problematic. For this reason, we should abandon the type of explanations proposed by brain-centred cognitive science. I will also claim that we need to investigate radical forms of embodied cognition for the best alternative to brain-centred cognitive science, since only radicals avoid the problematic synthesis of neurocentrism and computationalism.

My argument goes as follows. First, I will briefly review the theoretical synthesis of neurocentrism and computationalism in cognitivism, the most classical form of cognitive science (1.1.1). From there, I examine the status of this synthesis in the more contemporary approaches of connectionism (1.1.2) and predictive processing (1.1.3). I will then give a rough overview of the empirical problems that neurocentrism and computationalism, working together, brought about for cognitivist models of artificial intelligence, and the consequences of these problems for our general understanding of cognition (1.2.1). Although neurocentrism and computationalism are interconnected theses, I will argue they are not interdependent, at least not in connectionism and predictive processing (1.2.2). We can therefore reject the synthesis of neurocentrism and computationalism as necessary to explain cognition. After that, I will suggest that neurocentrism is founded on a theoretical prejudice that I name the mind-world dichotomy (1.2.3).

Section two will survey two significant philosophical problems of the mind-world dichotomy: representationalism (1.3.1) and the explanatory gap (1.3.2). Considering these problems, our motivations to abandon neurocentrism are not only scientific but also philosophical. In addition to the empirical and philosophical issues of brain-centred cognitive science, it is also problematic that neurocentrism is mainly based upon methodologies that study cognition in the lab. Although beneficial to identify some underlying causes of cognition, cognition in the lab misses significant aspects of this phenomenon. We need thus to incorporate methodologies that observe cognition in the field. This strategy helps us realize that cognition is a phenomenon deeply rooted in the body and the environment (1.3.3).

In the final section of this chapter, I will briefly survey three main types of alternative proposals to brain-centred cognitive science in the field of embodied cognition: weak (1.4.1), moderate (1.4.2), and radical embodied cognition (1.4.3). I will argue then that only radical approaches can overcome the mind-world dichotomy and neurocentrism (1.4.4). In the second chapter of this work, I will focus on the arguments against computationalism from the perspective of one subclass of radical embodied cognition: enactive cognition.

1.1 Brain-Centered Cognitive Science

A widely accepted view among the community of cognitive scientists is that cognition is like a function of information processing accomplished by a computational system (see, e.g., Thagard 2005, chap.1). The mind, they hold, amounts to the characteristics of the software we run in our personal computers. From this standpoint, the mental software of human beings is seen as physically implemented in the sophisticated machinery of the brain, and the brain is the hardware that runs the mental software (cf. Clark 2000, chap.1). I call this general description and conception of cognition as information processing *computationalism* and the belief that cognition is physically implemented in the brain *neurocentrism*.

The synthesis of computationalism and neurocentrism in a scientific account of cognition was initially made by *cognitivism*, the first form of brain-centred cognitive science. The models of cognitivism based on classical computations supported the thesis that cognitive systems are something radically separated from the external world and confined to the boundaries of the head.

In this section, I will briefly review the origin of the synthesis of computationalism and neurocentrism in cognitivism (1.1.1), and the subsequent adoption of neurocentrism by connectionism (1.1.2) and predictive processing (1.1.3) within their own computational models.

1.1.1 Cognitivism

Cognitivism is the most classical and paradigmatic form of brain-centred cognitive science. This scientific account of mental phenomena developed the metaphor of the mind functioning as a computational system and of the brain working as a computer. The rise of computational science in the middle of the twentieth century, for example, in the foundational work of Turing (1937) and Shannon (1948), prompted scientists and philosophers to use computational models to produce well-founded hypotheses concerning the formal processes at play in cognition, notably in human reasoning (e.g., Newell and Simon 1961). Since these first computational models were also valuable to explain brain mechanisms at the macroscale, the isomorphism between mental and brain functions suggested that brains were the physical implementation of minds (McCulloch 1949; Newell and Simon 1997).

Computational systems accomplish information processing tasks that transform discrete values or inputs into other values or *outputs* thanks to applying specific rules or *algorithms*. The paradigmatic example of a classical computational system is the hypothetical *Turing Machine* (Turing 1997). In the present, we find a diversity of information processing systems. Some of them are *digital*, as the Turing machine, while others are not. Digital computations process identifiable units that carry on all or nothing values. Non-digital computations, by contrast, can process the values of variables that are continuously changing (Piccinini and Scarantino 2011). Cognitivist models are based on *classical computations*, the original type of digital computations.

A classical computational system must first encode in symbolic tokens any non-symbolic source of information (Piccinini and Shagrir 2014). Essentially, this means that the system needs to transform an outside source (i.e., a physical event) that is meaningless for the system into something manageable by the syntactic rules of the system (cf. Fodor 1981). That is, the system needs to add semantic value to the physical input, thus creating an *input representation*. The semantic value or meaning of an input representation is assigned syntactically by the computational system itself (see Fodor 1975). Therefore, the input value is pre-specified by the system, and the system is responsive only to those physical inputs that it can put in its own terms. For cognitivism, these terms are symbolic and resemble the symbols of human language. The representations at work in cognitivism are hence symbolic, *language-like representations* (Haugeland 1997, 16).

In classical cognitivist models, input representations are transformed by computational systems thanks to the application of sequences of instructions or algorithms that usually follow the binary rules of symbolic logic (Haugeland 1997). After the information processing is complete, the system delivers a response that could be an *output representation,* i.e., a representation useful for another module of the computational cognitive system, or a *motor command* to perform a bodily action, i.e., a physical output. Susan Hurley (2001) called this basic design (input > information-processing > output) *the classical sandwich model of cognition* (figure 1).

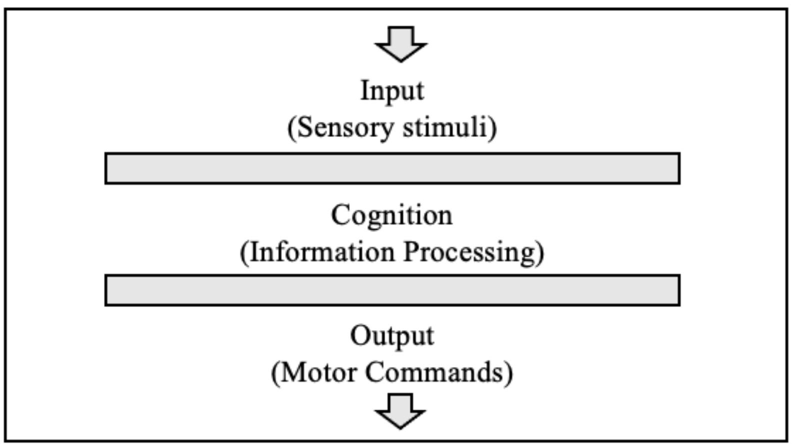

Figure 1. – A basic sketch of the classical sandwich model of cognition

Since, in the sandwich model, cognitive systems need the information provided by sensory inputs and the bodily performance of its motor commands for interacting with the environment, we conceive cognitive processes as separated from any other environmental process. Hence, the mind becomes enclosed in the head's boundaries, as the brain is the machine responsible for the information processing.

Cognitivists do not only appeal to computational models to explain the formal organization of cognition, but they also use these models to sketch brain processes at a macroscale. At the microscale, neuronal physicochemical activity is highly dynamic and complex because neurons exhibit different levels of hierarchical organization (Simon 1962). Neuronal systems of the brain are usually interrelated and depend on each other to accomplish a cognitive function. However, for Simon (1962), many neuronal systems are decomposable. They are systems that can be treated as functional units that work in a relatively independent manner. The implications at the macroscale of observation are obvious: brain processes exhibit specialized *functional modules* of information processing. These modules are interconnected linearly and form broader computational systems of information processing. From this perspective, therefore, the brain is a hyper-sophisticated computational system composed of multiple sub-specialized and interconnected subsystems (Bassett and Gazzaniga 2011). The isomorphism of computational cognitive systems and brain processes, interpreted computationally, suggests that the computationalist metaphor of mind was a highly reliable scientific model of cognition (Clark 2000, chap.1).[2]

1.1.2 Connectionism

Although cognitivist models seemed to describe brain processes accurately at the macroscale, it became increasingly evident to neuroscientists that things were different at the microscale. At this level, what matters is to explain the interactions between two neurons, or small clusters of neurons, instead of the functional modules described at the macroscale.

In the eighties, a second major form of brain-centred cognitive science called *connectionism* addressed this problem by creating models of cognition based on interactive networks of artificial neurons (Boden 2006, chap.12). These models were valuable for creating solid computational hypotheses about the information processing at play at the microscale and conceiving cognition as a more dynamic, flexible, and complex phenomenon than otherwise assumed.

The typical design of connectionist networks consists of three different layers of neurons: the input layer, the hidden layer, and the output layer. Input layers receive incoming stimuli, while the middle or hidden layer is responsible for information processing. Finally, the output layer delivers the response of the network (Thagard 2005, chap.7; figure 2).

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[2] The focus of classical cognitivists was nonetheless on the computational aspects of cognition (e.g., logical rules, algorithms, representations, etc.) not in its physical implementations.

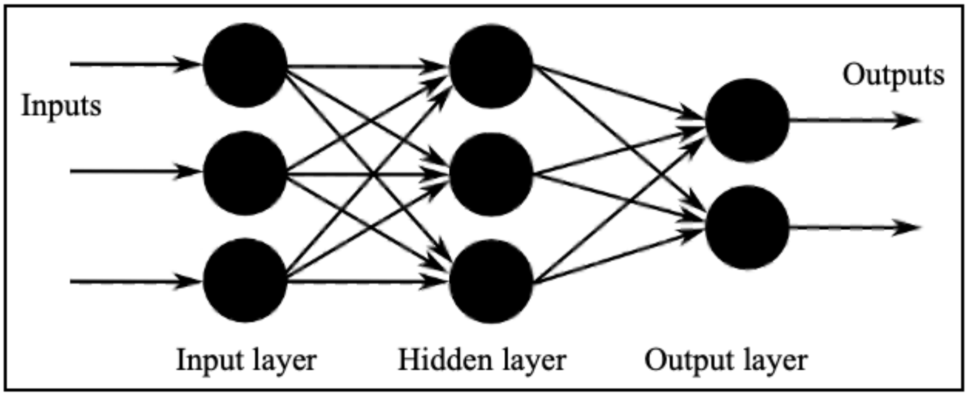

Figure 2. – A basic connectionist network

The environment provides stimuli to the input layers of the network. The hidden layer processes the information thanks to the emergence of patterns of activity on the web. These patterns are caused by the input and the already existent constraints of the network. The output layer delivers the response of the system, produced by the emergent patterns of the web.

At the level of individual units, the activation of connectionist patterns follows Hebb's rule of neuronal activation.[3] In contrast, connections between units are strengthened thanks to mechanisms that allow units to have a sort of memory that makes them susceptible to activation given the presence of a stimulus (Rumelhart 1997). As a result, connectionist networks emulate the physicochemical activation of biological neurons in the brain.

In the connectionist model, single units (isolated neurons) do not accomplish information processing but the collective activation of multiple neurons (the network) that produces a distributed pattern in the network. The input layer triggers the web activity, but its already existing connections constrain the pattern of activity. These connections depend partially on the network's physical design and the strength of the connections dynamically constructed between neurons. The regularity of the value of inputs will create patterns of regularity across the web, delivering typical

[3] Basically, Hebb's rule indicates that if a neuron (A) receives an input from another neuron (B) at a time when both units are highly active, then the weight W(AB) to (A) from (B) should be strengthened (Rumelhart 1997, 215).

outputs as a result. All this activity is still open to dynamic changes if the input value constantly changes (Smolensky 1997).

The open-endedness of these neuronal networks marks a crucial difference between cognitivist and connectionist models. Connectionist networks are based on rules of inference that handle statistical information instead of logical rules (Smolensky 1997). Therefore, connectionist networks do not need to be pre-programmed like cognitivist models. They can handle dynamic changes in the environment and self-organize to adapt their responses to new circumstances, constantly establishing new patterns of activity (Smolensky 1997). Connectionist networks are therefore more robust, flexible and dynamic models than cognitivist ones.

It is a matter of debate if the information processing of real neuronal networks is digital. They do not show the transmission of discrete vehicles of information but distributed patterns of activity that continuously change (cf. Piccinini and Scarantino 2011). It is also debated whether these patterns are representational or not since it is hard to attribute semantic value to these activity patterns (Clark 1997, chap.8). From a neurocentric perspective, however, it is common to assume that neurons represent features of the environment at some level of neural activity.

Connectionist networks have a clear advantage over cognitivist models for explaining cognitive activities like learning, remembering, and recognizing patterns (Churchland 1997). These activities depend on more dynamic interactions with the environment, and connectionist networks do not require the extensive algorithmic programming of classical computations to process the information necessary for these activities. Connectionist models are, however, more imprecise than the cognitivist ones, especially for explaining more abstract cognitive functions like those at work in explicit reasoning and logical operations. For this reason, cognitivism is standardly considered to be the most successful scientific model of cognition thus far (Shapiro 2010).

1.1.3 Predictive Processing

The most contemporary form of brain-centred cognitive science is based on the computational approach of *predictive processing* (Clark 2013; Hohwy 2013; Wiese and Metzinger 2017). Like connectionism, predictive processing proposes a more dynamic model of cognition than that of classical cognitivism. Unlike connectionism, however, predictive processing does not conceive the brain as a passive system that waits for informational inputs to create patterns of neural activity. Instead, the brain is an active generator of these patterns, which arise from the hypotheses it makes about the environment (Clark 2013).

Brain hypotheses in predictive processing take the form of hierarchical statistical models called *generative models*. In this hierarchical order, the high-level models calculate the probabilities of responses from the low-level models. These latter models measure the probabilities of present and future sensorial inputs (Clark 2013). Thus, the brain creates a statistical representation of the environment at different spatiotemporal scales (Wiese and Metzinger 2017).

Environmental models are constantly adjusted as a result of the acquisition of new information based on Bayes rules of inference. These Bayesian models recalculate prior probabilities considering new events or new information. The new information creates a mismatch or *surprisal* between hypothesis and facts (Clark 2013), triggering changes in the cascade of predictions from the higher to the lower level models. The recalculation of probabilities has a high-level cost of energy (electrical energy in the case of our computers, and metabolic energy in the case of the brain), so instead of creating new models based on incoming information, the computational system only calculates the disparity between the expected inputs and the real ones. This is a process called *prediction error minimization* (Hohwy 2013; figure 3), and the compression of information (i.e., the focusing of the system on mismatches) is called *predictive coding* (Wiese and Metzinger 2017).

The flow of information between the brain, the body, and the world envisioned by predictive processing is so dynamic that some cognitive scientists claim it should be viewed as a non-neurocentric model of cognition (Friston et al. 2010; Bruineberg, Kiverstein, and Rietveld 2016; Clark 2016). For this reason, we need to distinguish between neurocentric and non-neurocentric forms of predictive processing. I will talk later about non-neurocentric forms of predictive processing (1.2.2, 1.4.3, 5.2.2). Here, I will focus on Hohwy's (2013, 2016) *prediction error minimization approach*, one of the predictive processing models that more strongly supports neurocentrism.

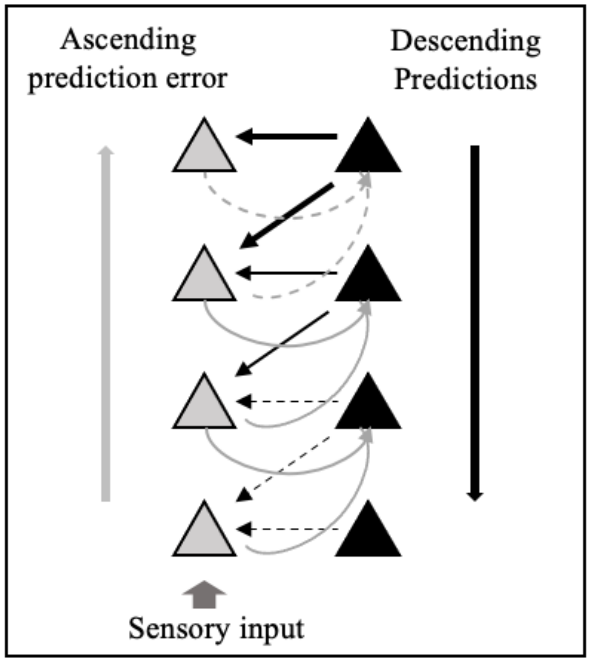

Figure 3. – A very basic prediction error minimization model

Black triangles represent the hierarchical generative models the brain creates as hypotheses of the environment in perceptual inference. Grey triangles represent the mismatch between the statistical expectation of the hypotheses and the current information provided by sensory input, i.e., prediction error. The lines represent the feedback necessary between predictive models and surprisal to minimize error.

Neurocentric interpretations of predictive processing are based on the belief that perception occurs in accord with Helmholtz's perceptual inference theory (Hohwy 2013, 2016). Helmholtz argues that our brain makes inferences about the outside world, based on the insufficient information our sensory organs provide (Gordon 2004). Conceived as an inferential machine-organ, the brain for Helmholtz is similar to a computational machine in the contemporary era. As in the sandwich model of cognitivism, the brain is isolated from the environment (Wiese and Metzinger 2017). The only way to escape from the black box is to maintain constant sensorimotor feedback with the environment (Clark 2013).

Sensorimotor interaction in predictive processing nonetheless implies two different types of processes: *perceptual inference* and *active inference*. Perceptual inference describes the readjustment of brain hypotheses (generative models) that occur physically, as changes in the constraints produced by neural connections (Clark 2013). By contrast, active inference implies changes in the environment induced by the motor action of cognitive agents. The primary divergence between neurocentric and non-neurocentric forms of predictive processing lies in two different interpretations of active inference (*EnInt*).

Neurocentric predictive processing recognizes that bodily actions can change environmental conditions (either by changing the materiality of the environment or by changing the situation of the body in the environment). These cause alterations in the generative models of the brain (see, e.g., Seth 2015; Hohwy 2016). For this reason, sensorimotor loops, not just sensorial stimulation, causally constitute the statistical space of the brain models (Clark 2016). Neurocentric authors insist nonetheless that cognition as such occurs in the brain exclusively because it is the brain and no other organ of the body that executes these information processing tasks (Hohwy 2016). For this account, the body and the environment merely provide inputs and outputs, and, therefore, reproduce the classical sandwich model of cognition.

The claim that it is the brain, and not the whole living organism, which alters the dynamic relationship between the body and the environment is challenged by defenders of the *free-energy principle* that lies at the heart of the natural explanations of predictive processing (Friston 2010; Kirchhoff and Froese 2017; Ramstead, Kirchhoff, and Friston 2019). I will come back to this issue later (1.2.2). Still, we must provisionally conclude that approaches of predictive processing like prediction error minimization share with connectionism and classical cognitivism the synthesis of computationalism and neurocentrism at the core of its theories of cognition.

1.2 The Prejudice of the Mind-World Dichotomy

Neurocentrism entails the assumption that the mind and the world are radically separated. Physically implemented in the human brain as a computational system, the mind is isolated from the extracranial surroundings. The brain can only communicate with the outside world thanks to the information provided by the senses and the motor commands it sends to the body. I have referred before to this architectural description of cognition as the sandwich model (1.1.1).

Many empirical problems beset this model, and this section survey some of them (1.2.1). It also argues that the sandwich model of cognition is not intrinsic to all forms of computationalism and that neurocentrism is not a direct consequence of computationalism either. Therefore, we can analyze the pros and cons of neurocentrism and computationalism in cognitive science separately (1.2.2). Since neurocentrism is not intrinsic to computationalism, I will also argue that the radical separation of mind and world is fundamentally based upon the theoretical prejudice of modern sciences of mind that we can call *the mind-world dichotomy* (1.2.3). It will be later showed that empirical and philosophical problems arise because of this prejudice (1.3).

1.2.1 What Computers Could Not Do

The research program of cognitivism has probably been the most successful scientific approach to cognition in the history of cognitive science. Its computational models of mind have been helpful for scientific explanations in neuroscience, psychology, linguistics, artificial intelligence, and many other areas. Despite all the differences they have from one author or one field to another, they can still be grouped together insofar as they all detach cognitive systems from the rest of the world. It is presupposed that information processing *requires* that the cognitive systems first encode (symbolically) inputs provided by the external world. For cognitivism, there is just no room for cognition without mental representations.

However, confining cognition to the boundaries of the head has turned out to be a problematic assumption. Cognitivist models' failures are usually due to the isolation of cognitive processes from the environment. This has been remarkably demonstrated in the field of artificial intelligence, where the robotic agents of cognitivists have been incapable of sustaining efficient sensorimotor interactions with the environment. These failures have pushed cognitive scientists to look for alternatives to describe more dynamic interchanges between agents and the environment.

Under the principles of cognitivism, artificial intelligence models depend on the production of symbolic representations and the processing of these representations with algorithmic rules. John Haugland (1997) called these models *Good Old-Fashioned Artificial Intelligence* (GOFAI). GOFAI models were highly successful at solving abstract operations like mathematical and logical problems. For example, computers playing chess at the level of the most skilled human players exhibited the potential of these types of artificial intelligence.

The success of GOFAI came to a halt when the limitations of the sandwich architecture of cognitivism became evident. Our everyday actions require the use of functions like perception and motor action. These functions do not seem to require abstract operations, at least not at the conscious level. Cognitivism hypothesizes, however, that computational processes are involved in these functions but at the sub-personal or unconscious level. Paradoxically, computational systems needed to encode an enormous amount of information to perform the simplest functions of action and perception. They also needed to be programmed with a vast number of instructions to process this information, much more than computers need to perform the abstract operations for playing chess (Dreyfus 1992; Dreyfus and Dreyfus 2000).

In principle, a computational system can handle everything that can be put into symbols and manipulated by algorithmic rules. Nevertheless, any real system in the physical world, even a computer, has spatiotemporal constraints. Thus, what may be, in principle, computable may not necessarily be computable given actual spatiotemporal constraints in the physical world (Hendriks-Jansen 1996). Furthermore, the amount of information processing in a computational system, even for the most straightforward functions based on motor action and perception, were found to be so huge that these constraints challenged the possibility of a cognitivist approach to action and perception in artificial intelligence (Boden 2016, chap.2). It was therefore not surprising that GOFAI could only produce robots with abysmal performance, only capable of acting in highly controlled environments. In short, they were unable to function effectively in complex and dynamic real-world environments.

Moreover, the fact that not only humans but other living organisms, even those with very simple or no nervous systems at all, *do* exhibit a great capacity to deal with the world in concrete bodily actions, without explicitly accomplishing lots of computations, put the hypotheses of the cognitivist program for explaining these aspects of cognition into question (Wheeler 2005, chap.3).

This is not the end of the matter; cognitivism faces at least two deeper sets of problems. First, living organisms exhibit the capacity to find objects of value (positive or negative) spontaneously and dynamically for their own purposes, such as when they recognize food, shelter, or potential threats. They seem to spontaneously experience some features of the world as more (or less) relevant than others. This is tantamount to say that living organisms exhibit normative guided behaviour (see

2.4). By contrast, cognitivist artificial intelligence robots need to be fully pre-programmed to attribute relevance to particular features of the world. Cognitivist robots cannot assign any sort of value or meaning to the environment by themselves (Froese and Ziemke 2009). This is a rough and straightforward description of what Harnad (1990) called *the symbol-grounding problem*.

Secondly, worldly situations are commonly complex, dynamic, and many of their components are inherently contingent. Hence, to recognize the relevant features of a real-world situation to accomplish a determinate task, a cognitive agent needs a great deal of cognitive agility and flexibility to recognize the situation and adapt its actions accordingly. However, robots constructed under cognitivist theories proved incapable of adapting by themselves to contingencies in the environment. Consequently, they were unable to identify what might be relevant in a particular context. This briefly describes *the frame problem* (cf. Dennett 1987; Boden 2016; Wheeler 2005).

The failures of GOFAI were not only problematic for creating efficient sensorimotor machines. They also exhibited the problems of cognitivism for explaining how cognition occurs in biological agents. For example, evolutionary psychology adopted cognitivist descriptions of the mind as a functional, modular system with pre-programed responses (see, e.g., Cosmides and Tooby 1987). For this type of psychology, living organisms' behavioural responses and psychological states, including humans, are determined by information encoded in genes and expressed in highly specialized brain modules (see, e.g., Pinker 1998). This, however, makes it difficult to account for the flexibility of organisms to adapt to different situations in their development. It is also hard to explain why organisms of the same species sometimes use very different strategies to solve the same problem (Lloyd 1999). Indeed, the idea of a pre-programmed mind employing genetic information is no less problematic in biological organisms than it is in artificial systems (cf. Hendriks-Jansen 1996).

1.2.2 Non-Neurocentric Computational Models

Despite these practical problems of cognitivism, standard connectionism and prediction error minimization have insisted on locating cognition in the head. The main problem for these theories is not applying their alternative computational models to explain cognition formally but to interpret these models from a neurocentric stance (cf. *EnInt*, chap.5).

Although connectionism is a more dynamic model than cognitivism, typical connectionists separate the cognitive domain from the outside world. Cognition happens in the network; the outside world merely provides inputs and receives outputs from the network. The distributed pattern of activity in the network is interpreted as distributed representations (Clark 1997, chap.7). Thus, the sandwich model is at play once again. Some defenders of cognitive neuroscience hold that we can produce hybrid computational models of cognition to overcome the discrepancies between the functional logic of cognitivist models at the macroscale of brain processes and the dynamical complexity of neuronal activity at the micro and mesoscales (Churchland and Sejnowski 1988). The idea, in short, is that cognitivism and connectionism explain both mind and cognition in computational and neurocentric terms, but at different explanatory levels (Harnad 1990).

Connectionist information processing, however, conforms to the logic of dynamical systems theory (Smolensky 1997), and this theory has shown that non-neurocentric interpretations of cognition are possible (see, e.g., Port and van Gelder 1995). Dynamical system theory models the change of a system that continuously evolves according to different variables. Sometimes these variables are other dynamical systems, and when two or more of these systems co-evolve in time, constraining their behaviour mutually, we say that they are coupled. For the coupling of two dynamical systems, a system does not need to encode anything from the other; they only need to constrain (physically) their behaviour (van Gelder 1997). From this perspective, different neuronal networks can mutually constrain their activity (Freeman 2000). Similarly, bodily motor actions and sensorial organs can also constrain the activity of neuronal networks (Kelso 1995), while environmental processes can constrain the bodily actions and sensorial feedbacks of agents (Turvey and Carello 1995). All this sustains the hypothesis that the brain, the body, and the environment form a dynamical system that works as a unitary whole (*RadEmCS*; *EnInt*; Fuchs 2018).

Predictive processing also provides for the possibility of modelling cognition as an embodied phenomenon. The free-energy principle describes processes of equilibrium between the interactional space of a living agent and the environment system, rather than the creation of representational states in the brain. This puts pressure on neurocentric interpretations of predictive processing (Bruineberg, Kiverstein, and Rietveld 2016).

The free-energy principle is a mathematical theory describing organisms as self-organizing systems that maintain low levels of entropy, thus avoiding systemic disintegration while interacting with the environment to minimize their free energy (Friston 2010). Entropy, in thermodynamics, is the measure of chaos and disorder of a system, whereas, from a statistical view, chaos is related to the unpredictability of states of a system. Entropy is therefore related to the informational measures of uncertainty and surprisal (Shannon 1948; Friston 2010). Variational free energy measures the probabilities of a predictive or generative model to mismatch with the current sources of information, that is, of surprisal (see 1.1.3). Free energy is therefore equal to the amount of surprisal or uncertainty of a predictive model. Living organisms tend to reduce this informational uncertainty that is traduced physically in the conservation of low entropy levels (i.e., organisms stay alive).

One of the free-energy principle applications is the predictive processing model of the brain and cognition (Friston 2010). As an organ that accomplishes free-energy reduction, the brain tends to produce generative models that maintain low levels of uncertainty and entropy. The free-energy principle can also be applied to the interactions of the whole living organism with the environment (Allen and Friston 2018). In this case, the generative model does not take the form of an internal representation that is physically implemented in the neural structures of the brain, but instead, we can see that the whole organization of the organism, or its phenotype, is shaped by the processes of free energy minimization. For this reason, supporters of the free-energy principle hold that the organism becomes the model of its environment, or its ecological niche (Bruineberg et al. 2018; Ramstead, Kirchhoff, and Friston 2019).

Connectionism and predictive processing involve, therefore, computational models that are suitable from a non-neurocentric perspective (cf. table 1). This means that our computational models of cognitive processes do not force us to accept uncritically the claim that cognition is confined to the boundaries of the head. Neurocentrism is a belief that some philosophers and scientists hold before the apparition of computational models. In the following subsection, I will argue that neurocentrism is funded indeed on a critical prejudice of early scientists of mind that was inherited from the theoretical claims of modern philosophers. I will call this prejudice the mind-world dichotomy.

	Computations	*Neurocentric interpretation*	*Non-neurocentric interpretation*
Cognitivism	Classical computations (symbolic & syntactic)	Encoding of information in symbols	N/A
Connectionism	Differential equations & dynamical systems theory	Neural information processing	Dynamical systems coupling (brain-body-environment)
Prediction error minimization	Bayesian statistical models	Brain segregation	Active inference

Table 1. – The primary forms of brain-centred cognitive science

In the table above, I sum up the three main types of brain-centred cognitive science that have been discussed thus far, the type of computations of their models of cognition, and the neurocentric and non-neurocentric interpretations of these types of computations.

1.2.3 The Mind-World Dichotomy

The constitution of scientific models always involves more than empirical evidence and mathematical tools. These models also involve ontological and epistemological assumptions that frame the possible explanations of such models (Kuhn 1970; Lakatos 1978). In this section, I argue, more specifically, that neurocentrism is fundamentally grounded on one such assumption, a philosophical thesis that I call *the mind-world dichotomy*.

I define the mind-world dichotomy as the assumption that mind and world are two object-like entities with radically different properties. The dichotomy implies that mind and world are independent of each other, and any relationship between the two is fundamentally causal and linear. The origin of the mind-world dichotomy is found in Descartes's ontological dualism, in which he describes mind and world as ontologically different entities (cf. Dennett 1991; Wheeler 2005; Rowlands 2010).

Cartesian dualism takes the form of a mind-world dichotomy once the gap between mind and world is adapted to the physicalist and reductionist frameworks of modern sciences of mind. *Physicalism* believes that the only things that exist are those entities and processes described by the science of physics (cf. Neurath 2012). A closely related position, *reductionism*, implies that scientific laws are ultimately deducible from the laws of physics. This means that the knowledge of all other sciences (such as biology, psychology, sociology, etc.) are, in principle, reducible to physics (Nagel 1961). Although physicalism is an ontological hypothesis and reductionism an epistemological claim, many scientists and philosophers combine both claims into an *ontological reductionism* (cf. Sarkar 1992). This reductionism claims that the properties of all physical systems, from genomes to neutrinos, depend on the properties of the parts that compose these systems. The behaviour and characteristics of living organisms are then seen as a direct consequence of their physical composition, i.e., they are conceived as the result of the sum of their parts. Suppose we observe seemingly novel or different behaviours and properties of physical systems, where these systems nonetheless have similar parts. In that case, this is not because of a sum beyond parts, but because some characteristics of these systems *supervene* on their basic physical composition at different spatiotemporal scales and levels of organization (cf. Davidson 2001). [4]

The sciences of mind frequently assume physicalism and reductionism. Consequently, mental phenomena, just as any other phenomena, are seen as being in principle reducible to their underlying physical causes (Anderson 2007, chap.6). There is, however, a gap between mind and world in at least two different senses. On the one hand, there is a distance between the mental realm circumscribed to the boundaries of the head, separated from the rest of the physical world (cf. Rowlands 2010, chap.1). On the other hand, there is an explanatory gap between the causal explanations of mental phenomena and the experiential aspects of these phenomena that can be studied from a subjective perspective alone (cf. Chalmers 1995). Since philosophers and scientists alike often tend to conflate the two, the mind-world dichotomy causes multiple problems for explaining mind and cognition. I am briefly surveying some of these problems in the next section.

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[4] The wetness of water is a classic case, it is not a novel sum, but an aggregate behaviour arising only on a sufficiently large space and time scale; water is not quite 'wet' for the water-strider insect, it's 'sticky'.

1.3 The Philosophical Problems of Neurocentrism

The empirical problems of the sandwich model moved philosophers of cognitive science to question the philosophical bases of neurocentrism, thereby forcing a reappraisal of classical problems in philosophy of mind such as representationalism (1.3.1) and the explanatory gap (1.3.2). Our motivations to abandon neurocentrism are thus not only scientific but also philosophical. In addition to the empirical and philosophical problems of neurocentrism, there are problems inherent to the methodologies of brain-centred cognitive science: these methodologies study cognition in the highly controlled environments of the lab (1.3.3). Although these methodologies are helpful to identify some underlying causes of cognition, they miss significant aspects of this phenomenon. Many authors of embodied cognition have suggested incorporating methodologies that observe cognition as it happens in real environments. This strategy reveals that bodily and environmental processes are causally relevant for the constitution of cognition, and not only what happens in the brain.

1.3.1 Representationalism

Representationalism is probably the issue most frequently criticized of the neurocentric concepts of the mind. It originates in Franz Brentano's (1995) account of intentionality. As is well known, Brentano borrows the term 'intentionality' from medieval philosophy. The word derives from the Latin *intentio,* which means "directed at."[5] Intentionality describes the particular characteristic of mental states that, in contradistinction to physical phenomena, refer to something, and that is something other than themselves. In the philosophical jargon, intentionality concerns, therefore the *aboutness* of experiences: my perception, for instance, is *about* the maple tree in the garden of my neighbour, my memory is *of* my friend who has recently died, my imagining is *of* the Minotaur of Crete, and my thoughts are *about* who will win the presidential election in the U.S. In these

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[5] Defining the concept of intentionality in detail involves a complex discussion about how many authors in the last two centuries have interpreted the relation of our mental acts and the objects those acts intend. Since this discussion exceeds the scope of this thesis, I will do only a very general description of this term but that will be hopefully sufficient to clarify my argument about how the standard accounts of intentionality of representational theories of mind remain deeply Cartesian.

examples, we find that the objects,[6] my mental acts refer to, have different modes of presentation. In some cases, the objects are currently present (e.g., the tree I see through the window). In other cases, they are absent (e.g., my dead friend), while in some others, they are simply unreal (e.g., the Minotaur). An important lesson follows from this: in Brentano's eyes, intentionality does not in any way imply the presence (or the absence) of the intended object.[7]

A closer analysis of the differences between these modes of presentation may be helpful to specify Brentano's position even more, for the contrast between the presence and absence of the intended object may not be as obvious as it first may seem. On the one hand, for non-present and unreal objects, the references of our mental acts cannot be physical objects that are currently present. So far, this is clear. On the other hand, however, although objects of perception may be physically present, their presence is only partial. The maple tree I see through the window, for instance, shows me only one of its visual profiles (e.g., the upper part of the tree), yet my perceptual experience is not about this piece of the tree but the whole tree. Therefore, it seems that my experiences *never* refer directly to physical objects, *not even in perception*; instead, they seem to be mediated by something *standing in* between the physical reality of the world and subjective states of the mind. This is the birthplace of Brentano's representationalism.

For representational theories of mind, since mental acts refer to objects that are not present or not fully present, as in the case of perception, it follows that the mind cannot be directly related to physical objects of the world but to intermediary (intentional) objects that "re-present" these

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[6] Objects in this case does not necessarily mean solid things but defined contents that are distinguishable from other contents. Henceforth, I will use the term "object" in this general way that can embrace physical objects and mental contents. If I need to be more specific about the nature of these objects, I will use an adjective such as "physical object" for a solid thing or "mental object" for a representation or a concept.

[7] This is the most common interpretation of Brentano's theory of intentionality that corresponds to his early work. Brentano later adopted a form of reism that eliminates the possibility of an ontological dualism (cf. Moran 2000, chap.1). Nevertheless, this obscure theory of intentionality has been thus far irrelevant for representational theories of philosophy of mind, cognitive science, and phenomenology, the subjects most relevant to this thesis.

objects (e.g., Searle 1983). The contents of my experiences are, according to these theories, *copies* of physical reality; they are mental representations.[8] This is clear, for representationalists, in the cases of imagination and memory, where the objects of my experience are not "in the flesh"—any experience of these objects *must*, they would argue, be re-presentations. However, they further argue that the same is true in cases of perception, where my vision of the maple tree is not really about the physical tree but about a mental representation of the tree. For this reason, even if the physical nature of my senses gives me only one profile of the object, my experience is about the whole object.

Many philosophers have suggested this and like hypotheses in the analytic tradition (see, e.g., Searle 1997; Tye 2002). They give further support to their representational accounts, appealing to Fregean semantics (cf. Crane 2001). There are, nonetheless, also significant naturalized accounts of representationalism that explain the connection between mental representations and physical objects causally (e.g., Fodor 1981; Dretske 1986). In the same line of thought, philosophers like Ruth Millikan (1984) attribute the natural origin of this causal connection to processes of natural selection. Roughly speaking, these proposals suggest that a living organism possesses the capacity to represent the external physical world internally. Thanks to adaptation processes in its evolutionary past, the ensemble of its sensorial organs and nervous system has evolved to accomplish these functional tasks.

A problematic version of Cartesianism exists in these representational theories of mind. Mental representations are usually described as object-like entities that possess an unclear ontological

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[8] I am aware that my sketch in here of representational theories of mind may caricaturize the proposals of these theories. However, since there is a wide corpus of representational theories that hold different notions of representations and different manners to argue in favor of a mediated relation between mind and world, a deeper description of these ideas would implicate an extensive analysis that goes beyond the scope and interest of this thesis. It is not my aim to reject representationalism but to show the problems this theoretical standpoint has carried for cognitive science, motivating thus the emergence of embodied cognition. By contrast, I think that the general formulation I'm offering apply to the most standard theories of mental representations. For more details about representational theories of mind see Crane (2001, chap.1), and about representationalism in cognitive science see Egan (2012).

status that seems to differ from physical objects as such (cf. Dreyfus 2000). Natural processes might cause these representations, but it is hard to see if they also possess causal powers. The most common way of defining the role of mental representations in scientific explanations of mental phenomena is by reducing them to their functional role (Dretske 1986). Representations have the function of carrying information; that is, they encode external physical features into symbolic *tokens* that can be manipulated by the computational architecture of the mind (Fodor 1981). This definition, however, is not unproblematic, for it is based on the idea that the mind is a computational system that operates as software implemented by the hardware of the brain. Unfortunately, this division between software and hardware once again imposes a dichotomy between physical and mental realms (cf. Jackendoff 1987), just as Descartes did in his metaphysics.

There are also epistemological problems inherent to the mind-world dichotomy. Suppose the physicochemical activity of the brain is the direct cause of mental states. In that case, it is possible to imagine scenarios where the brain could be removed from its usual contact with the world and still have world-like experiences. Hilary Putnam envisioned the famous mental experiment of brains in a vat, a scenario where an evil scientist isolated our brains from our bodies and the rest of the world (Putnam 1981). In this scenario, our brains can survive thanks to the nutrients provided by an artificial machine. Our experiences, by contrast, are caused by the physical stimuli produced by the same machine that emulates the stimulation of our sensorial organs in normal conditions. It seems impossible for us to know with certainty what we are living, in what amounts to no more than a mere illusion in such a scenario.

The analogy is not simply whimsical. Whether subjective experiences are caused by the world or by an evil scientist's machine is irrelevant because we already live in an illusion of the world and an illusion of ourselves. For instance, for Metzinger (2003, 2009), all our conscious experiences of the world are simulations created by the brain that hardly correspond to the world as such.

From this standpoint, the world as such is nothing but physicochemical processes governed by physical laws. Our experiences are akin to hallucinations (Metzinger 2003, 51), mere by-products of brain processes (Anderson 2007, chap.7). Contrary to Descartes, not even the ego is real because our identities are also part of the hallucinatory realm of our minds (Metzinger 2009). Subjective experiences such as perceptions, thoughts, emotions, and desires are ultimately irrelevant for the causal framework of the natural world.

The claim that the empirical world is a big illusion also puts in danger the epistemological bases of all scientific knowledge. Putting aside the skeptical arguments of foundationalist epistemologies (Descartes 2008; Carnap 1967), it is hard to understand how we can rely on our observations to support our scientific claims if we hold that the world we know is illusory. We first experience all the phenomena we make theories of. Even when objects like black holes are predicted by theoretical constructs before they are directly or indirectly observed, these phenomena need to make sense first in our conceptual schemes. That implies experiential aspects, no matter if they are mere numbers and abstracts signs.

In the case of mental phenomena, things get worse. We do not begin our study of perception by looking into the retina or the brain's V1 zone. Instead, we start our scientific inquiries by asking how we perceive the colours red or green, or why my vision shows me only one object if I have two eyes, and so on. I can hypothesize that I can begin my scientific inquiries of cognitive phenomena in experience, and, once I got enough theoretical knowledge to elaborate my theories in purely causal terms, I can throw away my experiences, like eliminativists aim to do (Churchland 1986). However, what is the guarantee that the experience where I began my scientific theories was accurate? If this experience is illusory, is it not a contradiction to use it as the origin of my explanations?

The problem with Metzinger's position is obvious: we can claim that experiences are illusory *only* because they are created by the brain and not because they are false. Experiences can put us indirectly in connection with the real world of raw physical processes. For instance, when I see the colour red in a tomato, even if the tomato is not red, this experience still helps me to study the perception of red things. I can trust my *false experience* of the tomato insofar as such an experience is a reliable basis for studying the physiological processes underlying this phenomenon.

The problem is that we can see differences in how different subjects experience the same event in their everyday lives and in the history of philosophy and science (e.g., Mach's static description of a visual scene versus Gibson's dynamic description, cf. Noë 2004). There is also empirical evidence that some aspects of perception are culturally relative (Pettersson 1982). All this means we would need to select which illusions are best for starting our scientific endeavours. Nevertheless, what then should be the criteria?

If we study subjective experience employing deductive methods, like Descartes, we risk remaining trapped in the world of illusions. The result is that it appears to be senseless for subjectivity to analyze itself. Maybe, as Ray Jackendorf (1987) proposes for cognitive science, subjective experience should simply constrain all scientific labours and should be discarded once we have developed a well-supported hypothesis. Be this as it may, it still looks untenable to say that a world of illusions can guide knowledge that presumes to be the light at the exit of Plato's cave.

1.3.2 The Explanatory Gap

The neglect of subjective experience leads us to the second dimension of the mind-world dichotomy: the explanatory gap. In a physical world described by physicalism and reductionism, subjective experience is more an obstacle than a resource to study mind and cognition. Contrary to our most immediate intuitions, our experience does not interact causally with the physical world for mainstream sciences of mind. I may think, for instance, that my feeling of hunger makes me want to eat a strawberry. From the neurocentric perspective, however, my feelings cause nothing. My brain states result from information obtained from my body, and my response to this information causes me to look for this fruit and eat it. There is simply no need to invoke my "subjective feelings" in this story. Libet (1999) did experiments where he apparently "proved" that our brains make decisions just moments before we are consciously aware of them (although see Dennett 2004; *EnInt*), thus reinforcing the view that subjectivity is superfluous.

This fits all too well with reductionism. Indeed, since subjective experience is a non-observable phenomenon, and given that subjectivity is irrelevant to causal explanations of mind (Churchland 1981), subjective experience is seen as a by-product of brain processes (Anderson 2007). With no causal interaction with the physical world, subjective experience becomes an *epiphenomenon* (Huxley 1898), i.e., a phenomenon that merely supervenes on brain processes.

Epiphenomenalism, and the correlated view of the world as a big illusion, leave open some unsolvable problems. For example, even if, in principle, we can scientifically explain all the mechanisms that cause the emergence of mental states, we still cannot explain the particular feelings of these states, e.g., how it feels like to undergo these states and no others. Jackson (1982) illustrates this problem in a hypothetical case of a scientist named Mary, who investigates and knows everything about the causal origins of the colour red and our capacity to perceive this colour. Nevertheless, Mary cannot know what is like to experience the colour red because she has lived in an environment where red is absent. This scenario puts one crucial aspect of mental phenomena (subjective experience) out of the reach of science and points to critical methodological aspects for studying the mind.

If the first-person perspective is inaccessible from the scientific perspective, how can I know that other beings are sentient like me? This is commonly known as the problem of *other minds* (Dretske 1973). To solve this problem, I can use inferences and simulations to explain that other beings that are similar to me likely possess the same kind of mental states and experiences that I do (although see *EnInt,* chap.3). This problem becomes more challenging, though, when we ask about the subjective feelings of other types of living organisms. This problem is exemplified by Nagel (1974), who wonders how it is possible to have epistemological access to the experience of an animal like a bat, which deploys very different sensorimotor interactions with the world.

Moreover, as Reber (2019) argues, this sort of problem leads us to contemporary questions about the status of forms of artificial intelligence that display similar behaviour and responses to human minds. The classical response to the problem of mentality in artificial systems is the imitation game of Alan Turing (1997). He states that a machine can be seen as intelligent as long as the responses of a machine are similar enough to human responses that we cannot discern whether this is a machine or a human being.

This solution has its critics. John Searle (1997) pointed to what he called *the Chinese Room problem*. In this problem, Searle describes a scenario where a person is put in a box or a room and must translate sentences from English to Chinese. This person does not know any Chinese. To accomplish the task, she needs to use handouts and dictionaries to translate correctly from one language to the other without any idea of the meaning of the sentences she is translating. From the perspective of people outside the room, the person inside appears to know Chinese perfectly. This is like what occurs when we attribute intelligence and mentality to machines that successfully perform tasks that we do, using our cognitive and mental capacities (such as *Google translate or Siri*, for instance). However, like in the case of the Chinese room, machines (or software like *Google translate or Siri*) do not *make sense* of what they are doing. The real problem is that we cannot affirm or deny mentality by appealing to our external observations alone; to do this, we need some other criterium. All this seems to imply that accounting (even exhaustively) for causal explanations cannot suffice to explain mental phenomena.

1.3.3 Cognition in the lab

As mentioned above (1.2.1), the early models of GOFAI were only capable of functioning within highly controlled environments. This was because it is easier to construct a model designed to deal with a reduced number of variables than one that must dynamically change from one variable to another or to deal with many variables at once. Real-world environments are full of contingencies, variables, shifts of environmental contexts and agents' motivations. In this regard, the cognitivists Marvin Minsky and Seymour Papert (1988) recognized that artificial intelligence at the sensorimotor level could not use a general model of intelligence, as more classical cognitivists suggested (Newell and Simon 1961). For Minsky and Papert, sensorimotor agents need to adapt their strategies to different environments and to different sets of variables in the same environment, according to the context of the sensorimotor task. Minsky and Papert (1988, 262-263) called these different environmental contexts *microworlds*. For cognitivism, these conclusions did not make the task of cognitive science easier; instead, they exhibited the challenges of the programming needed to produce efficient robotic agents. Controlling and simplifying environments is nonetheless a pervasive strategy of modern sciences of nature. Scientists need to isolate phenomena to highlight the relevant causal variables they are trying to explain. The world in the lab is thus exceptional and artificial. Moreover, this lab world becomes an abstraction (in the literal sense of removal) of specific features of the world (cf. Smolin 2013, chap.4). Although this strategy is helpful for the analysis of certain phenomena, it seems to obscure the study of cognition.

The cognitive anthropologist Edwin Hutchins has been one of the most recalcitrant critics of this strategy of brain-centred cognitive science. As an anthropologist, Hutchins did not put the phenomenon he was studying into a controlled environment; instead, he got immersed in the field of cognition. His most remarkable work has been to analyze how cognitive tasks are collectively accomplished in a navy vessel (Hutchins 1995). In this work, he described situations in which the vessel's operation did not depend on the sum of the efforts of different cognitive agents, but on dynamic interactions among multiple agents. These agents use various technological artifacts, thereby producing distributed patterns of cognition across the socio-material network that constitutes the vessel operation. The navigation of modern vessels, like many other phenomena, is so complex that its conditions cannot be simply recreated in the lab. Even if we try fragment phenomena and try to put the pieces under more controlled situations, reducing thus the number of variables to analyze, we risk losing sight of the nature of the phenomenon we are trying to explain.

Cognitivism faced, therefore, the problem of over-abstracting cognitive phenomena even in its area of greatest success: human reasoning. Initially, the models of human reasoning were highly abstract and normative (Simon and Newell 1958). They tried to explain how human agents make decisions, solve problems in ideal conditions, and achieve their best performance. However, these models ignored the limitations that real agents face in obtaining all the information needed for optimal decision-making. They also neglect the constraints of time that push agents to elaborate strategies (heuristics) for taking actions without a total consideration of the information they already possess (Todd and Gigerenzer 2003). Hence, the ideal scenarios of the early days of cognitivism needed to become more grounded in the real world in order to understand the concrete strategies of agents that deal with worldly situations. Simon described this new perspective as *bounded rationality* (Simon 1972). More realistic models of rationality have progressively included other variables, e.g., corporeal states, emotions, expectations, cultural habits, etc., limiting and shaping our rational capacities (Todd and Gigerenzer 2003). All this shows that despite the undeniable progress made, the strategy of isolating cognitive phenomena into the lab, i.e., over-abstracting the interactions of agents into highly controlled microworlds, has become gradually more and more problematic for cognitivism. The need for more dynamic models became more evident than ever.

1.4 Embodied Cognition

The history of science has demonstrated that a scientific research program is not abandoned simply because of its inherent problems. On the contrary, it is always possible to add auxiliary hypotheses that help the research program overcome these problems (Lakatos 1978). However, it is different when we have robust theoretical tools that construct solid alternatives to the established theories. This is what embodied cognition has been doing for the last thirty years.

Hubert Dreyfus was one of the first philosophers to highlight the problems of cognitivist artificial intelligence or GOFAI. In his work, Dreyfus argued that cognitivists had adopted mistaken biological, psychological, epistemological, and ontological assumptions, leading cognitive scientists to misunderstand the very nature of cognition (Dreyfus 1992). However, it was until the 1990s when Rodney A. Brooks revolutionized the engineering of mobile robots, implementing new architectures that addressed many of the problems that Dreyfus had diagnosed previously in GOFAI. Of special significance that in Brooks's designs, agents do not need to internalize the outside information but exploit the information already available in the environment (Brooks 1991). The emergence of Brooks' artificial intelligence was a crucial moment in the history of cognitive science. He proved that it was possible to model basic forms of cognition (sensorimotor cognition) in ways that reject the central presuppositions of neurocentric cognitive science. Indeed, his models were more efficient and simpler than those of cognitivism.

Varela, Thompson, and Rosch's *The Embodied Mind* (*EmMnd*) is published almost in parallel to Brooks's work. This ground-breaking work rejected the main philosophical presuppositions of brain-centred cognitive science and looked for a new way to conceive and study cognition. Around this time, Antonio Damasio (1994) questioned the Cartesian background of mainstream neuroscience that assumed the mind-world dichotomy and neglected the crucial role of emotions and affects on the activities of cognitive agents. In the same decade, models of cognition based on dynamical systems theory began to study perception as a dynamical process that coupled the brain, the body, and the environment in a single complex system (Kelso 1995). Dynamical systems theory was also helpful for explaining the attunement of the body and the environment in sensorimotor interactions without the intervention of internal representations (Turvey and Carello 1995). At the end of the nineties, Andy Clark and David Chalmers (1998) took the idea of embodied cognition even further. These philosophers made the controversial claim that our minds can be spatially localized beyond the boundaries of the brain when we use artifacts to expand our biological, cognitive skills. Consequently, brain-centred cognitive science was no longer the only game in town at the dawn of the new millennium. However, the very different theoretical backgrounds and agendas behind the different forms of embodied cognition have impeded the unification of a single research program as an alternative to brain-centred cognitive science (Shapiro 2010).

Here, I propose a distinction between three different forms of embodied cognition: weak, moderate and radical embodied cognition.[9] The first still assumes the central dogma of brain-centred cognitive science. Although its supporters accept that the body plays a significant role in cognition, they think the body merely generates a particular type of neural representations. Therefore, we may speak in this case of weak embodied cognition. Moderate embodied cognition, by contrast, rejects neurocentrism but remains attached to the thesis of computationalism, causing thus statements that seem contradictory from both the perspective of brain-centred cognitive science and the one of radical embodied cognition. Finally, defenders of radical embodied cognition are thinkers who explicitly reject neurocentrism and computationalism. In what follows, I will survey these three alternatives, suggesting that radical embodied cognition is the most promising alternative insofar as it is the only branch that explicitly aims to overcome the prejudice of the mind-world dichotomy.

1.4.1 Weak Embodied Cognition

Weak embodied cognition acknowledges that abstract forms of cognition like imagination and thought are grounded on more basic sensorimotor levels. However, they conceive the sensorimotor level of cognition as a particular set of brain processes, different from those supporting more abstract forms of cognition. Weak embodied cognition hence does not really look at the concrete dynamic processes that cut across the brain, the body, and the environment to explain the emergence of cycles of action and perception. On the contrary, they appear to buy in the same distinction that the opposite view works with. A paradigmatic example of weak embodied cognition is the theory of *b-format representations*.

Goldman and Vignemont (2009) found that embodied cognition comprises a wide variety of approaches, not all equally viable for a scientific approach to cognition. While some approaches

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[9] Gallagher (*EnInt*) uses the label weak embodied cognition in the same way I do. Hutto & Myin (*RadEn*) use the labels ultra-conservative, conservative, and radical embodied cognition to name the three types I am describing in here.

trivialized the claim that cognition is embodied, others had no clear theoretical base for supporting it. These authors, therefore, proposed a "sanitized" theory of embodied cognition that involved the existence of a particular type of representation, corresponding to sensorimotor areas and pathways of the brain that they called b-format representations. These representations have the peculiarity of being active either in action, perception, or in processes of empathy, with the motor actions of other agents (e.g., mirror neurons: Rizzolatti and Craighero 2004). Moreover, the same representations originating in sensorimotor activity were also activated in higher cognitive activities such as thought and imagination, if such activities were related to contents of action and perception (see also Gallese and Lakoff 2005; Goldman 2012).

Like standard definitions of internal representations, b-format representations theory entails the belief that, while accomplishing cognitive activities, our brains need to use information that is not available in the environment at the moment (it is offline [Wilson 2002]). This information is contained in representational formats, physically implemented in brain processes and structures. Therefore, the defenders of b-format representations adopt the same sandwich model of cognition described by classical representationalists. However, there are many reasons for challenging this theory that neglects the dynamicity and complexity of social and sensorimotor interactions (*EnInt*).

Although interactions with other people can trigger activity in sensorimotor areas in the brain, this does not entail that the bodily movement of other people is represented internally. It just shows that bodily interactions are at the basis of social encounters. First, it is not only the brain but also the whole body, which gets prepared or ready for action when we look at others realizing a bodily action (Frijda 1986). Muscular tensions, the rhythm of heartbeats, glandular segregations, etc., are part of our action-readiness when we perceive other people's bodily actions, not only neural pathways (Bruineberg and Rietveld 2014; Colombetti 2014).

Second, other people cannot be internalized in representational formats due to the highly unpredictable and dynamic changes of their actions and responses (Gallagher 2015). Interacting with other agents demands unforeseeable and creative responses from agents and emotional and expressive (gestural) aspects that challenge the possibility of decoupling an agent's actions, perceptions, emotions, and expressions from the same kind of activities produced by others (Gallagher 2005; *EnInt*).

Third, dynamicity and unpredictability are not exclusive to social interactions. Environmental situations also change constantly in cycles of actions and perception. For classical representational models of action and perception, cognition consists of interpreting perceptual data from sensorial inputs and sending motor commands to motor outputs so that agents can manage the contingencies of environmental situations (Pylyshyn 1984). These explanations, however, neglect the environmental and bodily contingencies that produce continuous (online) variations and adjustments in sensorimotor loops (Clark 1997). Perceptually, the flow of sensorial stimuli dynamically changes thanks to the body's action (Thelen and Smith 1994). Bodily actions also vary dynamically due to multiple contextual variables of the environment (e.g., pressure and inertia) and of the body itself (e.g., energy levels and emotional states). Sensorimotor systems need to change constantly and adapt dynamically to the circumstances, establishing a dynamical coupling with the environment. This coupling cannot be encapsulated in representational formats, at least not in the traditional manner (*EnInt*).[10] These conclusions do not deny the significant role of the brain in sensorimotor and social interactions. However, they lead us to see that brain processes are just one fragment of the transcranial body-environment system. The brain actively modulates the interactional system in this system, but it does not need to internally represent the world or the body for this task (Fuchs 2018).

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[10] In moderate versions of embodied cognition, there are also hypothesis that consider the existence of special types of representations (minimal representations) like predictive emulators (Clark and Grush 1999) or action-oriented representations (Wheeler 2005). Although this kind of hypothesis are sound because they highlight that we always need more than real-time or online dynamics to explain the efficient coordination of cycles of action and perception, they also entail a much broader conception of representations than the classical ones. In these versions, representations are either highly dynamic and plastic to be seen as vehicles decouplable from the brain-body-environment system (*MndLf*), or they are conceived as vehicles implemented all across this system (Wheeler 2005, 193). If this is the case, Gallagher (*EnInt*) argues it might be better to abandon the talk of representations because is useless (see also *RadEmCS*) and recognize instead the existence of structural dynamic wholes (*Gestalten*) that predispose the brain-body-environment system to acquire a particular dynamic coordination (Gallagher et al. 2013; *EnInt*, 161).

The solution of weak embodied cognition thus looks more like the classical use of *ad hoc* strategies to maintain the theoretical core of a scientific theory (Popper 1962). Weak embodied cognition changes nothing regarding the sandwich model of cognition because cognition is once again pictured as the processing of encapsulated vehicles of information detached from the concrete body and, consequently, from the rest of the environment (cf. *RadEn*).

1.4.2 Moderate Embodied Cognition

Moderate embodied cognition, in contrast to weak embodied cognition, accepts that cognition is not restricted to the brain, since there are many cases where cognition involves the coupling of the brain-body-environment system as a single functional unit (e.g., Clark 1997). Nonetheless, this approach still endorses the claim that cognition consists of information processing (Wilson and Clark 2009) and accepts that most of the information processing that characterizes cognition occurs in the human brain (Clark 2008b). Moderate embodied cognition thereby rejects neurocentrism but endorses computationalism. The hypothesis of the extended mind (henceforth "the extended mind") is one of the best examples of moderate embodied cognition in this regard.

The extended mind claims that cognitive systems are *occasionally* constituted by the brain, bodily, and environmental structures (Clark and Chalmers 1998). The defenders of this hypothesis base their arguments on a functionalist perspective they call *extended* or *embodied functionalism* (Wheeler 2010). For cognitivism, computational cognitive functions are physically implemented in the brain exclusively. However, for proponents of extended functionalism, information processing is causally supported by extended systems that cut across the brain, body, and the environment (Clark 2010). Paradigmatic examples of extended mind are using notes as memory cues or a piece of paper for mathematical operations (Clark and Chalmers 1998; Wilson and Clark 2009). Extended functionalism is not committed to any particular form of computationalism but assumes that cognition involves some form of information processing. The revolutionary idea is that information processing can be physically implemented in very different systems, not exclusively in the human brain.

Extended functionalism nonetheless entails problems for both neurocentric cognitive science and radical embodied cognition. From a neurocentric perspective, cognition does not merely involve information processing functions, but also the spontaneous generation of semantic representations needed to accomplish computational cognitive functions (Adams and Aizawa 2008). No other physical systems exhibit the spontaneous production of semantic representations other than the human brain (Searle 1997; Adams and Aizawa 2001, 2008). Therefore, from a neurocentric perspective, the bodily and environmental processes involved in cognitive tasks do not fulfill the criteria of cognitive processes (Adams and Aizawa 2008). These processes are better seen as auxiliary causal processes of cognition (cf. Rupert 2009).

From the standpoint of radical embodied cognition, the extended mind is no less problematic, since extended functionalists still endorse computationalism, which radical embodied cognition rejects. On its grounds, from this standpoint, cognition is rooted in the sensorimotor interactions of an agent and the environment. These interactions can be perfectly modelled by non-representational models of dynamical systems theory (e.g., Turvey and Carello 1995; Beer 2000). These models need not to assume a radical separation between the brain, the body, and the environment. Therefore, as Hutto and Myin (*RadEn*) claim, from a radical perspective, minds are not extended but *extensive* because their constitution implies the coupling of the brain, body, and environment as a unitary system from the start. Moreover, for some radicals, the living body of cognitive agents plays a role that breaks the symmetry with the environment, modulating their interactions with the environment (Thompson and Stapleton 2009). This means that the structures and processes of the environment cannot play the same role as brain and bodily processes, which is one of the claims made by extended functionalism (Clark 2008b).

1.4.3 Radical Embodied Cognition

Radical embodied cognition explicitly rejects the theses of computationalism and neurocentrism. Although many approaches of radical embodied cognition have focused on the rejection of representationalism and not of computationalism as such, this led to a redefinition of the whole phenomenon of cognition. We find this to be the case in the two main forms of radical embodied cognition: *enactive cognitive science* and *ecological approaches to cognition* (cf. figure 4).

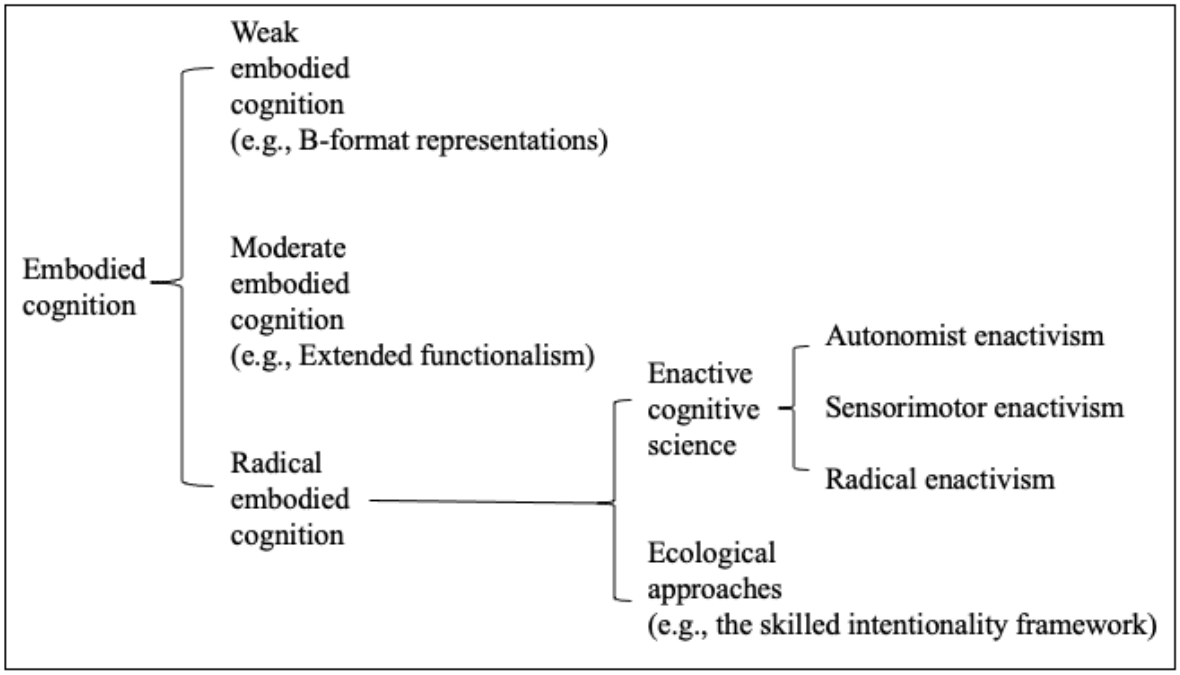

Figure 4. – The main branches of embodied cognition

This figure broadly illustrates the main branches of embodied cognition, according to the accounts I gave in this section.

Enactive cognition or enactive cognitive science originated in the claims of Varela, Thompson and Rosch in *The Embodied Mind* (*EmMnd*) where they argued that cognition was not information processing but *enaction*. This idea is more complex than many cognitive scientists usually assume and needs a deep examination to reveal its philosophical implications. I will take this task in the next chapter (2.1). In the meantime, we can say that enaction consists of a twofold claim: (1) perception is based on regular patterns of sensorimotor interaction between an agent and the environment, and (2) all forms of cognition are ultimately grounded in the same sensorimotor patterns (*EmMnd*, 173). Defining cognition as enaction thus leads to rejecting the notion that perception is representational and computational because sensorimotor patterns are seen as concrete "happenings" in the world that depend on concrete bodily actions of agents. Dynamical systems theory (Thompson and Varela 2001), and more lately, the free-energy principle (Kirchhoff and Froese 2017) has reinforced this claim on an empirical basis.

There are nowadays many proposals of radical embodied cognition that claim to be enactive. The first and foremost form of enactive cognition is the *enactive approach* that I will name for practical purposes *autonomist enactivism* (*EmMnd*; *MndLf*; *SmLf*; *LngBod*). [11] I will argue later that this approach is the most radical form of embodied cognition because it is the one that puts in question most deeply the philosophical presuppositions of brain-centred cognitive science. *Sensorimotor enactivism* (Noë 2004) is, chronologically speaking, the second major branch of enactive cognitive science, mainly based on the theory of *sensorimotor contingencies* (O'Regan and Noë 2001). This theory describes perception as the acquisition of practical knowledge or know-how of lawful sensorimotor correlations. *Radical enactivism,* the third major form of enactive cognitive science, undermined representational theories of mind and cognition by demonstrating how an account of information without representational content, information as co-variation, helps us to understand the sensorimotor basis of cognition (*RadEn*; *EvoEn*). Other philosophers and scientists, most notably Shaun Gallagher (Gallagher 1995, 2005; *EnInt*) and Thomas Fuchs (Fuchs 2017,2018), have also made significant contributions to modelling sensorimotor and social cognition from a non-computational and non-neurocentric point of view and that we can fairly call enactive. Nevertheless, these authors have not been explicitly committed to the main principles of one of the three primary forms of enactivism (autonomist, sensorimotor, or radical).

Although the focus of enactive cognition was originally on how individual bodily actions causally constitute cognition, there is now an increasing interest in how social interactions and environmental structures are also constitutive of this phenomenon (e.g., McGann 2014b; *EnInt*;

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[11] It is common in the field to name this approach "autopoietic enactivism." I do not use this term, as it has been rejected by its main supporters, who object to how misunderstandings arising from this label have attached to other claims. The theory of autopoiesis (Maturana and Varela 1980, 1994) has certainly been important for the development of the theory of biological autonomy that lies at the basis of the "enactive approach." However, this theory is insufficient for explaining life and cognition from the standpoint of the most recent versions of this enactivism (see 2.3.4). I am calling this enactive approach "autonomist enactivism," as Barandiaran (2017) suggests, because this label helps us highlight that autonomy distinguishes living and systems from the rest of the physical systems we know, and it is a constitutive aspect of cognition that other approaches, brain-centred and embodied, fail to recognize.

EvoEn). This subject has been significant for enactive cognition to explain how cognitive activities that are seen as properly human (such as imagination, symbolic language, and abstract reasoning) have scaled up from basic cycles of action and perception. The study of the role of environmental structures for cognition has, nonetheless, been the focus of the other main branch of radical embodied cognition, that of *ecological approaches*.

Ecological approaches to cognition originate in the work of the American psychologist James J. Gibson, who created a non-representational and non-neurocentric theory of visual perception almost in parallel with the emergence of cognitive science. For Gibson, perceivers do not need to represent information internally because the environment already has an informational structure accessible to organisms through locomotion (*EcApVsPr*). Gibson called this informational structure *ecological information,* and it is on this informational basis that perceivers can access the most primitive forms of perceptual meaning, which Gibson calls *affordances*. In this regard, our perception is primarily guided by what things afford as *possibilities for actions.* The chair affords sit-ability, this cup affords grasp-ability, and so on. All these pragmatic "meanings of things" are affordances, and Gibson's thesis is that these are *perceptually* accessible to the agent.

Michael Turvey (1992), Edward Reed (1996), Harry Heft (1989, 2001), Anthony Chemero (2003; *RadEmCS*), and other ecological psychologists have continued to develop the original concepts of Gibson to make ecological psychology a solid scientific theory that rivals mainstream forms of sciences of mind. The skilled intentionality framework is nowadays probably the most systematic and complete ecological approach to cognition (Bruineberg and Rietveld 2014; Rietveld and Kiverstein 2014; *EcEvAf*). Adapting the framework of ecological psychology to address Wittgenstein's account of socio-cultural practices, this approach has constructed a robust theory of skillful human practices. Contrary to other ecological approaches, this approach has incorporated a theory of how individual agents become attuned to ecological frameworks that are both natural and cultural (see also Ramstead, Veissière, and Kirmayer 2016). As a theory of bodily attunement, skilled intentionality works from an embodied interpretation of the free-energy principle (Friston 2010), and from the phenomenological work of Merleau-Ponty (*PhP*). The notion of skilled intentionality suggests that the skilled intentionality framework is not only an ecological approach to cognition, but also an enactive one, since it describes how agents enact a sensorimotor domain of interactions based on the natural and social constraints that shape their interactional space (Kiverstein and Rietveld 2018). The complementarity between enactive and ecological approaches for a unified and more robust account of radical embodied cognition seems necessary. However, in the following chapters, I will consider significant challenges to this task.

Radical embodied cognition is not exempted from problems and criticisms. Since enactive cognition has traditionally focused on forms of cognition that lack explicit forms of consciousness, it has been accused of reviving behaviourism and explaining phenomena that we can hardly call cognition (cf. Aizawa 2014). There is also a challenge of scaling up explanations of the basic levels of cognition based on non-representational models to the abstract complex forms that seem to imply the use of internal representations (Clark and Toribio 1994). Many of these problems are nonetheless proper of scientific programs that are still under construction. There is no reason to think that such problems cannot be addressed and surmounted soon (see, e.g., *EvoEn*; *EnInt*; *LngBod*; Kiverstein and Rietveld 2018).

1.4.4 Beyond the Mind-World Dichotomy

This chapter has argued that brain-centred cognitive science is based on two fundamental theses: computationalism and neurocentrism. These theses were synthesized in cognitivist models of cognition to offer the thus far most crucial scientific endeavour to understand mental phenomena. However, the neurocentrism of cognitivism has involved multiple empirical and philosophical problems.

In the face of these problems, alternative computational models of cognition such as connectionism and prediction error minimization have been elaborated. However, we have seen that, despite the progress they have made, these views still endorse the same problematic neurocentric thesis we find at the core of cognitivism, at least insofar as they assume a mind-world dichotomy. They insist on locating the mind in the brain as something isolated from the rest of the world. I have shown, however, that their computational models can be interpreted differently and can be useful to see cognition as a process that cuts across the brain, the body, and the environment as a singly unitary system. This is what embodied cognition has been doing in the last thirty years.

Among the field of embodied cognition, there are nonetheless approaches that look for a reshaping of the same neurocentrism of brain-centred cognitive science. The program of weak embodied cognition reduces the real body of agents to a special sort of representations in the brain. Other moderate versions of embodied cognition explicitly reject neurocentrism but stay committed to problematic interpretations of computationalism that cause contradictory statements from both a neurocentric perspective and a more radically embodied one. For this reason, radical embodied cognition becomes the only real alternative to neurocentrism. There is still open the question of what makes radical embodied cognition a most promising account of cognition than any other form of cognitive science, aside from its rejection of neurocentrism. We also need to explain why these radical approaches reject the idea that cognition consists of information processing. I will respond to these questions in the next chapter. Chapter two argues that enactive cognition, particularly autonomist enactivism, offers important arguments that purport to reject computationalism and redefine our traditional conception of cognition. Later, in chapter four and five, we will see that additionally to enactivism, we need an ecological approach to overcome the problematic mind-world dichotomy.

Chapter 2 – Enactive Cognition: From Sensorimotor Interactions to Autonomy and Normative Behaviour

Enactive cognition is one of the two main branches of radical embodied cognition that stand against the theoretical core of brain-centred cognitive science. Chapter one defined this core as the synthesis of two theses: neurocentrism and computationalism. I argued that neurocentrism is highly problematic from both empirical and philosophical points of view. In contrast to brain-centred cognitive science, enactivists think of cognition as a process extended across the brain-body-environment system. Hence, cognition cannot be spatially localized within the boundaries of the head. We can model the extended dynamical processes of cognition computationally, but that does not mean that cognition is a computational function. For enactivists, cognition is instead enaction. However, what exactly this affirmation means is often unclear. How the different actors in the field understand 'enaction' often depends on how each scientific approach envisions the construction of the enactivist paradigm in cognitive science.

This chapter argues that there are two main types of enactivism based on different meanings of the claim that cognition is enaction. I will call these types *weak enactivism* and *strong enactivism*. Weak enactivism is built on the belief that cognition is rooted in sensorimotor correlations established via mechanistic interaction processes between agents and their environments. Strong enactivism, on the other hand, sets the basis of cognition in the constitutive autonomy of agents and their capacity to create and adapt their own norms of interaction with the environment. I will argue in favour of strong enactivism because it offers more accurate and complete descriptions of the systemic constitution of real cognitive agents (i.e., living agents). This can better explain the sort of behaviour these agents exhibit.

I start examining the philosophical foundations of enactive cognition in its seminal work *The Embodied Mind* (*EmMnd*). This will help us to appreciate the original proposal of enactive cognition. In this book, the authors argued against two important tendencies in modern sciences and philosophies of mind, according to which cognition is a phenomenon grounded either in the absolute foundations of the physical world or the constitutive mind (2.1.1). The proponents of enactive cognition argue instead that cognition depends on the contingencies given in the history of interactions between embodied and enculturated subjects and their natural and social environments (2.1.2).

Despite these clear philosophical foundations, two divergent interpretations were advanced from the claim that cognition is enaction. The first interpretation makes a partial reading of the scientific claims of the authors of *EmMnd* and neglects their philosophical bases. This interpretation gave birth to weak enactivism (2.2.1). The second reading, by contrast, offers a more complete and specific definition of enaction, founded upon the early theory of autonomy and the philosophical foundations of *The Embodied Mind*. As I will show, therein lies the origin of strong enactivism (2.2.2).

Nowadays, the theory of sensorimotor contingencies (O'Regan and Noë 2001) or sensorimotor enactivism and radical enactivism (*RadEn*) are approaches that support the vision of weak enactivism. By contrast, Autonomist enactivism (*MndLf*) and arguably Friston's variational approach (Allen and Friston 2018) are examples of strong enactivism. I will focus here only on the main differences between *radical enactivism* and *autonomist enactivism*, since they are, from a *theoretical* standpoint, the most robust theories of weak and strong enactivism, respectively. I will therefore review the central hypotheses of radical enactivism (2.3.1) and show the kind of support orthodox theories of life and evolution have provided to this theory (2.3.2). We will see that this biological background has led radical enactivism to dismiss the theory of autonomy and has caused three significant shortcomings in their conception of cognition. First, radical enactivism has failed to provide more specific criteria to distinguish conceptually between real cognitive agents and artificial imitators (2.3.3). Second, it cannot distinguish systemically between mere self-organizing systems and cognitive systems (2.3.4). And third, radical enactivism misses one aspect that seems to be a distinctive feature of cognitive systems: *agency*.

The supporters of autonomist enactivism, on the contrary, define cognitive systems as autonomous systems in precarious conditions. Importantly, these systems can adapt their behaviour to alter these conditions while interacting with the environment. As far as we know, only living beings fulfill this definition. For this reason, autonomist enactivists claim cognition is rooted in the systemic constitution of life. I call this definition *the theory of biological autonomy* (2.4.1). This theory also entails that living agents enact their own normative domain of interactions with the environment, performing an activity called *sense-making*. (2.4.2). Cognition as enaction, for autonomist enactivism, is one form of sense-making. This innovative conception of life and cognition describes living organisms as agents, and focuses on how developmental, and not just phylogenetical processes are central to the constitution of these agents and their behaviour (2.4.3). This chapter concludes by arguing that the focus of autonomist enactivism on the development of organisms, and the inclusion of agency and subjectivity as constitutive aspects of cognition, makes this enactive approach capable of avoiding the three shortcomings of radical enactivism and of any other form of weak enactivism (2.4.4).

2.1 The Philosophical Foundations of Enactive Cognition

In *EmMnd*, the founders of enactive cognition, Francisco Varela, Evan Thompson, and Eleanor Rosch, made two main types of statements. The first type was a philosophical claim that cognition is a phenomenon that lacks absolute foundations and must be studied from both a first and a third-person perspective. This was so, they argued, because cognition involves subjectivity. In their view, subjectivity is, however, *embodied* and does not coincide with the classical accounts of subjectivity we find in the Cartesian tradition. Subjectivity is, therefore, an *embodied subjectivity.*[12] The second claim made by these authors was scientific and defined cognition as enaction. The following two subsections focus on the philosophical claims of the authors of *EmMnd,* first on their criticisms of the main philosophical traditions that influenced modern sciences of mind (2.1.1), and later, on their own views of mental phenomena that were supported by phenomenological philosophy (2.1.2). Section two will address the main scientific statements of the founders of enactive cognition.

[12] Thomas Fuchs (2018, xix) uses this term to describe the ontological unity that implies the *dual aspectivity* of a person as a unity of "lived body" and "physical body." Although less detailed, the philosophical theses of Varela et al. (*EmMnd*) already contained this dual aspectivity described by Fuchs, and, as I will argue, it should be seen as the most fundamental philosophical basis of enactive cognition.

2.1.1 A World without Egos and Egos without Worlds

The Embodied Mind begins with criticisms of the two main philosophical tendencies in modern sciences of mind, namely *naïve objectivism* and *disembodied subjectivism.*[13] For a complete understanding of the scientific claim that "cognition is enaction," we need to bear in mind that Varela and colleagues were looking for a *middle way* or an *entre-deux* between these two problematic philosophical traditions (*EmMnd*, 3, 236).

Naïve objectivism relies on three essential claims. The first claim is *ontological*: the objects of the world exist as such, i.e., with intrinsic properties that are independent of our knowledge and experience of them. From this perspective, nature is a subject-independent reality (e.g., Bunge 2006). The second claim is *epistemological* and amounts to saying that we can eventually know this subject-independent reality thanks to the inductive methods of science (Mill 2012; Hacking 1983). Since subjective experience is a phenomenon that others cannot observe, the experiential aspects that accompany cognition must be excluded from scientific theories of cognition. Consequently, there is a third *methodological* assumption: we can eventually explain cognition employing the third-person perspective methodologies of science without considering the first-person perspective (Churchland 1986).

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[13] Varela et al. (*EmMnd*) called these two assumptions *realism* and *idealism* respectively. I prefer to use, on the one hand, the term naïve objectivism instead of realism to highlight that the problem of modern sciences of mind, for enactive cognition, is not to aim some sort of objectivity in science, i.e., the existence of objects that transcends our subjective experience. The problem is rather their blind adoption of the naïve attitude of many modern scientists and philosophers, and which implies to neglect the role of our own bodily, cultural, and historical immersion in the description and explanation of all phenomena we experience. We will see below that such realism or naïve objectivism corresponds to what Husserl calls the *natural attitude* of experience in the case of our everyday lives (Husserl 1982) and the *naturalistic attitude* in the case of modern sciences (Husserl 1970). On the other hand, I use the term *disembodied subjectivism* to highlight that although enactive cognition makes subjectivity a constitutive part of cognition, it is not a traditional (i.e., disembodied) form of subjectivity.

The disembodied view of subjectivity that we generally associate to Descartes, by contrast, did not use empirical observation as its primary method for knowledge but is somewhat grounded on subjective thought. More specifically, this sort of subjectivism relies on deductive reasoning. Using a speculative and deductive method, Descartes (2008), the so-called father of this philosophical stance, criticized the fallibility of empirical knowledge and concluded that the most secure foundation of knowledge is our own ego. We know the story: even if everything that we perceive is illusory and what we think is false, it is still true that our thinking ego is being cheated, and it is unquestionable that our ego, as a thinking thing, as a *cogito,* exists. This existence is nonetheless abstract because, for Descartes, it is only the ego *as it is thinking* that exists. The cogito is a *disembodied ego*. It is only in his rational capacities that we find the foundations of our knowledge of the external world (*EmMnd*, chap.4, 7; Rowlands 2010, chap.1; although see Seager 1988).

For Varela et al. (*EmMnd*, chap. 10), both tendencies are misleading because the two share a common error: the quest for secure foundations of knowledge. Neither the empirical world nor the cogito is the solid ground objectivists and subjectivists were looking for. Enactive cognition proposes instead to embrace the groundless ground of our existence as the point of departure for our scientific inquiry of cognition. *Therefore, the first step towards a non-foundationalist cognitive science recognizes that cognition is a phenomenon that cannot be explained, neither in pure objectivist terms nor in those of pure subjectivism*.

Varela and colleagues (*EmMnd*) admit that our study of cognition originates in and is continuously constrained by subjective experience. For instance, the causal explanations of perception, imagination, memory, decision-making, etc., are based on descriptions originating either in the experience of the cognitive scientist or in the reports of the experience of other subjects (eventually interpreted by the cognitive scientist). Scientists use these original "data" to elaborate theoretical hypotheses about the causal processes underlying mental phenomena. Since modern scientists have found significant correlations between brain activity and subjective experiences, mind scientists can infer a causal connection between reported subjective experiences and brain processes. Nonetheless, subjective experiences are phenomena we cannot directly observe and are difficult to standardize. The reports and intuitions of different subjects, scientists, and philosophers are often variable, divergent, and even contradictory. The empirical observations made in the controlled environments of laboratories, by contrast, are more reliable. Therefore, many scientists conclude that we must dispense subjective reports and base our causal explanations of mental phenomena on empirical data alone (e.g., Churchland 1986).

The problems of measuring and controlling data provided by subjective experience prompted physiological approaches, like behaviourism, to neglect the importance of what takes place in the non-observational realms of mental phenomena. Behaviourism proposed instead to focus on the observable behaviour of minded subjects. Cognitivism, the first and most classical form of brain-centred cognitive science, realized that behaviourism went too far and proposed to computationally model some of the non-observational aspects of mental phenomena (the functional aspects). Computational models of cognition aimed to pass over the marshes of subjectivity, conjecturing formal models that more reliably correlated subjective reports to observed brain processes. Nonetheless, these computational models tended to forget their subjective origins and the importance of having continuous feedback from subjective experience to make these models more accurate (e.g., Kahneman and Tversky 1979; Jackendoff 1987).

A disembodied subjectivism is no less problematic than naïve objectivism, in any case. According to subjectivist philosophies, the ego is what makes intelligible the external world. The causal laws we observe in the empirical world, for instance, are not part of nature as such but simply represent how our minds make sense of worldly events. The order might be psychological, as Hume suggested, or transcendental, as Kant proposed, but this does not change much. The nature of the ego is also more slippery than it seems *prima facie*. For Descartes, the existence of the cogito is a self-evident truth, but the ego as an existent thing (as an object) cannot be found anywhere.

If the cogito is not the foundation of experience as a substantial thing, it is still possible to claim that the ego is something like a transcendental self, i.e., a condition of possibility of experience. Kant (1998, A108), for instance, described some sort of transcendental ego as the unity of apperception. This ego-like transcendental structure is, in Kant's philosophical system, the necessary condition for the unity and coherence of spatiotemporal experiences. Such an ego is, nonetheless, as with Descartes, a mere principle; as such, it cannot be experienced either. Kant's transcendental ego, too, thus appears as a pure abstraction, i.e., as an ego that, enclosed in itself, finds itself only indirectly in the act of self-reflection (cf. *EmMnd*, 70-72).

Varela and his colleagues not only argue that it is impossible to find a concrete self or an ego in the speculation of Cartesian-like philosophies, but they also think that it is impossible to find it empirically. There is no evidence of a "central command," not even of a constant dynamic unity in brain processes that correlates to the unity of our different experiential acts. Instead, the brain exhibits a diversity of dynamic processes that vary according to the different conditions of the environment, and to the different tasks, we must accomplish (*EmMnd*, 72-79). That is, the unity of the self varies according to the nature of the practical tasks at play in the current circumstances. Therefore, the self is not a solid unity, independent of the dynamic interaction of an agent and the environment; its unity is rather contingent and depends on the coupling of the body and the environment (*EmMnd*, 123-130).

Considering all these arguments and evidence against the foundationalist ambitions of objectivism and subjectivism, Varela and colleagues suggest an alternative approach to cognition that rejects grounding this phenomenon either in the world or in the subject's mind. Instead, we should recognize mind and cognition as phenomena that are *entre-deux,* a middle way, between these two opposites. The middle way is not a third dimension between mind and world; rather, it is the original embodied dynamics in which Self and World are two poles of the same relational structure. I will call this middle way *embodied subjectivity*.

2.1.2 Embodied Subjectivity

To better understand embodied subjectivity and the importance of this thesis for the research project of enactive cognition, we should look at its philosophical background. Although Varela and colleagues found in Madhyamaka school of Buddhism the most trustworthy source for understanding the middle way in *EmMnd*, in subsequent works, the philosophical discipline of phenomenology becomes the theoretical pillar of enactive cognition (cf. *MndLf*; Thompson 2016, 2018).

Phenomenology has influenced enactive cognition in many ways. In this section, I will briefly address two of their shared views. First, I will show how autonomist enactivism and phenomenology have questioned the background assumptions of mainstream scientific thought. Secondly, I will explain how phenomenology questions the conclusions reached by Cartesian and transcendental philosophies by pointing out how they neglect the role of the body and the world in the constitution of lived experience.

The thesis of embodied subjectivity begins with recognizing the existential condition of human beings that Heidegger (1962) called *being-in-the-world*. This being awakes to conscious reflection in a world already structured by relations of meaning,[14] or more properly speaking, by what Merleau-Ponty (*PhP*) called *sense.*[15] For Merleau-Ponty, sense involves the particular orientation in which things appear before us (cf. Morris 2018, 7-8). Sense is not intrinsic to things; it is akin to the practical and affective significance of things situated in specific contexts of action that we

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[14] Steven Crowell has claimed that phenomenology places the theme of meaning as philosophy's main concern. Crowell (2013, 10) describes meaning as "the intelligibility of things," but more simply, we can say it is how things appear as they do. Phenomenological analyses of meaning are directly or indirectly founded (via Husserl) upon Brentano's theory of intentionality. This theory analyzes how both the acts and objects of consciousness are related (see 1.3.1). Phenomenology rejects the representationalism intrinsic to Brentano's early theory of intentionality (Crowell 2013; see also Doyon 2015), and arrives at what we can call horizonal theories of intentionality, discernible in the works of the main phenomenologists: Husserl, Heidegger, and Merleau-Ponty. A horizonal theory of intentionality does not assume that meaning is intrinsic to the objects of consciousness. Instead, meaning can be understood as the normative (correct or incorrect) appearance of things in networks of interrelated aspects, such as temporality, bodily actions, or the bodily presence of others (see 3.3).

[15] "Sense" in Merleau-Ponty's phenomenology is a concept determined by the meaning of this word in French (also *sense*), one that involves direction or orientation (cf. Landes 2013). This quality of orientation is a central aspect of our experience of phenomena. In perception, for instance, any visual object appears in a certain manner, and is located in relation to us and to other objects and people. With this in mind, we can say that sense describes meaning in the way that Crowell defines "meaning" (see the note above). However, as a word, sense is a useful term for distinguishing the way that things appear, from the idea of "semantic meaning," or the definitions of a linguistic utterance. This latter usage is the most common usage of the term "meaning" in philosophy of mind and brain-centred cognitive science.

can call *horizons* (*PhP*). [16] The significance of things and their horizons originates in the dynamic interaction of a living body and its surroundings. These surroundings are natural and physical, but, for humans at least, they are also social and cultural. Therefore, our lived experience of the world is not a reproduction or a representation of how the world is, independently of us; instead, it is the *disclosure* of our own bodily entanglement with the world. As the starting point for the scientific study of cognition, the adoption of this existential condition described by phenomenologists radically transforms the project of enactive cognition (cf. 3.3).

Phenomenology uses a rigorous method to describe and analyze lived experience. Phenomenological descriptions, however, are not about the contents of individual subjective experiences; they rather concern the structural aspects or *invariants* of these experiences (Gallagher 1997). They are, in this sense, essential or eidetic descriptions, not psychological or introspective ones. To accomplish this sort of analysis, Husserl applied a strategy called the phenomenological *epoché* (Husserl 1982, §32). The epoché puts on hold any judgement about the positive existence of the objects we experience, judgements we usually make in our everyday lives. Husserl calls this everyday attitude the *natural attitude* of experience (Husserl 1982, §30). By utilizing the epoché, a new dimension of experience opens itself: we shift our attention from the things given in lived experience to *how* they are given in lived experience. When we do so, we leave the natural attitude behind and adopt what Husserl calls the *phenomenological attitude*. (Husserl 1982, §50)

The natural attitude is not exclusive to our everyday experiences; it is also present in philosophy and science. Empiricism is the philosophical tradition that has most clearly (albeit only implicitly) endorsed this attitude insofar as it grounds all kinds of knowledge on objects given *in* experience. Since empiricists recognized, like Descartes, that our senses are fallible, they transferred the foundations of knowledge to our capacity to infer the causal basis of phenomena from empirical observations (cf. Mill 2012). From this standpoint, therefore, causal theories of observable phenomena, rather than direct perceptual experiences, give us access to the intrinsic reality of the

[16] The notion of horizons in phenomenology has multiple interrelated meanings but I offer one more specific in 3.3.

world. Husserl (1970) called this specific form of the natural attitude in modern sciences *the naturalistic attitude*.

The phenomenological method, therefore, consists in systematically bracketing both our natural and naturalistic attitudes. After the epoché, the second fundamental step is *the phenomenological reduction* that asks us to adopt a transcendental analysis of the structures of experience (an analysis of how things are given within experience). That is, the epoché and the reduction altogether shifts our attention from *what* is given within lived experience (the empirical world) to the structures that make experience possible (the transcendental dimension of experience) (Zahavi 2003, chap.2).

The phenomenological method, nonetheless, must not be confused with Descartes's skepticism or with any other form of disembodied subjectivism. Phenomenology, contrary to Descartes, does not really question or doubt the existence of the empirical world (Zahavi 2004). Phenomenology is rather a particular way to look at the world we are immersed in, or, as Husserl claimed, a method for "going back to things themselves" (Husserl 2001b). Hence, to appreciate the distinction between phenomenology and Cartesianism, we must acknowledge that what the epoché puts on hold is not the existence of the world itself but the belief that the objects are in themselves, in the way we find them *within* our natural attitudes of experience.

On the foundations of Husserl's phenomenology, both Heidegger and Merleau-Ponty realized that phenomenology could not be the enclosure of a rational subject within its abstract thoughts because the subject is inevitably and permanently open to the world (*PhP*). Therefore, phenomenology is best understood as the analysis of this existential condition.[17]

The continuous and unavoidable opening of the embodied subject to the world is what makes the methodology of phenomenology necessarily fallible (cf. *PhP*). However, the natural, and even the naturalistic attitudes of subjects are not mere errors, defects, or weaknesses of cognitive subjects. They are instead the existential condition of beings in the world. The natural attitude corresponds

[17] Although Heidegger never made explicit his concern for the role the body plays in the constitution of a situated existence (*Dasein*), his descriptions of Being-in-the world seems to presuppose this role (Dreyfus 1991, 41).

to how we live every day when interacting with things and people around us in the most ordinary ways. The fundamental weakness of the natural and naturalistic attitudes is elsewhere: it lies in the neglect of the *facticity* of our own existential situation as embodied and enculturated beings (*PhP*; Merleau-Ponty 1964a). Unless we pay attention to this situation, we risk falling prey to dogmatisms that can impose a single theory, ideology, or cultural form as universal models that produce universal and unquestionable truths.

Phenomenology engages in an exercise of self-reflection to avoid such dogmatism. The goal is to identify the invariant structures that make up the constitutive entanglement of embodied (practical, affective, erotic, and expressive) subjects and their world. In the case of human beings, the embodiment is not a bare physical relationship between an isolated individual and the world. It is always also shaped by culture. Hence, our existential condition is embodied and enculturated (cf. Heidegger 1962; Husserl 1970; *PhP*).

Therefore, the transcendental stance of phenomenology does not consist in abstracting the rational subject from the world in which she lives but in performing hermeneutics of facticity (Heidegger 1962). That is, we do a self-interpretation of our embodied and enculturated existence.

The transcendental task of phenomenology is precisely what autonomist enactivism takes up in *EmMnd*. The enactive approach criticized the naturalistic attitude at the heart of neurocentric cognitive science, which completely disregards that embodied subjectivity is a condition for doing science. Before being a scientist, a person is a human being embedded in the horizons of the world she lives in. She adopts theoretical prejudices, methodologies of observation, makes use of the theoretical and technological tools of her age, and unavoidably biases her investigations by personal and cultural prejudices, etc. Her scientific labour thus necessarily arises within a pregiven and meaningful world that Husserl (Husserl 1970) called the *lifeworld*. The human condition of cognitive scientists is what the authors of *EmMnd* (chap.1) call a *fundamental circularity*, because the scientists and the philosophers remain trapped in a circle of self-interpretation within the world.

The first aim of enactive cognition in *EmMnd* was, therefore, to make cognitive scientists recognize this existential condition. This approach claims that we need a methodological analysis of experience to guide our scientific inquiries about mind and cognition to acknowledge the embodied and enculturated existence of cognitive agents.

2.2 The Divergent Paths of Enactive Cognition

Upon reviewing the philosophical claims set out in *EmMnd*, it should be clear that, from an enactive perspective, a scientific study of cognition should involve explanations that avoid positing absolute foundations. Therefore, if we claim that cognition is enaction, the roots of cognition should be contingent and labile, not totally predetermined.

This philosophical view, however, is admittedly still too general to serve as a definition of enaction, and it is also subject to different interpretations. To help clear this up, let us first recall that the word enaction has two different nuances of meaning. Enaction can refer to the *acting out* of a play or a story. In this sense, enacting something is like doing a *mise en scène* of a pre-given script, as when actors played Caligula at the *Théâtre du Nouveau Monde*. This enacting of Caligula is different from simply reading Camus' work in a book. A second sense of the word enaction refers to putting a new law into effect. Note that this kind of enactment produces a new set of constraints and rules for behaviour in society. Thus, when the Canadian parliament made the public sale of Cannabis legal, it enacted a law that changed the habits of people living in Canada. With these two senses of the word in mind, we can now ask if the claim that cognition is enaction means that cognition arises from the action of agents as a result of predetermined guidelines, or if cognition involves the creative emergence of new guides of behaviour. Curiously, these two alternatives resemble two possible interpretations of the claims made by Varela and his colleagues in *EmMnd* that will be reviewed below.

2.2.1 Weak Enactivism

The most common and loosest interpretation of the claim that cognition is enaction centres on the thesis that all forms of cognition are rooted in cycles of action and perception (e.g., *EvoEn*; *EnInt*; *EcEvAf*). Concrete sensorimotor interactions of agents and their environments constitute these cycles (e.g., Noë 2004; *REC*; Myin and Degenaar 2014). This conception of cognition as enaction contrasts with the claim of brain-centred cognitive science according to which cognition is a computational function that simply processes information received from the outside world.

In the following two classical passages from *EmMnd,* we can find support for this standard interpretation and what enaction means in this context:

> In the enactive program, we explicitly call into question the assumption—prevalent throughout cognitive science—that cognition consists of the representation of a world that is independent of our perceptual and cognitive capacities by a cognitive system that exists independent of the world (*EmMnd*, lxvi).

> We can now give a preliminary formulation of what we mean by *enaction.* In a nutshell, the enactive approach consists of two points: (1) perception consists in perceptually guided action and (2) cognitive structures emerge from the recurrent sensorimotor patterns that enable action to be perceptually guided (*EmMnd*, 173).

If we look attentively, the first passage describes the negative stand of enactive cognition against one specific aspect at the core of brain-centred cognitive science: representationalism. The second passage provides a positive definition of enaction as sensorimotor interactionism. *In this first interpretation, the definition of enaction consists of two sub-theses: perception is guided by action, and any form of cognition is based on the same sensorimotor patterns that constitute perception*.

This first interpretation of enaction is not strictly speaking wrong, nor does it necessarily contradict the philosophical thesis of embodied subjectivity. Nonetheless, this interpretation falls short of the philosophical commitments of Varela and his colleagues. The fact that cognition is rooted in sensorimotor correlations does not exclude the possibility that a set of pregiven properties of the world and the agents' bodies predetermine the constitution of their cycles of action and perception. That is, the definition still does not preclude one to locate the absolute foundations of cognition in the constitution of the subject independent world.

Although the concrete action of agents is needed *to enact* the relational field of movement and sensation, the characteristics of the relational field are fundamentally pre-given, like the script of a play. This first interpretation of the claim that cognition is enaction in *EmMnd* thus corresponds with the first meaning of the word enaction noted above.

I call the type of enactivisms derived from this interpretation *weak* because they make a partial and superficial reading of the claims of Varela and his colleagues in *EmMnd*. Moreover, if our view of cognition depends on no more than sensorimotor interactions, we risk missing the essential features of cognition and cognitive agents. I will look into this problem later (2.3.3). For the time being, let me insist that, in my interpretation, enactive cognition requires a more robust basis for the construction of a new paradigm in cognitive science than the one that weak enactivism offers. To see through the implications of supporting weak enactivism, I will examine the problems of radical enactivism in 2.3, which is one of the best examples of this type of enactivism.

2.2.2 Strong Enactivism

For the founders of enactive cognition, perception and cognition do not simply emerge from a physical system that maintains efficient sensorimotor interactions with the environment. *For a system to be cognitive, its interactions with its surroundings must be relevant or significant for the system itself*. This significance cannot be preprogrammed, as held by older models of cognitivist artificial intelligence, nor can it be predesigned in the body type of agents, as with the models of embodied artificial intelligence (see, e.g., 1.2.1 and 1.3.3). The significance of sensorimotor interactions must be relevant for the dynamic constitution of the cognitive agent and for the patterns of behaviour this agent has enacted in its previous interactions with the environment. That is, *the sensorimotor interactions of cognitive agents are normative* (they are correct or incorrect), but the norm at work in these interactions cannot be given in advance, that is, independently of the concrete existence of the agent.

On the contrary, *it is in the action of agents that interactional norms are enacted*. This conception of enaction gets closer to the second meaning of the world enaction that we read above, i.e., the act of putting laws that guide and constrain the behaviour of individuals in a society into effect. Nevertheless, there is a difference, for in this case, the laws (or norms) are enacted by the subjects themselves, not by an entity that sits hierarchically "over" these subjects. This definition helps us see that the hallmark of a strong enactivism equates enaction to the act of *bringing forth a world of significance based on the autonomy* that characterizes the constitution of a cognitive agent (*EmMnd*, 155). Let me explain this idea more clearly.

Enacting or bringing forth a domain of significance originally means that, from an environment that is chaotic or structureless, a cognitive system can produce regular patterns of interaction and become responsive to a specific set of features in the environment. This is what the example of the Boolean cellular automata named Bittorio shows (*EmMnd*, 150-157).

Bittorio is designed as a ring with eight modules or cells with a value of 1 or 0. These rings interact with a chaotic environment of random values (also of 1 or 0), thereby altering the emergent patterns of Bittorio's cells. After enough time interacting with the environment, Bittorio self-organizes its own states and becomes responsive only to some patterns of interaction, whereas other patterns do not alter its structure.

One of the most relevant aspects of this example is that Bittorio is not preprogrammed to accomplish its task. Instead, what makes Bittorio capable of generating this "structural coupling" with the environment is its "autonomous organization." The authors of this book use autonomy as a synonym for *operational closure* (*EmMnd*, 156), which means that the activity of the different components of a system is interconnected. In this case, a change to the state of one of the cells of Bittotrio alters the whole organization of the system. However, the whole organization of the system will depend on how this alteration is related to the current states of all other cells. The organization the automata acquires over time (autonomous organization) and the responsivity of this system to more specific inputs (structural coupling) is a process of self-organization, and it remains open to structural changes. In Varela's interpretation, the relevant patterns of interaction *become* Bittorio's world. This does not mean that Bittorio has an experience of its environment. It only means that a system with autonomy can create order from a chaotic background, but this order co-emerges with the systemic organization of the system (cf. *EmMnd*, 157).

Therefore, *strong enactivism* makes the theory of autonomy central to define cognition as enaction. The theory of autonomy makes enaction fundamentally an act of bringing forth a domain of significance that is not previously given, either in the cognitive system or in the intrinsic features of the world, but is rather enacted in the history of interaction between an agent and its environment.

We can now appreciate the intimate connection between the philosophical claims of embodied subjectivity and the scientific claim of strong enactivism. We saw earlier that embodied subjectivity implies the philosophical thesis that cognitive phenomena cannot be understood either in purely objective or in purely subjective terms. In contrast, it is the middle way or the lack of absolute foundations that more appropriately describes the dynamic entanglement of the body and the world. This middle way is shown in the thesis of strong enactivism, which embracing the theory of autonomy put the grounds of cognition in the interaction of the agent-environment system itself and not in the pregiven constitution of the two components of this system. Therefore, to claim that cognition is enaction, we need not just to change a representational model for a sensorimotor one (see table 2). We also need to create scientific models that acknowledge the contingent existence of bodily agents laying down their paths while walking (*EmMnd*, 239).

The following section will show how radical enactivism embodies weak enactivism. From there, I will consider the problems of radical enactivism and argue that only by adhering to a strong enactivism, like the one of autonomist enactivism, we can avoid these problems.

	Weak enactivism	**Strong enactivism**
Meaning of enaction in English	Acting out	Law (or norm) creation
Meaning of cognition as enaction	Cognition is grounded on sensorimotor correlations.	Cognition brings forth a world of significance for autonomous agents.
Philosophical foundations	The relational sensorimotor field of the agent-environment system builds the foundations of cognition.	There are no absolute foundations of cognition.

Table 2. – Comparative table of Weak and Strong enactivism.

This table summarizes the main differences between weak and strong enactivism.

2.3 Radical Enactivism as a Form of Weak Enactivism

Weak enactivism is the most common form of enactive cognition. Chronologically, the theory of sensorimotor contingencies is the first form of weak enactivism. This theory is probably the most influential approach to perception in the field of enactive cognition. It focuses on explaining the dependency of the contents of perceptual experience on laws that govern sensorimotor correlations (O'Regan and Noë 2001). Briefly, perception is essentially grounded on sensorimotor interactions (see 3.2). However, this enactivism makes no explicit reference to the theory of autonomy, causing explanatory issues, from the standpoint of a strong enactivism (cf. Thompson 2005). A more recent version of weak enactivism is the ecological approach of the skilled intentionality framework. This framework claims to be enactive (*EcEvAf*). However, if this is the case, it is a weak enactivism because its supporters think that the ultimate foundations of perception lie in the ecological laws that correlate the skills of organisms and the possibilities for action in the environment (see 5.2). Other approaches can work together with enactivism, advancing on the path of the weak position, but the nature of their theoretical backgrounds can also bring these approaches to strong enactivism. This is, in my opinion, the case with both Gallagher's phenomenological enactivism and Fuchs' works on social cognition (see figure 5). [18]

However, this section will focus on how radical enactivism adopts a weak enactivism view because this approach is the most robust and complete form of weak enactivism in the field. I will show that despite its advance in offering an alternative to brain-centred cognitive science, significant problems result from its commitment to a weak form of enactive cognition. I will not intend to convince the reader that radical enactivism is an unsuitable project for the study of cognition,[19] as I did not intend it with brain-centred cognitive science. Instead, I would like to emphasize the weaknesses inherent to a misconception of the original research project of enactive cognition. This discussion should also demonstrate that autonomist enactivism is thus far a better alternative (2.4).

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[18] Fuchs in *The Ecological Brain* (Fuchs 2018) endorses more clearly a project of strong enactivism, founding his view on the theory of biological autonomy of autonomist enactivism.

[19] A deeper analysis of and argumentation against the claims of radical enactivism are needed for such a task.

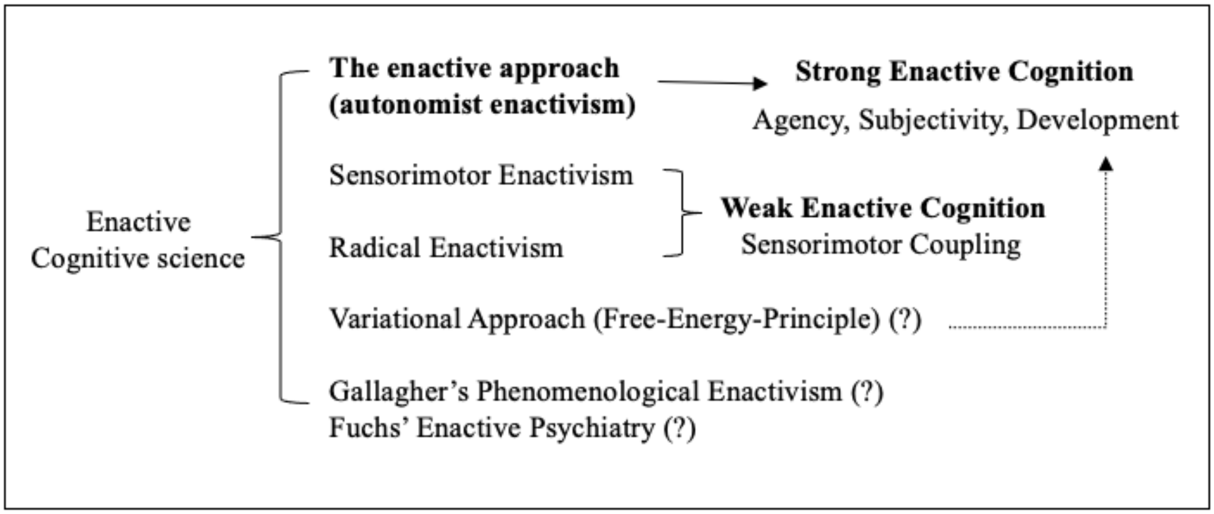

Figure 5. – The field of enactive cognition

This figure illustrates the variety of enactivists approaches I mention in this chapter. They are distributed according to their localization in the division I made between the divergent paths of weak and strong enactivism within the field of enactive cognition.

2.3.1 Anti-Representationalism and Teleofunctionalism

Radical enactivism was born as an approach that primarily focussed on rejecting representationalism. For radical enactivism, representations are vehicles of contentful information. That is, they are internal brain states with conditions of correctness. The conditions of correctness of a representational state, such as a perceptual state, is a truth-condition. However, for radical enactivism, this is not a complete description of what happens in basic forms of action and perception; whence the need to develop a sustained critique.

The main argument of radical enactivists against representationalism is that the information used by basic cognitive systems does not need to be contentful (*RadEn*). Instead, information at this level is better understood as the lawful covariation between different facts of the world (*RadEn*). Covariations do not need to be represented because they already exist as such in nature. The number of rings of a tree and the number of times the Earth travels around the sun covary independently of our knowledge of them. The two phenomena, nonetheless, are not informational until there is an agent capable of disclosing the covariation between the two events (*RadEn*, 63-71). For radical enactivism, this is what so-called “basic minds” do.

Fundamentally, basic minds are sensorimotor systems that can be us when we perform very simple sensorimotor tasks, such as walking, swimming, or chopping wood. Basic minds can also be animals or even artificial intelligence robots like Brook’s (*RadEn*, 39-46). Radical enactivism affirms that there are lawful correlations between movement and sensory feedback. Given these correlations, the environment provides information thanks to the lawful covariation of movement and sensorial changes. Basic minds need not to encode anything from the outside to enact this information. They only need to be sensitive to the relevant informational covariations (*RadEn*, 68). Therefore, the conclusion is that *basic cognitive systems exploit the information already available in the environment*. In this light, internal representations appear superfluous.

Despite the convergencies of radical enactivism with various claims we find in the work of Varela and colleagues, radical enactivism never endorsed the theory of autonomy nor the thesis of embodied subjectivity. Instead, radical enactivism bases its natural explanations of basic cognition in theories of biology that contradict the claim that cognitive agents are autonomous systems, as strong enactivism implies.

To explain the natural origins of non-contentful sensorimotor information, radical enactivism appeals to biological teleofunctionalism (*RadEn*, 71-82). For radical enactivism, the ability of living organisms to exploit environmental information is not directly caused by purely physical determinations. This view would be accurate for ecological approaches since they hold that dispositional properties determine sensorimotor correlations (e.g., Turvey 1992). Instead, for radical enactivism, sensorimotor interactions of living organisms are normative. These norms are functional norms that involve the suitable accomplishment of a predeterminate biological function (*EvoEn*, 116).

Biological functions refer to the usefulness that traits and behaviours of living organisms have or have had in the past for the survival of their species. These functions possess the *telos* of stably maintaining a species’ fitness (successful rates of reproduction). It is hence a *teleofunctionalism*. This does not imply that organisms use these functions purposively. Instead, it means that we can observe that a trait or behaviour of an organism has a determinate use in terms of the survival and reproduction of an organism.[20]

For philosophers of mind like Ruth Millikan (1984) and Fred Dretske (1986), teleofunctionalism can explain the natural origin of internal representations. This approach is known as teleosemantics. This perspective aims to explain how mental contents are normatively correlated to the facts of the world. For teleosemantics, organisms are efficient in representing the outside world because their representational functions have been helpful for the preservation of their species (Godfrey-Smith 2006). Evolutionary processes of natural selection are, therefore, the causal origin of representationalist functions.

Radical enactivism adopts a very similar stance, although it puts aside representationalism. Following Fodor's (1990) criticisms of teleosemantics, radical enactivism holds that what matters for preserving life and reproduction is not knowledge of facts of the world as such (true statements). Instead, for radical enactivism, it is the efficient exploitation of the information already available in the environment that counts as phylogenetically valuable for species survival (*RadEn*, 81).

For representational theories of mind like teleosemantics, intentionality consists in producing internal representations of the external world. This is a Brentanian type of intentionality (*EvoEn*, see also 1.3). On the other hand, radical enactivism proposes to think of exploiting environmental information (as covariation) in terms of a non-Brentanian form of intentionality that its supporters call *Ur-intentionality* (Hutto and Satne 2015; *EvoEn*). This intentionality, I insist, implies a normative relation between cognitive systems and their environments. The adjective *normative* indicates that there are *right* (and *wrong*) accomplishments of biological functions determined by

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[20] This functionalism of living systems observed from the perspective of the scientist is sometimes referred as "teleonomy" (see e.g., Maturana and Varela 1980, 1994). This notion contrasts with the concept of "teleology," used by autonomist enactivists to describe the purposiveness intrinsic to the autonomy of living systems (see 2.4.1).

natural selection processes (*EvoEn*). Radical enactivism describes, therefore a *functional normativity*.

Once it has explained the natural origins of non-contentful forms of intentionality, the second challenge for radical enactivism was to understand the natural origins of content (Hutto and Satne 2015). Some forms of cognition, like thinking and reasoning, depend on propositional attitudes that refer to states of affairs in the world. These forms of cognition need conditions of correction that Ur-intentionality cannot provide. Here is when Wittgenstein comes in.

In accord with Wittgenstein, radical enactivism holds that sociocultural practices, especially linguistic practices, in contrast to natural processes, involve conditions of truth, but these conditions depend on public norms (*EvoEn*). That is, it is only in the public domain that statements about the facts of the world can be evaluated as true or false. In this regard, it is important to note that the emergence of complex forms of human cognition also depends on evolutionary processes. The emergence of sociocultural practices and linguistic exchanges in humans is caused by evolution and natural selection (*EvoEn*). Therefore, the origin of cognition and its development from basic levels to higher ones is explained phylogenetically, and evolutionary processes become the fundamental pillar of natural explanations of radical enactivism.

2.3.2 The Blind Watchmaker

Biological functionalism is an explanation of life that strongly resonates with cognitivism's causal explanations because both equate living agents to artificial machines. Mechanistic and functionalist conceptions of life have their own historical tradition in theoretical biology. In light of the emergence of Newton's physics and Descartes' mechanistic philosophy of nature, at the beginning of the nineteenth century William Paley (2009), thought that nature was like a giant clockwork machine that functioned according to a purpose set by God, who was akin to a watchmaker. In this picture, the order of the natural world is given by a previous design. Therefore, an organism's behaviour is predetermined by a metaphysical entity.

Charles Darwin's (2008) theory of evolution made this conception of nature hard to support because the idea of the evolution of species fundamentally depends on natural selection. This process nonetheless seems to require that random changes occur in nature (e.g., genes mutation), thus allowing species to adapt to the changing circumstances of the environment. More contemporary biologists like Richard Dawkins (1986) took up the watchmaker metaphor and, incorporating Darwin's ideas, claimed that nature played the role of a blind watchmaker. This is to say that even though no pre-given teleology exists in nature, there is yet a machine-like functioning at work. This machine is no longer the clockwork machine envisioned by scientists and philosophers of the seventieth century; instead, it incorporates randomness, chaos and overall temporal evolution. There are nonetheless lawful processes that constrain chaos and randomness. In the case of life, this process is natural selection.

Natural selection implies a process through which biological lineages of phenotypes (species) survive, maintaining a steady reproduction rate (i.e., fitness) over broad periods of time. For orthodox theoretical biology, adaptation is the fundamental mechanism of natural selection (Lewens 2007). This process involves the random variation of genotypes (genetic information) that produce variants in the phenotypes of species. Some of these variants are more successful than others in their fitness because they are better adapted to the conditions of the environment. In the long run, phenotypes with better fitness become predominant in their species. From this perspective, organisms are usually conceived of as an ensemble of functional systems that has been selected phylogenetically (Gould and Lewontin 1979). Every functional system, including the behaviour of an organism, contributes to the survival and fitness of its species (Dawkins 1982; Cosmides and Tooby 1987; see also Lloyd 1999). This is precisely the idea behind teleofunctionalism.

From the standpoint of radical enactivism, the capacity to exploit information as covariation is one of the processes of adaptation of organisms. If this is the case, the blind watchmaker or, as Millikan (1984) prefers to name it, Mother Nature, is the only one responsible for the design of living and cognitive systems.

2.3.3 The Missing Mark of the Cognitive in Radical Enactivism

Radical enactivism has construed a solid approach to cognition. Its non-representational theory of information and its support from teleofunctionalism have gained credibility in the community of cognitive scientists for a non-neurocentric study of cognition. All these benefits depend on weak enactivist claims, specifically on locating the roots of cognition in sensorimotor interactions, but without reference to the early theory of autonomy of Varela et al. (*EmMnd*), and without assuming that we need non-absolute foundations to explain cognition.[21] Why do we need to look for more than weak enactivism and look for a more robust version of enactive cognition?

There are three important reasons to look for something more than what radical enactivists have to offer. First, radical enactivism cannot distinguish between pure mechanical systems exhibiting intelligent-like behaviour and natural intelligent agents. Second, sensorimotor interactions may very well be helpful to enact information as covariation, while coordinating the body and the environment thanks to self-organization processes. However, there is no clear criterium to distinguish systemically between two self-organizing systems that coordinate together (a common phenomenon of nature), and systems that use this coordination to transform their own dynamics and the coupling they maintain with other systems. Third, there is no account of the agency of cognitive systems, at least not at the basic level of cognition. Agency seems to be a characteristic of living systems, the ones we know for sure are cognitive systems, but basic minds do not imply this feature.

I will argue later that autonomist enactivism, the most important form of strong enactivism thus far, can address all these shortcomings.

For the time being, let me be more specific about the first problem that I will call *the problem of the mark of the cognitive.*[22] Despite the significant support that radical enactivists find in theories

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[21] For radical enactivism, subject independent processes, biological and physical, are the causal bases of basic cognition.

[22] This name was created by Adams & Aizawa (2001, 2008) to highlight the incapacity of Clark and Chalmers' (1998) hypothesis of the extended mind to distinguish between mere functional computational systems and a truly cognitive systems (i.e., the brain, for Adams and Aizawa). Although the problems of radical enactivism to distinguish a mere sensorimotor system and a cognitive system are different from those of the extended mind, I think radical enactivism is also in need of a definition of the features that make a cognitive system different from any other type of dynamical system.

of biological teleofunctionalism for their theory of Ur-intentionality, their descriptions of basic minds and basic cognition do not exclude the possibility that artificial systems can exploit information as covariation in the same way biological systems do. This is, in principle, not an issue for radical enactivism. Varela et al. (*EmMnd*) also recognized the similarity of Brooks' designs of robots and the scientific claims of enactive cognition.[23] The differentiation between artificial and biological cognitive agents is vital for cognitive science, nonetheless, because it helps us to distinguish between those systems that only *seem* intelligent and those that are genuinely cognitive agents (cf. Adams and Aizawa 2008). Kenneth Aizawa (2014) has made some critical remarks about this cluster of issues.

Aizawa acknowledges that brain-centred cognitive science and enactive cognition describe different phenomena when they talk about cognition. Whereas brain-centred cognitive science has traditionally been focused on complex forms of cognition like reasoning and thinking, enactive cognition has been more attentive to the basic forms of action and perception. Cognition, for brain-centred cognitive science, thus consists in representing the outside world to solve problems and, for enactive cognitive science, essentially consists of intelligent and/or viable behaviour.

The adjectives' intelligent' and 'viable' are nonetheless tricky. For brain-centred cognitive science, intelligent behaviour implies cognition because the efficient accomplishment of motor actions involves computational information processing. However, as we saw in chapter one, Brooks' models are more successful than neurocentric models, and they do not need to accomplish any information processing. This embodied artificial intelligence model maintains a continuous and "efficient" or viable sensorimotor coordination with the environment. Where then does the intelligence of these embodied mobile robots lie?

The intelligence of robots might be seen in the efficiency of their behaviour, i.e., in sustaining viable sensorimotor interactions. However, robots are, in the end, sophisticated machines designed to accomplish sensorimotor tasks efficiently. The fridge in my kitchen is undoubtedly a less

[23] For Varela and colleagues however the early theory of autonomy can already posit a difference between the sort of systems created by embodied artificial intelligence and those of living systems. This is clearer in the theory of biological autonomy advanced by autonomist enactivism.

sophisticated machine than a mobile robot, but it is also a highly efficient machine for maintaining food at a specific temperature. This does not make my fridge intelligent. Without the specification that cognition consists of information processing, it becomes harder to define what is cognitive and what is not. The upshot is clear enough: *claiming that (basic) cognition consists in efficient sensorimotor interactions is not enough*.

Radical enactivism is not only incapable of distinguishing theoretically between real cognitive systems (as far as we know, many living systems) and cognitive-like systems (e.g., humanoids). It is also incapable of distinguishing *systemically* between merely self-organizing systems (e.g., whirlpools) and cognitive systems as such. To appreciate this point better, we need to consider first the role that dynamical systems theory has played in the field of embodied and enactive cognition.

2.3.4 The Missing Mark of the Living in Radical Enactivism

Dynamical systems theory has been one of the pillars of enactive cognition since this theory affords mathematical models to cognitive scientists for understanding the dynamical, normative behaviour of the brain-body-environment system, without implying that internal representations are involved in these processes (van Gelder 1997).

A dynamical system is a system that continuously evolves according to different variables. We can model almost every physical system as a dynamical system; a tornado, a steam engine, a living organism, a flock of birds, and the human brain are just some examples. In cognitive science, multiple brain, bodily, and environmental processes, causally relevant for accomplishing cognitive activities, can be modelled as dynamical systems. Moreover, it is possible to model the coupling of all these processes and claim that cognitive systems cut across the brain, the body and the environment (Clark 1997).

A dynamical system evolves according to multiple variables that affect the behaviour of the system to some degree. The temporal evolution of a system usually generates recurrent patterns of behaviour that work as a set of internal constraints. These constraints partially determine the system's behaviour and how the system responds to new variables. Since these constraints evolve continuously due to changes in the value of the variables, the system's behaviour remains open to new changes and to the emergence of new constraints (Thelen 1995). A dynamical system is thus a temporally open-ended system (van Gelder and Port 1995). However, the open-ended nature of dynamical systems is not only diachronic (open to changes of behaviour in the future) but also synchronic (a behaviour coupled to the behaviour of other dynamical systems). If two or more dynamical systems mutually constrain their behaviour, they become coupled and share a common history of temporal evolution (van Gelder 1997).

The other remarkable aspect of dynamical systems theory for cognitive science is that we do not need to define external variables of the system as inputs that need to be encoded in discrete units that the system will process as vehicles of information (van Gelder 1997). Somewhat, these inputs will alter the system's dynamic behaviour according to the already established constraints of the system. The system's responses (outputs) do not need to be specific commands of action but can be typical system reactions according to its own dynamical configuration. This means that dynamical systems theory makes room for non-representational models of cognition (e.g., Beer 1995).[24]

For radical embodied cognition, including radical enactivism, dynamical systems theory is a tool that allows us, as external observers, to understand how dynamic processes of the brain, the body, and the environment system are coupled (*RadEn*). This is the most recurrent use of dynamical systems theory in radical embodied cognition (e.g., Beer 2000).

From a dynamical perspective, it is impossible to distinguish between two basic physical systems that exhibit a coordinated behaviour while interacting dynamically and systems that use some form of cognition for interacting appropriately with the environment. A Beer's robot, for instance, is capable to recognize different shapes in figures and move efficiently to avoid diamonds and catch circles. The robot learned this behaviour thanks to evolutionary algorithms implemented in a connectionist network (robot's brain). The processes of self-organization that lead the robot to

[24] Although dynamical systems theory does not entail a refutation of representationalism, computationalism, or neurocentrism in cognitive science (van Gelder 1997), it allows to see how it is possible to think about cognition in a rigorously scientific manner without holding to the neurocentric presuppositions of cognitive science.

perform efficient sensorimotor interactions can be captured by a model of dynamical systems (Beer 2000). Externally, we can observe analogies between this artificial system and a living sensorimotor system. This does not mean, however, that Beer's robot is a truly cognitive agent.

From a strictly formal standpoint, and putting aside the complexity of the system, there is no strict differentiation between the type of coordination between an artificial agent and its surroundings, and the emergent coordination, after a while, of two pendulums that swing together on a movable surface. A dynamical systems description to distinguish between a cognitive and a non-cognitive system is therefore highly recommended. However, it is not implied by the descriptions of basic minds of radical enactivism. This is where strong enactivism and, more specifically, autonomist enactivism show its strength.

Strong enactivism, we saw above, involves a theory of autonomy. This theory slowly evolved, after *EmMnd*, into the theory of biological autonomy (*MndLf*), which posits that the primary organization of life (which is an autonomous organization) is a requirement for cognition. The first step towards a full-fledged theory of biological autonomy was elaborating the concept of autopoiesis, advanced by Varela and the Chilean biologist Humberto Maturana. They claimed that what fundamentally characterizes living organisms are their *self-producing* and *self-maintenance* organizational features (Maturana and Varela 1980, 1994). This means that living systems are a network of causally interdependent processes that allow a system to maintain a specific organization for a certain period of time, which is to say that living organisms possess an organization that keeps them alive. Part of the processes that physically constitute the body of an organism is usually the construction of *a semipermeable boundary.* This boundary separates autopoietic processes from the rest of the environment but allows the exchange of matter and energy that an organism requires for its autopoietic activities.

The paradigmatic case of autopoiesis is the living cell (*MndLf*, 98). A cell is a living organism that constitutes its own operational realm by building a semipermeable boundary, or membrane, that separates its autopoietic processes from the rest of the environment. Inside this membrane, an interconnected network of processes occurs. These processes maintain the organization of the cell and further produces its physical constituents from resources provided by the environment. The membrane, then, is a semipermeable boundary, allowing for the controlled exchange of matter and energy between the cell and the environment. Indeed, only through this exchange can the cell maintain its autopoietic organization (Weber and Varela 2002). [25]

The metabolic needs of an organism, therefore, guide or provide the norm the organism's sense of its own behaviour. Thus, bacteria (*E. coli*) tend to move towards an environment with a high glucose gradient because they find this place more appropriate for their metabolic needs (*MndLf*). For this reason, a living organism, as an autopoietic system, constitutes what the ethologist Jacob von Uexkūll (2010) described as an *Umwelt* (*MndLf*).

An *Umwelt* is the meaningful world a living organism enacts, similar to Bittorio's enactment of recurrent patterns of interaction. However, unlike Bittorio, living organisms distinguish the features of the environment according to their own existential concerns (to stay alive). In the case of living beings, therefore, enacting a domain of significance involves bringing forth differences that make a difference (*MndLf*, 57).

The theory of autopoiesis is thus fundamentally different from radical enactivism. For the holders of the theory of autopoiesis, living organisms are not blind mechanisms that behave according to functions completely predetermined by their phylogenetic past. Instead, they are agents that need to act according to a basic norm that is intrinsic to their existence: they must stay alive.

Any form of enactive cognition that adopts the route of strong enactivism must therefore endorse the claim that autonomy is an intrinsic feature of cognitive systems. Cognitive systems enact worlds of meaning, which is tantamount to saying they enact their own normative domain of interactions with the environment. Dynamical systems help these enactivisms to distinguish between simply self-organizing systems and autonomous systems, thereby giving empirical support to the theory of autonomy. As I will argue in the final section of this chapter (2.4.4), the

[25] Autopoietic systems are also described as systems that escapes from thermodynamical equilibrium thanks to metabolism, i.e., the exchange of mater and energy that allows the system to renovate its physical components for maintaining the same kind of organization (Juarrero 1999).

theory of biological autonomy of autonomist enactivism also helps us overcome the problem of agency, the third shortcoming I have ascribed to radical enactivism.

2.4 Autonomist Enactivism as Strong Enactivism

The early theory of autonomy of Varela et al. (*EmMnd*) was not only controversial and provocative for the orthodoxy of cognitive science, but it was also problematic for those sympathetic to this theory. Describing computer programs capable of enacting worlds was a problematic way of thinking about real agents capable of enacting living domains of significance (Bourgine and Stewart 2004). The theory of autopoiesis as the basic description of autonomy in real living systems was also unsatisfactory for describing the concrete temporal unfolding of life (Bitbol and Luisi 2004; Di Paolo 2005). Considering all these problems and controversies, autonomist enactivism elaborated two crucial concepts nowadays presented as its two pillars (Thompson 2018): the theory of biological autonomy and the definition of cognition as a form of sense-making. This section reviews the main features of these two concepts.

2.4.1 Biological Autonomy

The definition of life and cognition as autonomous processes, described by the theory of autopoiesis (Maturana and Varela 1980, 1994) and the early theory of autonomy (*EmMnd*), respectively, are finally synthesized and refined by Thompson (*LM*) into what we now know as *the life and mind deep continuity thesis* (Froese and Di Paolo 2009). According to this thesis, life becomes a necessary condition for cognition, and cognition becomes a special form of bodily interaction (sense-making) that resembles the fundamental interactions at play in the most rudimentary forms of life (*MndLf*).

The starting point for describing the continuity of life and mind is the systemic description of living systems as *autonomous systems in precarious conditions with adaptive behaviour* (henceforth *autonomous systems*) (*MndLf*; Di Paolo and Thompson 2014). For autonomist enactivism, this description is reproduced at multiple levels of interactions (sensorimotor, intercorporeal, and linguistic) in an agent-environment system.

Defining living systems as autonomous follows from the theories of autopoiesis. The notion of autonomous systems is nonetheless a more general definition than autopoietic systems. While it is true that all autopoietic systems are autonomous, not all autonomous systems are autopoietic. Autopoietic systems self-maintain and self-produce their systemic organization and the physical boundaries that separate this organization from the rest of the environment. There are nonetheless autonomous systems that self-distinguish themselves from the rest of the environment without constructing actual physical boundaries. For Varela (2000, 51-53), living systems such as the nervous and the immune system are two examples of autonomous but non-autopoietic systems. Therefore, the distinguishing feature of autonomous systems is not self-production but *operational closure* (Di Paolo and Thompson 2014).

Operational closure describes the interdependency of a network of processes necessary to sustain the dynamic organization of a system over time. The dynamic organization of the system also depends on causal processes that happen beyond the organizational boundaries of the network. However, such processes do not depend on the activity of the network. Hence there is an organizational but not necessarily a spatial distinction between what is "in" and outside of the autonomous system. For this reason, we can rightfully describe as autonomous many other living systems apart from unicellular organisms (the paradigmatic example of autopoiesis).

The shift from the theory of autopoiesis to the theory of biological autonomy also involves a more sophisticated description of the interactions a living agent maintains with the environment. In this regard, there is a marked difference between the early days of the theory of autopoiesis and the period that Barret (2017) calls the normative turn of autonomist enactivism. This turn starts with Weber and Varela's (2002) appeal to the phenomenological work of Hans Jonas, who claimed that living beings exhibit an intrinsic teleology.

For Jonas, this intrinsic teleology is not a mere attribution of a property of living beings from the point of view of an observer, but a feature inherent to the existential condition of living beings who must constantly escape their precarious condition (Weber and Varela 2002, 113). The laws of thermodynamics state that all physical systems tend to lose their systemic organization, which means that over time, they face disintegration. In the case of living beings, this means the constant threat of death. This tendency can be delayed through interactions with the environment, and metabolism is the most fundamental of these interactions. In light of this, Jonas (1966) claimed that living beings do not behave according to "external" causal determinations but according to their most fundamental norm: that of their own self-preservation. For this reason, the mother of all values is the affirmation of life (Weber and Varela 2002, 111).

The normative turn, however, also implies a shift in how to conceive this fundamental norm. Rather than being a positive affirmation of life, self-preservation of life is *a double negation* of its existential condition (Di Paolo and Thompson 2014). The bodily existence of living organisms has a natural tendency to death (a negation of life), but to be alive implies constantly moving away from this natural tendency (a negation of a negation). Life is, therefore, a frustrated suicide (Di Paolo 2009, 16) and reveals a permanent tension within organisms between these two opposite tendencies. This is not a banal clarification because it reveals the sort of normativity at work in the framework of autonomist enactivism. One of the consequences of this claim is that norms of life are norms of viability instead of norms of optimality (*MndLf*, 206). As long as the tension within the organism maintains viable the continuity of the system, the structural coupling with the environment remains stable and the norm is satisfied. There is no optimal adaptation of the organism to the environment because there are no optimal (a priori) conditions the organism must satisfy.

It is important to note that Jonas' description of precariousness in living beings does not suffice to define the existential condition of life. According to the laws of thermodynamics, it is not only living systems that find themselves in precarious conditions and threat by thermodynamical equilibrium but all physical systems. It is also important to mention that non-living self-organizing systems like whirlpools and tornados also avoid entropy temporarily, a fact that was overlooked by Jonas (Barandiaran and Moreno 2008). As a result, we can say that precariousness and self-preservation by themselves do not define life.

Autonomist enactivism defines life as the capacity of living beings to establish an *interactional asymmetry* with their surroundings, a feature that mere physical self-organizing systems lack (Barandiaran, Di Paolo, and Rohde 2009). Thus, living organisms can modulate and regulate their coupling with their soundings to produce effective ways to escape from systemic disintegration, thereby genuinely becoming agents (Barandiaran, Di Paolo, and Rohde 2009).

In this respect, it is when Di Paolo (2005) adds the feature of *adaptivity* to Varela's theory of biological autonomy that the normative turn is finally accomplished (Barrett 2017). This is because the agent's capacities to modulate its coupling with the environment significantly determines the norms of the interactional coupling. Consequently, the environment is enacted as a field of possibilities for action, as a place of possibility for altering the systemic conditions of living systems.

2.4.2 Sense-Making

The lived world of a living agent is a domain that is relevant for its own existential concerns. What we can see as a region of a meaningless domain of physics appears for a living agent as a meaningful world or as an *Umwelt* (*MndLf*). The enactment of this meaningful domain is what autonomist enactivism calls *sense-making*. This phenomenon is paradigmatically illustrated by experiments where *E. coli* bacteria are behaviourally responsive to high concentrations of glucose because it is valuable for the metabolic needs of these bacteria. They are, by contrast, irresponsive to other chemical components that do not affect their autonomous organization (*MndLf*).

Sense-making is nonetheless a controversial concept, and it is often unclear what phenomenon this term designates. The terminology of 'meaningful world,' 'domain of significance,' 'lived experience,' 'subjective perspective,' etc., usually refers to how we, as human beings, experience the world around us. De Jesus (2018) thinks, for this reason, that autonomist enactivism commits the error of anthropomorphizing the activity of living organisms. This criticism is understandable but also misleading.

In our everyday experiences, we usually attend consciously to things, people, landscapes, etc. Phenomenologically, the experience of all these objects appears to be founded on a more primitive layer of motor significations (*PhP*, see chap.3), possibilities for action, and affordances (*EcApVsPr*). However, these significations are not representations of things: their 'meaning' is not semantic, i.e., an internal vehicle of information that refers to an external object. The relevance or the significance of things, at this basic level of experience, is instead a bodily responsiveness to the opportunities the environment affords for motor actions. The ecological approach of the so-called "skilled intentionality framework" depicts this phenomenon as an emotional, bodily state described as a *readiness to act* (Bruineberg and Rietveld 2014). From this standpoint, emotions are constituted by multiple bodily processes (e.g., rhythms of breath and heartbeat, muscular tensions, glandular segregations, etc.). These bodily processes represent different degrees of organizational bodily equilibrium. The emotional feeling of readiness to act involves a certain amount of bodily tension caused by the presence of an affordance. That is, affordances call for motor actions, and this phenomenon is felt as a bodily tension (Bruineberg and Rietveld 2014). This feeling has different degrees of tension, so we may not consciously notice it. Yet this process is necessary for perception because this is what makes the presence of an environmental aspect relevant.

For autonomist enactivism, the same type of bodily affectivity happens for all living beings, from bacteria to humans (Colombetti and Thompson 2008). Once again, in more simple organisms, this affectivity is not necessarily like the complex emotions we live as human beings (Colombetti 2014). The basic affectivity of life is the bodily tension that organisms undergo due to states of organizational disequilibrium. The relevant aspects of the environment for autopoietic processes are then lived as affective bodily tensions (cf. Colombetti 2018).

This basic affectivity of life is akin to the affective state of humans described by Fuchs (2012) as "the feeling of being alive," which implies all the brain activity related to the basic regulatory processes of the body (Colombetti and Thompson 2005). This feeling of being alive is arguably the essential requirement for any kind of sense-making and cognition (Fuchs 2018). The conclusion to draw from all this is obvious: to understand sense-making, we must stop thinking about the enactment of *Umwelten* in purely cognitive terms. We must think of this enactment as correlated to basic bodily affectivity that all living beings share (cf. Colombetti 2018).[26] This basic form of sense-making, therefore, involves what we might call *bio-affectivity*.

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[26] In this context, questions about the phenomenal character of experience (Jackson 1982) or the "what is like" to be an *E. coli* bacterium (cf. Nagel 1974) are not pertinent. The goal of autonomist enactivism is not to compare the feeling of bacteria with our own experiential feelings. Autonomist enactivism has been clear about the incommensurability of experiences due to differences in the constitution of living bodies and the type of interactions these bodies maintain with the environment (Thompson, Palacios, and Varela 1992).

Thompson (*MndLf*) already took a step in this direction by clarifying that affectivity is necessary for perceptual experience. Given the temporal constitution of perception (Husserl 1991; Gallagher 1998; Varela 1999b), the appearance of relevant aspects in the environment follows expectations we have to fulfill via our motor actions. Similarly, bacteria move toward high sugar concentrations to fulfill their metabolic needs. Here, expectations do not refer to psychological states but to felt bodily tensions or states of organizational disequilibrium attributable to any living organism.

There is, however, an essential difference between the kind of normativity described in phenomenological and enactivist models: the basic autonomy of life and sense-making in all living organisms is guided exclusively by vital norms. So, while the same organization can acquire more complex forms at the sensorimotor level, which is where cognition actually begins, the notions of autonomy and sense-making not only play a fundamental role in understanding the bodily nature of cognition, but they are also the "pillars" of the whole system. I will come back to this in the next chapter (3.2.2). The following subsection describes the connection between the theory of biological autonomy and non-orthodox accounts of life and evolution. These theories emphasize the central role that organisms' development has in the actual constitution of the living.

2.4.3 Enactive Evolution

In a recent anthology of the philosophy of biology, John Dupré and Daniel Nicholson (2018) provide a manifesto for an ontology of processes in theoretical biology. They claim that:

> [T]he living world is a hierarchy of processes, stabilized and actively maintained at different timescales. We can think of this hierarchy in broadly mereological terms: molecules, cells, organs, organisms, populations, and so on. Although the members of

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The point is that bacteria are sensitive to the environment following their vital norms, just as we are like when after being immersed in the water for some seconds we look for oxygen in the air to breath. Sense-making is, therefore, a normative domain of interactions between a living agent and the environment guided by affective bodily processes. The basic Umwelt of an organism is not so much a cognitive world but an affective field.

> this hierarchy are usually thought of as things, we contend that they are more appropriately understood as processes (3).

This ontology of processes diverges from the orthodox definition of life in theoretical biology, that is, as complex physical systems determined by the information supposedly contained in the molecular composition of their genomic structures (Godfrey-Smith 2007). The proposed ontology by Dupré and Nicholson instead resonates with Thompson's affirmation in *MndLf* (166) that "we living organisms are historical and developmental beings."

From this perspective, the key to understanding the non-orthodox conception of life of autonomist enactivism is to see it as temporally open-ended. Living systems are oriented towards the future by an intrinsic teleology, looking forward to staying alive. The concrete attainments of this teleology (what is required for the self-preservation of organisms) are nonetheless historically determined. That is, the structure of living bodies and their biological needs carry on the phylogenetic and ontogenetic past of living systems. This past, nonetheless, does not entirely determine the body and behaviour of organisms but merely constrain their unfolding in time. Crucially, organisms remain open to the unexpected contingencies of the present. As such, living organisms resemble a path laying down in walking (*EmMnd*; *MndLf*).

The theory of biological autonomy puts the organism at the center of life's processes. Organisms, in this view, are not substantial things but dynamic processes. Autonomous living systems continuously change and adapt their concrete existence to the current circumstances of the environment, constituting the fundamental unit of life, and arguably also of evolution (Maturana and Varela 1980, 1994; *MndLf*). For the theory of biological autonomy, autopoiesis and autonomy are processes that logically and chronologically precede evolution. For one simple reason, evolution entails reproduction, and for there to be reproduction, the reproduced entity must first exist (*MndLf*).

Importantly, reproduction is not replication. Organisms do not simply engender copies of themselves. Biological evolution requires change and variation at the ontogenetic temporal scale and the phylogenetic scale. In this regard, newborn organisms retain *some* of their progenitors' characteristics and diverge from them.

For the orthodox view, variation among different generations of organisms is due to random variations in their genetic material. Some variations are successful in this so-called lottery of life and continue their reproduction, while others are not. The success of a lineage depends on the material condition in the environment. Some organisms will fit more adequately than others to environmental circumstances. Development, in this picture, is nothing more than the process through which genetic information is transcribed, expressing information encoded in genes in the appearance and behaviour we observe in organisms.

Seen as temporal processes, by contrast, organisms constitute themselves in their concrete development by modulating their interactions with the environment. Developmental processes are nonetheless constrained by structures, inherited phylogenetically, that comprise much more than genes. This is the general idea behind the alternative evolutionary theories of developmental systems theory (Griffiths and Gray 1994) and evolutionary developmental biology or "evo-devo" (Hall 1992). For developmental systems theory, the unity of reproduction of biological evolution is not simply genes, nor even the organism as a systemic unity independent of the environment. Instead, this unity encompasses the network of interdependent processes required for the ontogenesis of organisms, i.e., a *developmental system* (Oyama 2000). Likewise, evo-devo focuses on embryogenesis, holding that alterations in development patterns produce significant changes in evolution. This means that the visible changes in phenotypes and, consequently, changes in the reproduction rates of a species are due to changes in developmental processes and not just to random mutations in genes that the environment eventually selects (Hall 2012).

Thompson (*MndLf*) connects the claims of these theories with the theory of the biological autonomy of autonomist enactivism. He suggests that altogether these ideas can offer an alternative account of evolution that he calls *enactive evolution*. Such a view of evolution, unlike adaptationism, holds that organisms exhibit the robust (resistant to alterations) and flexible (open to change) structures of development that maintain the continuity of the organism and makes possible its reproduction.

Although there have not been significant works about enactive evolution after Thompson, there is increasing support in theoretical biology for ideas such as an ontology of processes (e.g., Dupré and Nicholson 2018), the agential normativity of living beings (see Moss and Nicholson 2012), and the concept of biological autonomy to explain the systemic complexity of multicellular organisms (e.g., Moreno and Mossio 2015). Much work is still needed to make something like the project of enactive evolution a solid paradigm in theoretical biology. However, the debates are now open, and there is nothing extravagant or purely speculative in the conception of life and evolution pursued by autonomist enactivism.

2.4.4 Groundless Grounds

The commitment of radical enactivism to orthodox theories of life and evolution is problematic because these theories neglect the agency and normativity that living organisms seem to exhibit. I have also declared in 2.3.3 and 2.3.4 that radical enactivism seems unable to distinguish between efficient interactional systems and genuinely cognitive systems. In this final section, let us see how autonomist enactivism can overcome these problems.

Agency is a label we use to attribute the capacity of acting according to their own will to certain beings; for instance, when I decide to extend my arm for a handshake, I am the agent of this act. Another person might respond to this gesture with a similar one, or she may refuse it, which means that she is probably also an agent. Typically, we do not attribute agency to machines like blenders and toasters because they do not make decisions to accomplish their functions. Instead, we are the ones who make use of machines for our purposes.

Nevertheless, the attribution of agency to beings becomes more problematic when we look deeper. On the one hand, contemporary artificial intelligence produces machines designed to look like intelligent beings that can exhibit agent-like behaviours (cf. Turing 1997). On the other hand, it is also possible that our purposive intentions are irrelevant for acting. Maybe our actions depend on the blind physical processes that sustain our conscious lives, but what we experience as a decision taken by ourselves is also a causal determination of processes in our brains (Libet 1999). Thus, a scientific approach to agency needs a more specific definition.

Autonomist enactivism uses an operative definition of agency based on the requirements of a system for being considered an agent. Di Paolo and colleagues (Barandiaran, Di Paolo, and Rohde 2009) distinguish three necessary and sufficient conditions for the agency of a system: *individuality, normativity, and interactional asymmetry.* Individuality consists of the system capacity to determine its own organizational realm. Normativity is the characteristic of a system to behave according to rules that produce positive or negative consequences for the system's organization. Finally, interactional asymmetry implies that a system, even if it is in constant interaction with other systems, can regulate and modify the conditions of its interactions (Barandiaran, Di Paolo, and Rohde 2009).

It is easy to recognize these three features of systemic agency in the descriptions of life given by autonomist enactivism. First, an autonomous system is a system that defines its individuality by self-distinguishing from the rest of the environment, sometimes by autopoiesis, sometimes simply by an operational closure. Secondly, the interactions of such an autonomous system with the environment are fundamentally determined by norms grounded on the self-identity and self-preservation of the system. Finally, the interactional asymmetry exhibited by the adaptive behaviour of these systems is due to their capacity of modulating (according to the proper norm) agent-environment system interactions. From this stance, life entails agency and cognition too.

Conversely, artificial sensorimotor systems that generate sensorimotor couplings, such as Brook's robots, do not exhibit agency because they do not possess the intrinsic teleology of life (Froese and Ziemke 2009). They can be dynamically coupled to the environment and modulate this coupling, but the external observer determines the norms of the coupling. Only living organisms determine their own norms because it is a matter of existential concern to sustain and modulate their interactions with the environment (Di Paolo 2009). *This fact changes everything*. The smart actions of life are due to their existential concerns, bodily affects, emotions, interests, all grounded in their developmental paths. The "intelligent" behaviour of artificial systems, by contrast, is determined by their design and the purposes of their creators (Froese and Ziemke 2009). Even if computational systems can be reprogrammed and updated to produce unforeseen outcomes for their human creators, these tasks are meaningless for the machines, and the fantastic results of their "actions" can only be recognized as such by human agents. This is not to say that it is not possible to create artificial forms of full-fledged intelligence. This is just to say that for such a thing to happen, artificial systems would need to embody the same autonomous organization of life (Di Paolo 2009; *SmLf*).

In this manner, autonomist enactivism *does* provide criteria to distinguish between cognitive agents and artificial systems with efficient behaviour. Cognitive agents are sentient beings that behave according to their own norms, which are rooted in their biological constitution. The systemic descriptions of living agents also distinguish between mere self-organizing systems and cognitive systems, which are necessarily autonomous systems in precarious condition with adaptive behaviour. That is, cognitive systems are, by definition, living systems. This systemic description of life also tells us that living beings are agents. They are beings that actively change their environmental conditions and their behaviour, considering their own purposes. Therefore, the strong enactivism project of autonomist enactivism offers just the sort of definitions that are missing in the weak enactivism project of radical enactivism (see figure 6).

(Shared assumptions)

Cognition is rooted in cycles of action and perception
Perception is guided by action (constituted by sensorimotor loops)

Radical Enactivism (as weak enactivism)	**Autonomist Enactivism** (as strong enactivism)
• Neglects and is skeptic of the philosophical grounds of *The Embodied Mind.*	• Philosophical foundations: Buddhism and Phenomenology; groundless grounds.
	• Subjectivity is intrinsic to cognition and to the study of cognition.
	• There is a fundamental circularity: cognitive science is a self-interpretation of the existential condition of our being-in-the-world.
• Rejects the theory of autonomy.	
• Describes a heteronomous determination of living organisms.	• Cognition is grounded on biological autonomy.
	• Cognition is sense-making.
• Focuses on the evolutionary processes as the causal origins of cognition.	• Focuses on developmental aspects of life and cognition.
• Has no clear mark of the cognitive.	• Life is the mark of the cognitive.

Figure 6. – The main differences between Radical and Autonomist Enactivism

The list above shows the main differences between the research projects of radical enactivism and autonomist enactivism as reviewed in this chapter.

Defining life as autonomous is still controversial. Such a claim needs more support and connection with non-orthodox theories of evolution to create a solid alternative to mainstream theoretical biology. However, it is also true that conceiving life as autonomous and normative is an idea gaining support in the field (cf. Moss and Nicholson 2012). For enactive cognition, the conclusion to draw from this is clear: autonomist enactivism, or any other strong enactivism that put autonomy and normativity at the basis of life and cognition, offers a more complete and accurate description of cognitive agents and cognition than those approaches taking raw sensorimotor correlations as the causal bases of this phenomenon. [27]

[27] Friston's (2010) variational approach, based on the free-energy principle, seems to support the same conception of life and mind of autonomist enactivism (Kirchhoff and Froese 2017; Allen and Friston 2018; Ramstead, Badcock, and Friston 2018). The accuracy of this claim is still unclear for some authors in the field though, given the proximity of this theory to Bayesian approaches of brain-centred cognitive science (e.g., Bitbol and Gallagher 2018).

Chapter 3 – Body-World Entanglement: On Sense-Making as Norm Development

Autonomist enactivism is founded on the belief that there are no absolute grounds to explain the origins of cognitive phenomena. Neither the world nor the constitutive mind can determine a priori the contents and structures of cognition. Instead, autonomist enactivists maintain that the history of interactions between the body and the environment provides the source of these phenomena (*EmMnd*). In this picture, the body is a living body, defined as an autonomous and adaptive system, one capable of determining and modifying, partially at least, its norms of interaction with the environment (*MndLf*). The self-determination of interactional norms is an essential characteristic of living and cognitive systems. This characteristic is what distinguishes real cognitive systems from purely mechanical ones. While these latter systems may have efficient functional behaviours that approximate the actions of cognitive systems, they possess no capacity to self-determine their own norms (Froese and Stewart 2010). If, as autonomist enactivists affirm, cognition depends on the autonomy and adaptive behaviour of a system, then cognition is rooted in life, and it is the autonomous organization of life that is the hallmark cognition.

The last chapter argued that this view provides us with more specific characteristics of cognition and cognitive systems than other enactivists accounts do. Although controversial, such an approach also explains the natural origins of minimal forms of subjective experience as affective sentience common to all living beings (Colombetti and Thompson 2008). This last analysis provides a basis for exorcizing what may be seen as metaphysical explanations of subjectivity from sciences of mind. Finally, an emphasis on the autonomy of life prompts us to look to phylogenetic *and* ontogenetic processes as determinant processes for the constitution of organisms' behaviour and cognition. This helps account for the plasticity and diversity of actions and strategies in different organisms of the same species.

Despite the advantages of autonomist enactivism, the programme has significant shortcomings. This chapter argues that one of the problems facing autonomist enactivism is its paradigmatic description of sense-making. This description tells us that a pre-given world of substantial objects with intrinsic physical properties acquires a particular relevance and signification for living organisms due to their unique biological concerns. Drawing on Varela, I call this description of sense-making *the thesis of significance as a surplus* (i.e., the thesis that meaning is a surplus wholly added by organisms to a physical domain, otherwise void of meaning) (3.1).

This thesis has motivated significant misunderstandings of the enactivist program (3.1.1). For some critics, sense-making involves some sort of constructivism (De Jesus 2018), internalism (Wheeler 2010), or idealism (Kiverstein and Rietveld 2018), where cognitive agents constitute or give form to their cognitive realm. This chapter argues that such interpretations are misleading because they neglect the implicit phenomenological dualism and fundamental circularity that characterizes autonomist enactivism (3.1.2).

This clarification does not exempt the thesis of significance as a surplus from real problems. Recall that the thesis of significance as a surplus suggests that subjectivity emerges from an objective world. If this is the case, then the foundations of cognition are located in the subject-independent world. Therefore, this thesis is problematic for autonomist enactivism because it contradicts its philosophical foundations (3.1.3). However, there is a more significant issue at stake: despite its advantages, the thesis of significance as a surplus offers poor descriptions of the processes that underlie sense-making. Critically, we must see that these processes do not occur in the interactions of autonomous systems and their raw physical surroundings. Instead, they happen in the midst of a pre-given set of normative interrelations enacted in the historical past of the body-world interaction. We must adjust our modelling of cognition if this latter affirmation is confirmed, including normative constraints in the list of constitutive processes of sense-making and not mere physical constraints. Consequently, the problem of the thesis of significance as a surplus is not only philosophical but also empirical.

Given the problems of the traditional definition of sense-making, this chapter proposes an alternative way to conceive it. I will call this new definition of sense-making *the thesis of norm-development* (3.2). In this view, sense-making consists in the *reconfiguration* of an *already* existent normativity in the agent-environment system. In place of a theory of emergence, where the normative domain (sense) arises from a non-normative one (non-sense), my conception of norm development assumes that the body-world entanglement is a condition of possibility for sense-making. In other words, my view takes for granted that there are always previously given normativities, enacted in the history of interactions of the agent-environment system, that enable, constrain, and motivate the enactment of new norms.

To support this thesis, I will argue that some descriptions of sense-making as norm development are already at play in some less-known descriptions of adaptivity and chemotaxis in E. coli bacteria (3.2.1). Norm development is also at play in autonomist enactivism's description of sensorimotor habits. (3.2.2) The dynamical interpretation of Piaget's theory of equilibration shows that sense-making (3.2.3), at the sensorimotor level, involves the constant development of normative configurations of the body-world entanglement from other previously given configurations, not simply the emergence of meaning from raw matter. Finally, I will argue that, from Merleau-Ponty's phenomenological perspective (3.3), the body-world entanglement is the condition of possibility for perception (3.3.3), and further, that perception involves the development of norms that constantly reconfigure this entanglement (3.3.4).

3.1 The Thesis of Significance as a Surplus

In the early days of autonomist enactivism, Varela described an essential difference between the concepts of 'environment' and 'world,' which he called *the surplus of significance* (Varela 1991, 179). This surplus of significance refers to the value that physicochemical events and objects in the surroundings of organisms acquire for them, given their concrete bodily constitution and needs. For instance, the chemical compound of 'glucose' has the significance of 'nutrient' for E. Coli bacteria that use this compound for their metabolic functions. For this reason, Varela distinguishes sharply between 'environment,' which stands for the physical surroundings of an organism, and 'world,' which corresponds to the meaningful aspects of these surroundings (those that trigger actions from this organism).

About a decade later, Thompson (Thompson 2004, 386) claimed that living *is* sense-making, which entails that being alive is a continuous process of making sense of the surrounding world according to organisms' biological needs and interests.

In *MndLf* (147), Thompson finally defined sense-making as the act of changing the "psychochemical world" into an "environment of significance and valence." I will call this way of describing sense-making as *the thesis of significance as a surplus*.

This thesis has been a recurrent source of criticisms from the supporters of other forms of radical embodied cognition. The problem they see is that this description of sense-making seems to imply just the sort of dualisms that characterizes brain-centred cognitive science. Hence, very little progress would be made.

While I agree that the thesis of significance as a surplus is a problematic description of sense-making, I disagree with the arguments against this thesis. In the following, I will clarify the problematic aspects of this typical definition of sense-making and then propose an alternative concept of sense-making. This section proceeds in three different stages.

In the first stage (3.1.1), I will first clarify the meaning of the twofold reference of terms like 'environment' and 'world' within the literature of autonomist enactivism. Autonomist enactivists have often used these two terms ambiguously, referring interchangeably to the lived world of agents and their physical surroundings. This semantic ambiguity has motivated several misunderstandings of the claims of autonomist enactivism. These clarifications let us see that the twofold meanings of the terms' environment' and 'world' of autonomist enactivism do not entail any of the dualisms occasionally attributed to this approach. Biological autonomy and sense-making theories rather entail the coupling of the agent and the environment *from the start*. Consequently, we cannot say that this approach assumes the traditional subject-object or internal-external dualisms.

In the second stage of the analysis (3.1.2), I will argue that the twofold reference of the terms' environment' and 'world' implies a phenomenological dualism that describes a dual aspect of the environment. This dualism is phenomenological because it involves two different modes of experience based on two different levels of corporeality: the subjective and the intersubjective. This dualism is not a traditional one though, the subjective world is not and cannot be worldless, as much as the objective world cannot be experienceless. There is only one and single world (or environment) humans live in two different modes of experience.

In the third stage (3.1.3), I claim that the real problem of the thesis of significance as a surplus contravenes the phenomenological dualism offered by autonomist enactivism. This thesis suggests that the subjective mode of experience originates in the subject-independent world. This world is presupposed in the intersubjective mode of experience as scientific descriptions of the physical world. Note that, by this account, the subjective mode does not arise due to a productive dialogue between the two modes of experience. I argue this is a methodological error because it sets the absolute grounds of cognition in causal physical processes, thus causing autonomist enactivism to contradict its own philosophical principles (i.e., the middle way). This helps explain why its descriptions of sense-making are often misunderstood. The real problem of the thesis of significance as a surplus is, nonetheless, that it also limits our scientific understanding of sense-making.

3.1.1 Stage One: The Environment as *Umwelt* and as *Umgebung*

Scholars discussing autonomist enactivism tend to use the words' environment' and 'world' in two different manners. Sometimes these terms designate the subject-relative world that is significant for the activities of living organisms, while some other times, the same words name the subject-independent world described by sciences like physics and chemistry. This twofold semantics causes unnecessary ambiguities.

For this reason, I will import the terminology of the Estonian etiologist Jakob von Uexküll (1992) and name the subject-relative world *Umwelt* and the subject-independent surroundings of organisms *Umgebung.*[28] Given the similarities between the claims of Uexküll and those of autonomist enactivism (*MndLf*), this terminology helps us avoid the semantic ambiguities of this latter approach and improve our understanding of the thesis of significance as a surplus.

In his most paradigmatic example of an *Umwelt*, Uexküll describes three essential features significant for the vital cycle of a tick: (1) an olfactory cue, from butyric acid in a mammal's sweat, (2) a tactile cue from a mammal's hair, and (3) the temperature of a mammal's body. For ticks, these three specific aspects of a mammal's body are relevant for getting the blood they need to reproduce (Von Uexküll 2010, 45). The relevance of these aspects depends on the constitution of the tick's sensorimotor system and the vital norms that motivate its sensorimotor behaviour. This

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[28] The German word *Umwelt* literally means the surrounding (*Um*) world (*Welt*). The *Umgebung*, in contrast, is what is given in the surrounding area.

happens in what Uexküll termed a *functional cycle*. The *Umgebung* of the tick, by contrast, comprises all those aspects of the environment that we can observe in the surroundings of ticks, including aspects irrelevant for the three functional cycles of these organisms.

We find the origin of the enactive conception of the *Umwelt* in *EmMnd*. Varela and colleagues stated that autonomous systems, while maintaining a structural coupling with the environment, specify *a domain of significance* (*EmMnd*, 155). This is illustrated by the example of a virtual autonomous system (Bittorio), which, after a period of interactions with its virtual surroundings, self-organizes and begins to select from its random milieu (i.e., its *Umgebung*) those aspects relevant to its autonomous constitution (*EmMnd*, 156). Later, the authors of *EmMnd* claim that something similar occurs with living organisms that enact different worlds of colour thanks to differences in their sensorimotor systems, biological functions, and environmental conditions (181; see also Thompson, Palacios, and Varela 1992).

In his book *Mind in Life*, Thompson (*MndLf*) made similar descriptions of the meaningful world of *living* sensorimotor agents, saying that "In the case of animal life, *the environment emerges as a sensorimotor world* through the actualization of the organism as a sensorimotor being" (59, my emphasis). In the same work, Thompson makes explicit the parallels between the enactment of a world of significance by an autonomous system and Uexküll's notion of *Umwelt*: "Sense-making changes the physicochemical world into an environment of significance and valence, creating an *Umwelt* for the system" (*MndLf*, 147).[29] Thompson or any other enactivist never uses the term Umgebung. However, for practical purposes, I will use it here to designate the "physicochemical world" that Thompson mentions in the last citation.

Although autonomist enactivists describe much like Uexküll two different types of worlds or environments that surround living organisms, they do not necessarily endorse a traditional dualism

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[29] Uexküll did not go deeper into explaining the origins of an animal's functional cycles. Thus, there lies open the possibility of fitting Uexküll's work into an account of life that is rigorously focused on development, such as autonomist enactivism is, or into more traditional explanations of life and evolution (see De Jesus 2018; Heras-Escribano and de Jesus 2018). Such an exercise is nonetheless irrelevant to the common definition of autonomist enactivism, as well as to Uexküll's conception of *Umwelt*.

or posit a radical separation between an epistemic subject and its objective world. De Jesus (2018) thinks the opposite, however. He claims that autonomist enactivism holds an *epistemological perspectivism* that posits the existence of two kinds of "worlds": the worlds enacted by a living organism (a subjective world), and the world as such (an objective world), over which the organism takes a perspective.

This is a misinterpretation of the claims of autonomist enactivism. Autonomist enactivism simply does not describe the disclosure of the world by a living body in epistemological terms. The relation between an organism and the environment is fundamentally based on the bodily affectivity of the living organism, and this affectivity is constituted and developed in the concrete existence of the organism and its interactions with the environment (Colombetti 2014; Fuchs 2012, 2017). Consequently, there is no epistemological perspective on the world; instead, there is a particular way to make sense of it.

Another related misinterpretation of the thesis of significance as a surplus is the attribution of a "bodily internalism" to autonomist enactivism. Brain-centred cognitive science is often deemed a cognitive internalism because all the relevant causal processes of cognition are said to happen within the spatial boundaries of cognitive agents or, more specifically, in the head. Similarly, for Wheeler (2010, 35; see also Clark 2008a), the theory of biological autonomy entails a new form of internalism since it encloses the relevant causal processes of cognition within the spatial boundaries of the biological body. From this standpoint, the environment may cause perturbations in the living body, but the world remains external and alien to organisms, only providing inputs for their bodily organization.

Wheeler's assertions are nonetheless unjustified for at least two reasons. In the first place, the living body as an autonomous system is, from the beginning, constituted by the agent-environment coupling. The sensorimotor domain of relevance (*Umwelt*) is enacted by sense-making, while the bodily self of the agent is defined by operational closure or self-making. Neither the body nor the environment is pre-specified in advance of the vital unfolding of the living body (Froese and Ziemke 2009). Indeed, thanks to a capacity for adaptivity, living organisms constantly shape and reconfigure their sense-making of the world.

The second reason that Wheeler's assertions are unjustified is that they fail to appreciate the capacity of the living body to reconfigure its own constitution adaptively, a capacity that allows living organisms to reshape their own organizational boundaries and incorporate objects and processes that were previously only part of the environment (Di Paolo 2009; Thompson and Stapleton 2009). *The boundaries between the body and the world are thus plastic and not predefined a priori* (i.e., independently of their concrete interactions). Beyond otherwise significant differences, autonomist enactivism holds in this respect a perspective very similar to externalist accounts of cognition, such as the extended functionalism supported by Wheeler. Indeed, positions like internalism and externalism do not apply to autonomist enactivism. These two positions typically assume the existence of pre-specified boundaries between agents and their environments, but autonomist enactivism does not (cf. Di Paolo 2009).

Therefore, the twofold semantics of the term 'environment' for autonomist enactivism is neither the manifestation of a traditional subject-object epistemic dualism nor of the internalism-externalism dichotomy that characterizes brain-centred cognitive science. However, it is still necessary to explain the sort of duality evoked by the use of the twin-terms *Umwelt-Umgebung*. I will argue, in the next section, that the constant shift between the semantic reference of environment as *Umwelt* and as *Umgebung* is motivated by *a duality of phenomenological aspects of the environment that mirrors the phenomenological duality of the body*.

3.1.2 Stage Two: The Dual Aspect of the Environment

From a phenomenological perspective, the environment can be experienced both subjectively *and* objectively, like the body itself. This subsection argues that autonomist enactivism implicitly endorses the same perspective.

Following Husserl's (1989) phenomenological descriptions, Fuchs (2018) claims that the body has a dual aspect: it can be conceived either as a lived subjective body (*Leib*) or as a physical or objective body (*Körper*) (see also Legrand 2006; Thompson 2005; *MndLf*). The lived body refers to our concrete bodily existence, the one that makes our experience of the world possible. My hand, for instance, has a sensitivity of touch and a particular way of articulating its movements to touch and grasp my cup of tea. My experience of the cup, explicitly lived or not, is possible thanks to this capacity of my hand to make sense of the cup by being able to grasp it (*PhP*; Gallagher 2005). Understood in this way, my hand is part of my lived body.

I can also shift perspective and see my hand with a certain detachment, as being before me or as an object that rests between the cup and my computer. As such, my hand is considered as an object that shares the same 'spatial' domain as other objects, and it is subject to the same kind of "objective" relations.

Although the body appears to our lived experience both as a subject and as an object, there are not two bodies. The distinction between the two is phenomenological, not ontological. My body has a dual phenomenological aspect (Fuchs 2018): it can be tacitly experienced as a body (*Leib*) that constitutes my experience of the world, or it can be experienced as an object (*Körper*) that is part of the world I inhabit.

We can find the same dual aspect in the environment. There is, for instance, something like a lived environment, which we understand as the domain we inhabit and with which we are familiar. The lived world of perception primarily consists of what Merleau-Ponty (*PhP*) called motor significations, but that we know more commonly, after Gibson (*EcApVsPr*), as affordances. *Affordances are those aspects of the environment that correlate to the motor intentions of what phenomenologists call the lived body*. The cup affords grasp-ability to my hand, the floor offers walkability to my legs, the chair affords sit-ability to my whole body. Heidegger (1962) called these aspects of the environment *ready-to-hand*. Nailing the wood, an experienced carpenter can sustain a continuous flow between her body, the hammer, and the wood. Dreyfus (1991) named this flow 'skillful coping.' In skillful coping, the perceiver does not need to reflect about her actions or the things her actions are directed to, because there is already at play an important attunement between the whole body-world system (Kelly & Dreyfus 2010). It is only when something goes wrong, or there is a need for significant adjustments in the performance of an action, that the carpenter will direct his attention to the environment and its specific aspects that we call objects (Heidegger 1962; Dreyfus 1991).

The objective environment, by contrast, is the space around us, full of objects that exist as such, as if they were totally independent of our interests and concerns. Heidegger (1962) called this aspect of the environment *present-at-hand*. Perceiving the environment, in this mode of experience, involves more a theoretical than a practical attitude on the part of the perceiver (Dreyfus 2007). I can look through the window and see houses, trees, birds, people, the blue sky, and so forth. I can explicitly refer to these aspects of the environment and share my experience of them with others thanks to the acquisition of language. These objects are, therefore, a common place of reference or meanings shared with others.

This dual aspect of experience explains the twofold sense of the terms' environment' and' world' within autonomist enactivism. The *Umwelt* of the tick is what we think resembles our lived environment. The environment appears before the tick as a dwelling place because it accomplishes there its vital activities, fulfilling its vital norms. When the circumstances are suitable, the tick acts, and maintaining the flow properly through its three functional cycles, it can reach something like the skillful coping described by Dreyfus. Skillful coping does not involve reflection or other complex cognitive functions that ticks do not possess. Skillful coping can be understood as the proper equilibrium between the agent-environment system (Bruineberg and Rietveld 2014). All organisms accomplish this equilibrium that satisfies their biological norms (Di Paolo and Thompson 2014). If things go wrong, organisms can modify their behaviour (adaptivity) without taking notice of the objects involved in their bodily actions, just as we do daily. Therefore, we can say that the enactive and Uexküll's *Umwelt* of any organism is like the lived environment of ourselves described by phenomenologists (although see Buchanan 2008; Kee 2020).

Our *Umwelt* is not reducible to the lived environment, in any case. We can detach ourselves and the particular aspects of the environment (objects) we perceive from their immediate perceptual context (Merleau-Ponty 1963; see also Moss-Brender 2017). We can situate these objects in abstract contexts or place them in symbolic horizons that pertain to the shared world of our cultural environments. We also have what Husserl (1970) called a *lifeworld*. In the cultural horizons of a lifeworld, objects can be manipulated abstractly or concretely to accomplish new bodily and now also cultural practices. Science is one of these practices, and the objects we describe in a scientific horizon pertain to a new dimension of meaning, but one that nonetheless refers to the same environment that we intend in the unreflective dimension of our perceptual experiences (Thompson 2016).

The problem has been that autonomist enactivism is not clear about the sense of its references to the environment or of the explicit existence of this dual aspect I have just described. The problems intrinsic to the thesis of significance as a surplus, nonetheless, cannot be found in the phenomenological dualism of *Umwelt* and *Umgebung* because such dualism does not entail anything like the mind-world dichotomy of brain-centred cognitive science. The following section argues that the real problem of the thesis of significance as a surplus starts in an inappropriate methodology of autonomist enactivism. This methodology is confusing about the relationship between scientific claims and phenomenological descriptions. It guides us to think that the contents (scientific claims) of one mode of experience (the intersubjective) are the original foundations of the other mode of experience (subjectivity).

3.1.3 Stage Three: Mutual Enlightenment

Although approaching cognition from a dual perspective improves our understanding of this phenomenon both from the scientific and the phenomenological point of view (*EmMnd*; *MndLf*; Fuchs 2018), we need to be careful in our methodology to avoid dualistic explanations that can miss the *in-between* nature of the *body-world entanglement* at the heart of autonomist enactivism. As I will show, this is precisely where the real problems of the thesis of significance as a surplus lie.

To recall: autonomist enactivism is founded on the thesis of embodied subjectivity, which recognizes in subjectivity an intrinsic aspect of cognition. One of the implications of this thesis is that cognitive scientists need to work under a fundamental circularity. This reminder precludes us from setting the absolute grounds of cognition either in the mind or in the world (see 2.1), which in turn requires maintaining a constant dialogue between the first and third-person perspectives of our study of cognition, i.e., between science and phenomenology (*EmMnd*).

As we have seen in chapter two, the third-person perspective of science does not involve, for autonomist enactivism, knowledge of a subject-independent world, but a new form of experience rooted in the intersubjective and enculturated lives of human beings (Thompson 2016). Describing sense-making as transforming an *Umgebung* into an *Umwelt*, however, commits the error of grounding one mode of experience (the subjective mode) on the experiential contents given in the other mode of experience (the intersubjective, enculturated mode). Therefore, the thesis of significance as a surplus suggests that the absolute grounds of cognition – including its subjective and meaningful dimensions – can be found in the physical world described by science, falling into contradiction with the middle way of the thesis of embodied subjectivity.[30]

From a methodological perspective, the relation between phenomenology and enactive cognitive science is complicated, and there have been efforts to ground scientific knowledge on the transcendental dimension of experience (e.g., Kant 1998), as well as efforts to ground phenomenological claims on the basis of scientific knowledge (e.g., McIntyre 1999). The most accepted proposals for this relation between science and phenomenology in enactive cognition are those that do not intend to ground one sort of knowledge on another but instead speak, like Gallagher (1997, 2012) exceptionally does, of a *mutual enlightenment.*

The mutual enlightenment of cognitive science and phenomenology argues that phenomenological descriptions can constrain and motivate causal explanations, and that causal explanations can constrain and motivate phenomenological descriptions of cognitive phenomena. This means that cognitive scientists should not pretend to find the ultimate roots of one mode of experience in the other one, but to sustain a dialogue between the two, thus maintaining the "groundless grounds" of enactive cognition.

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[30] It could be argued that our scientific, intersubjective mode of experience constitutes a more finely-grained description than that of the purely subjective, or ego-oriented mode of experience. For this reason, such an intersubjective account plays a more fundamental role in our understanding of cognitive phenomena. This hierarchical superiority of the intersubjective mode however should be understood as only practical and not theoretical. That is, insofar as science is more useful for our understanding of cognition (for the practical purposes we have), it could have a primacy over phenomenology. Historically, however, the primacy of science over phenomenology has led us to misdescribe cognitive phenomena and have produced problematic explanations. This is exactly what Varela et al. (*EmMnd*) argued in his criticisms of brain-centred cognitive science. However, I will argue that a similar mistake happens to many enactivists in their classical descriptions of sense-making. For this reason, I suggest that a better route to understand the relation between the two modes of experience is Gallagher's (1997) proposal of a mutual enlightenment.

I will later (3.3) return to the subject of the relation between enactive cognition and phenomenology. For the time being, let us conclude that the gap between the two modes of experience is not a gap that needs to be closed as the so-called "explanatory gap" of the mind-body problem might. From both the enactivist and the phenomenological perspectives, the gap implied by the dual aspect of the body and the environment has the positive function of forcing us to adjust and attune our scientific and phenomenological claims via a mutual enlightenment (see also Fuchs 2018).

Nevertheless, this is not the only problem. As I see it, the problems of the thesis of significance as a surplus are not only methodological, for it led autonomist enactivism to misconceive sense-making as an activity in which living agents are decoupled from their own ecological and developmental history. These are the most problematic aspects of this thesis, and it is by redefining sense-making, we can start overcoming these problems.

A conception of sense-making that stops thinking of it as the transformation of a meaningless realm of physics into a normative domain of life and cognition cannot only fit better in the conceptual framework of autonomist enactivism, but it should also produce more accurate scientific models of cognition. This is the most significant reason for overcoming the theory of significance as a surplus.

If sense-making transforms a non-normative domain into a normative one, then the relevant constraints and variables of the agent-environment coupled system will be only the physical constraints of the environment. On the contrary, if, as I will suggest, sense-making involves developing an already existing normative domain into a new one, then a normative set of constraints and not only a physical one is crucial for understanding cognition as a form of sense-making.

In the following section, I will demonstrate that some works of the enactive approach already show that sense-making emerges from developmental processes rather than processes of adding significance to the physical realm. In the end, we need to go even further. Since the development of norms does not depend only on the development of the body but also on the environment as a normative domain, we need to redefine the relation between the body and the world, something I will consider in chapter four. However, the relevance of the theory of norm development the next section appeals to should be seen not as a mere conceptual adjustment of autonomist enactivism but also a call for adjusting our scientific understanding of sense-making.

3.2 The Thesis of Norm-Development

The entanglement of the body and the world is the condition of possibility for sense-making, and sense-making is the continuous development of the norms already at play in this entanglement. I will call this description of sense-making *the thesis of norm development*, and I will defend this thesis in the rest of this chapter in three different ways. First (3.2.1), I will argue that bacteria chemotaxis and the metabolic needs motivating this chemotaxis imply a body-world entanglement and not a body-world dichotomy, as the theory of significance as a surplus suggests. Secondly, I will show that the account of sensorimotor habits of autonomist enactivism implies norm development in their dynamical account of Piaget's theory of equilibration (3.2.2 & 3.2.3). Finally, I will argue that, from a phenomenological perspective, the body-world entanglement is the condition possibility for perception and that the similarities between Merleau-Ponty's account of perception and the notion of sense-making (Thompson and Stapleton 2009) further supports the thesis of norm development (3.3).

3.2.1 The Body-World Entanglement of Living Organisms

According to the classical descriptions of sense-making in the paradigmatic example of Escherichia coli (E. coli) bacteria moving towards a medium with a high concentration of glucose, bacteria and their surroundings are seen as two separated entities that become linked thanks to the bio-affective responsiveness of the bodies of bacteria to the properties of this chemical compound.

Although this bio-affective bond may accurately describe the relational, normative domain of bacterial bodies and the world's physical properties, we must be aware that such a bond is possible only because of a *previous* bond between the body (of bacterium) the world. This is not a phenomenon that emerges from or supervenes upon raw physical processes. Contrary to those described in the case of the cellular automata Bittorio, the self-organization processes of living beings do not produce ordered patterns of interaction from a "random milieu" or a chaotic, meaningless world. On the contrary, cognitive and living processes are always *constrained by a* *previously established normative domain*, *enacted in their own past*, or more precisely, by a set of constraints established in the history of interactions of the living system and the environment.

Chemotaxis is a basic sensorimotor behaviour that allows bacteria to swim in a medium, either in a straight line or randomly, due to the articulated movements of their flagella and the sensitivity of these bacteria to the chemical composition of their mediums (Barham 2012). These two movements are also referred to as *running* and *tumbling*, respectively. E. coli usually run, but when they find locations with high concentrations of glucose, they begin tumbling to remain in areas that provide a metabolic benefit. Traditional explanations of chemotaxis say that this happens because E. coli have a sensorimotor pathway that responds mechanically to the presence of certain chemicals (Adler 1969). Scholars of autonomist enactivism, on the other hand, see chemotaxis as a normative-oriented behaviour that depends on an organisms' metabolism (Egbert, Barandiaran, and Di Paolo 2010). If this is the case, running and tumbling are actions that depend on self-organization processes happening at the interior of the operational closure of a bacterium. This is to say that these behaviours occur under self-organization processes, just as much as they depend on the presence of specific chemical compounds in the environment that shape the behaviour and bodily constitution of a bacterium (cf. Barandiaran and Egbert 2014). Attaining equilibrium in a bacterium's body through sensorimotor behaviour satisfies a fundamental sensorimotor norm (the bacterium' flagella's coordinated action). However, this norm is grounded on the vital metabolic norms that maintain the viability and the autonomy of the system. The viability of the system represented by a state of organizational equilibrium of a bacterium is a norm that does not simply emerge from the pre-given composition of the body of this organism. The vital norm is instituted as a result of processes of development that cause the expression of specific genes and not others.

There are various chemical compounds beneficial for E. coli's metabolism, including glucose, lactose and sucrose. From the standpoint of autonomist enactivism, the responsiveness of E. coli to one or many of these compounds is not determined by dispositional laws, as some authors suggest (Heras-Escribano, Noble, and de Pinedo 2015). It is established in the developmental path of the bacterium. This is more explicitly and carefully described by less typical descriptions of chemotaxis (Barandiaran and Moreno 2008).

Barandiaran and Moreno posit that normativity, at the level of life, entails two different kinds of processes: constructive processes and interactive processes. The first set of processes consists of the network of processes needed to maintain the autonomous organization of a living organism. They are topologically localized in the boundaries of the organizational closure of the system. The second set comprises the processes of interaction between the agent and the environment needed to maintain the system's viability. It is important to note that both sets of processes are necessary to preserve the viability of the system, i.e., both constructive and interactional processes are constitutive of the vital norms of a living organism. When E. coli bacteria find low levels of glucose and higher levels of lactose, the bacteria change their constructive processes (their gene expression) to metabolize lactose instead of glucose, adapting its interactional processes to the current conditions of the environment (Barandiaran and Moreno 2008). The change in the body of the bacteria to metabolize lactose causes the emergence of a different normative domain of interaction. Lactose acquires a significance caused by the circumstances of the agent-environment system as a whole, the body of the bacteria has been adapted to incorporate this compound.[31]

The enactment of the norm of lactose as valuable for the metabolic needs of E. coli is not the result of the constitution of the autonomous system independent of the immersion of this system in its concrete environment.[32] Since the enactment of this norm implies changes in the body of the living agent or in its constructive processes, the adaptive behaviour of an agent also entails some sort of *incorporation* of the environment. In this case, the enactment of a vital norm consists of reconfiguring the whole agent-environment system and not simply of how the agent makes sense of the environment as such.

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[31] The body changes its gene expression adaptively to metabolize lactose instead of glucose in a process known as the Lac Operon mechanism (Barandiaran and Moreno 2008, 334).

[32] This phenomenon involves the phylogenesis of bacteria (inherited genes), adaptive ontogenesis (the expression of specific genes for lactose metabolism), and the current conditions of the environment (an environment with low levels of glucose and higher levels of lactose) (cf. Barandiaran and Moreno 2008; see also Egbert, Barandiaran, and Di Paolo 2010).

Therefore, from an enactive perspective, when we describe the emergence of a vital norm, like *E. coli* bacteria "running towards glucose," we should not state that an organism projects meaning on a raw physical substance. It is more proper to say that an organism *incorporates* an aspect of the environment into its already constituted interactional domain. An incorporation, in this case, means a reorganization of the already existent body-world entanglement of the agent-environment system, the acquisition of a new sense or a new norm for the sort of interactions this system maintains.

The origin of vital norms is not only ontogenetical, but also phylogenetical (Zimmer 2008). The descriptions of the so-called enactive evolution (the connection between the theory of biological autonomy and non-orthodox theories of evolution) should help us explain the temporal connection between different generations of organisms and the processes of autonomy and reproduction (*MndLf*). I cannot go further into this question here; to do so would require a careful treatment of genetic and epigenetic processes beyond this thesis's scope. However, we must bear in mind that the development of any organism is constrained by processes that involve the inheritance of a developmental niche that includes genomic and extra-genomic material (cf. Arnellos 2018). The following subsection address the second and most important argument for the thesis of norm development, namely the account of autonomist enactivism of sensorimotor habits, which is the level where cognition, properly speaking, begins.

3.2.2 Sensorimotor Norms: Sense-Making as Norm Development

The approach of autonomist enactivism to the sensorimotor level of autonomy and sense-making is built on the theory of sensorimotor contingencies. This theory describes perception as the capacity of an individual to master lawful correlations of sensory inputs and motor actions (O'Regan and Noë 2001). However, in a careful analysis of this theory, Buhrmann, Barandiaran and Di Paolo (2013) realized that a more precise definition of sensorimotor contingencies was needed, as well as an adequate account of the mastery or 'know-how' of these contingencies. Autonomist enactivism proposed to create an operational definition of sensorimotor contingencies based on the conceptual framework of dynamical systems theory. This redefinition of sensorimotor contingencies allowed autonomist enactivism to recognize the organizational features of life at play in the constitution of sensorimotor habits.

The classification of the operational framework of autonomist enactivism distinguishes four types of sensorimotor contingencies: *sensorimotor environment, sensorimotor habitat, sensorimotor coordination, and sensorimotor schemes* (*SmLf*, 53-58). A sensorimotor environment describes the lawful correlations between sensorial stimuli and movement, such as changes in the elliptic form of a circular object when we take a particular view of it (Noë 2004). The sensorimotor environment ignores, for convenience, certain changes that occur in the specific movement of a body. A sensorimotor habitat, by contrast, denotes the changes occurring in the body and the brain that determine the enactment of a particular sensorimotor correlation, such as the specific motor actions needed to recognize the softness of a sponge. A sensorimotor coordination describes how multiple sensorimotor correlations interact together to accomplish a particular bodily action, like the bundle of motor movements needed for grasping a cup of coffee. Finally, a sensorimotor scheme is a sensorimotor coordination that has a specific normative domain. That is, sensorimotor correlations are coordinated in such a way that they deliver good or bad outcomes for the accomplishment of a bodily action.

It is important to emphasize that the first three types of sensorimotor contingencies are abstract ways of understanding the possible correlation between motor actions and perceptual feedback. In the notion of sensorimotor schemes, we begin to uncover the real phenomenon of action and perception simply because cognition, as sense-making, is necessarily normative according to the theory of biological autonomy. Thus, the most critical task is to discover where the normativity of sensorimotor schemes comes from if it does not wholly rest on the biological level of autonomy.

The normative domain of sensorimotor actions is constituted by *sensorimotor habits*. Bodily habits are generally composed of more than one sensorimotor scheme. Preparing coffee in the morning, for instance, involves a temporal sequence of different sensorimotor schemes. I look for the bag of coffee and filters in the cupboard, then I put the filter in the machine and add the coffee. After this, I put the water in the machine. Finally, I push the button to turn on the machine. Other activities like swimming, by contrast, require me to coordinate multiple sensorimotor schemes at once, such as kicking with my legs, making stroking movements with my arms, and breathing.

The recurrence of any such successful sequence or a synchronic bundle of sensorimotor schemes produces a tendency to repeat the same dynamic network in similar situations. Di Paolo and colleagues (*SmLf*) have argued that this process is akin to the way neurons have the tendency to be activated together when the same input is present. That is, they follow Hebb's rule of neural connections (cf.1.1.2).

The interdependency of multiple sensorimotor schemes to preserve sensorimotor habits suggests that they have an operational closure (*SmLf*). This means that sensorimotor habits acquire autonomy because multiple sensorimotor schemes are interdependent diachronically or/and synchronically for the suitable accomplishment of a bodily action.

However, the dynamic nature of the world, environmental circumstances, practical contexts, and the physical conditions of the body are in constant change. Hence, the autonomous organization of habits is subject to precariousness, i.e., the operational closure of networks of sensorimotor schemes can be lost. Sensorimotor agents are conveniently capable of dealing with the world's contingencies and regulating their interactions to sustain the autonomous organization of sensorimotor habits. Thus, interactional asymmetry is also present at this level (*SmLf*, 156). Habits, therefore, acquire their own normativity, one that depends on sustaining the same sensorimotor networks that constitute a sensorimotor habit.

Bodily habits are usually part of wider contexts of action. I make coffee for breakfast, swim in a public pool, or cook dinner for my family. The broader networks of habits that constitute a context of action are called a *microworld* (Varela 1999a; *SmLf*). In these microworlds, the dynamic coupling of multiple sensorimotor habits becomes mutually sustained, either as sequences or synchronic bundles present for accomplishing a sequence of actions. That is, there is a fractal reproduction of the interdependency of sensorimotor networks that goes from sensorimotor coordination to sensorimotor schemes, or from sensorimotor schemes to sensorimotor habits, and from sensorimotor habits to microworlds (*SmLf*). There is a mutual reinforcement and a tension between the different fractal levels of sensorimotor autonomy that creates a highly dynamic and stable sensorimotor life.

3.2.3 Piaget's Theory of Equilibration

The interplay of stability and change in the sensorimotor life of agents is illustrated by a dynamical interpretation of Piaget's theory of equilibration (Di Paolo et al. 2014; *SmLf*). Two processes are crucial here: *assimilation* and *accommodation*. Assimilation refers to integrating an environmental aspect into the agent's physiological or cognitive/behavioural structure (*SmLf*). This means that when an unexpected contingency appears in sensorimotor actions, an agent-environment sensorimotor system must recognize itself to assimilate this contingency. Therefore, the dynamic coordination of the body and the world needs to agree with a sensorimotor norm (*SmLf*, 84). Accommodation then describes the processes through which an agent modulates its physiological and behavioural structures to facilitate the assimilation of an aspect of the environment that is not yet assimilated. Equilibration is, therefore, the process by which a sensorimotor organization reaches new stability, reducing the tension and the disparity caused by encountering the unexpected.

The process of agent-environment system reconfiguration that characterizes sense-making is the sort of phenomenon that Piaget's theory of equilibration describes. Piaget describes the process of assimilation as incorporating a new environmental aspect into the interactional domain of the agent-environment system. Accommodation, by contrast, describes the adjustments the agent needs to accomplish to incorporate or assimilate the recently encountered aspect of the environment. For Piaget, accommodation seems to consist of the adjustments an agent performs in its own body, whereas for autonomist enactivism, these changes can take place in the environment as well (Di Paolo et al. 2014). From a dynamical interpretation of Piaget's theory, given the coupling of the agent and the environment, changes in the parameters of any of the two systems can produce changes in the constraints of the whole coupled agent-environment system.

Perhaps the best example and illustration of an incorporation from a Piagetian perspective is one given by Di Paolo et al. (2014) in their dynamical description of how the bodily coordination of three basic sensorimotor schemes (sucking, breathing, and swallowing) needed by newborns to feed from the breast of their mothers eventually lead agents to acquire new sensorimotor schemes like feeding from a bottle of milk. The acquisition of new sensorimotor schemes involves adjusting the already existent sensorimotor coordination of the baby (the already established configuration of the agent-environment system) to enact a new normative domain of sensorimotor interactions. From the perspective of an external observer, there was a bottle of milk both before and after the baby can feed from it. However, from the perspective of the baby, there was nothing but a disruption or an alteration of the already established order, when the bottle was not like her mother's breast. There was a concurrence of chaos and order at the same moment when the baby first encountered the bottle, as well as a non-coincidence between the expectation sedimented in the past (the habit of breastfeeding) and the encountered new situation that diverged from what was expected. This encounter between the already established norm (breastfeeding), and the divergence of the new situation from this norm, enables the emergence of a new sense, or a new norm (bottle-feeding).

Sense-making

Norms of interaction are enacted in the developmental history of the agent-environment system

The thesis of significance as a surplus	**The thesis of norm development**
The emergence of a normative (i.e., meaningful or senseful) domain from a non-normative (e.g., lawful, meaningless, and purely physical) one.	The emergence of a normative domain from another previously given normative one.
• Betrays the Groundless Grounds philosophy of autonomist enactivism • Propitiate misunderstandings of the claims of autonomist enactivism. • Presupposes an initial radical separation of the agent and the environment. • There is a gap between the normative and the non-normative domains of life. • **Provides an inaccurate and highly abstract description of sense-making**	• Acknowledges the contingency of the Groundless Grounds philosophy. • Describes the subjective and the intersubjective modes of embodied experience instead of presupposing a gap between a subject independent world (as ready-made) and cognitive agents. • There is a temporal continuity of norms at different levels. • **Provides a more accurate and concrete description of sense-making.**

Table 3. – Comparative table of the two different definitions of sense-making

This table summarizes the consequences of supporting the two different definitions of sense-making exposed in this chapter.

We should now acknowledge that there are significant differences in supporting the two distinctive definitions of sense-making: as a surplus of significance and as norm development (Table 3) summarizes some of these differences). According to norm development, sense-making is, therefore, not the addition of value to a ready-made physical object, but the constant reconfiguration of the already established order into a new one, thanks to the temporal disparity between a past that is incarnated in bodily habits, and the unexpected contingencies of the world. This intertwining of temporality and embodiment is more clearly seen from the phenomenological perspective in what follows.

3.3 The Phenomenology of Norm Development

As mentioned in chapter two, phenomenology has been a significant influence on autonomist enactivism. For example, in *The Embodied Mind* (*EmMnd*), phenomenological resources helped shape the thesis of embodied subjectivity and opened the way to acknowledge the fundamental circularity of cognitive science. Later, phenomenology provided methodological resources to create experimental frameworks based on the rigorous analysis of subjective experience, clearly seen in the project of neurophenomenology (Varela 1996; Lutz and Thompson 2003). Another important way phenomenology has influenced autonomist enactivism is disclosing the bodily and worldly roots of cognition from a transcendental perspective (*MndLf*).

A transcendental philosophy does not make claims about the causal bases of phenomena but studies the conditions of possibility for phenomena as given in experience. Kant, the first transcendental philosopher, attempted to make the claims of his transcendental philosophy universally valid. Husserl (1997) pursued a similar path. However, phenomenology itself can disclose the limitations of phenomenological analyses and oblige us to be more modest about the transcendental character of our claims (e.g., *PhP*; Merleau-Ponty 1968).

Gallagher (1997), for instance, refers to phenomenology as a methodology that helps us uncover the invariants of experience. These invariants seem to be essential, eidetic, or even structural components of cognitive phenomena. However, we may fail to describe them correctly, both because phenomenology has its own methodological limitations and because the analysis of any worldly phenomena is, in the end, inexhaustible (*PhP*; Merleau-Ponty 1968). Therefore, if we find empirical evidence that contradicts our phenomenological theses, we can adjust and refine them, thanks to scientific knowledge.

The mutual enlightenment between enactive cognition and phenomenology that I mentioned before (3.1.3) helps us guide our scientific theories phenomenologically. Scientific theories, by contrast, constrain, motivate, and refine our phenomenological theses (see Gallagher 1997, 2012; Petitot et al. 1999). For example, autonomist enactivism can assist phenomenology in understanding the role of life for the constitution of lived experience, the nature of the living body, and the link between life and the natural world. By contrast, phenomenology can guide and constrain the development of the concepts and theories of autonomist enactivism. From this perspective, phenomenology can guide us to better understand and help define sense-making.

At this point, it should be clear that the enactment of a world of significance, described by the concept of sense-making, does not mean the production of a representational, symbolic, or any other formal world from the raw matter of the physical world. Instead, it means enacting a normative domain of interactions between a living agent and its environment. Norms of interaction are not aleatory nor determined from the outside of autonomous systems; instead, it is the existential condition of the living body which determines the correct or incorrect character of the interaction.

Normativity and meaning, in this context, are two intimately interrelated concepts. The meaning or significance of an aspect of the environment, for instance, is determined by the norm that makes its appearance possible: glucose ‘appears as food’ thanks to its usefulness for the metabolic requirements of E. Coli. However, we must not think that the norm is something over and above the meaning that the norm expresses (Morris 2018). The norm is not an a priori determination of the body or of the environment: the appearance of the ‘glucose as nutrient’ for E. Coli expresses at once the metabolic needs of E. coli (vital norm), their Chemotaxis skills (sensorimotor norm), and the relevant properties of the environment for these activities. As the enactment of significance, sense-making is the enactment of a normative domain or a set of actions and perceptions with a specific orientation for the agent-environment system.

From a phenomenological perspective, bodily action and perception also involve normativity and meaning (Crowell 2013). The phenomenological descriptions of Husserl and Merleau-Ponty on this subject have been central to the development of autonomist enactivism. First, however, let me review some of the central ideas of these two phenomenologists about the normativity of perception to substantiate my argument that sense-making is a phenomenon of norm development.

3.3.1 Husserl's Theory of Perception

The normative or meaningful character of perceptual experience can be traced back to Husserl's conception of intentionality, which he developed in opposition to Brentano's (cf. Crowell 2013; Doyon 2015). For Husserl, the relation between perceptual consciousness and its object is intrinsically normative and meaningful (Crowell 2013). The normativity of perception in Husserl's phenomenology is best understood in relation to the *structure of fulfillment* (Husserl 2001b).

In the case of perception, and contrary to other modes of consciousness, the structure of fulfillment is not derived from any other content of consciousness (e.g., a perception, a memory, a fantasy, etc.), but from the presence of the object itself (*in the flesh)*. This presence is nonetheless always partial or perspectival; as such, it generates what is best known as *the problem of perceptual presence* (Noë 2004; Overgaard 2012). Very simply put, the problem is that I only have a direct (sensorial) contact with one profile of the object (e.g., I only see the upper part of the tree from the view of my window). Husserl's idea is that I see the object itself *through* this profile. This is possible, since I do not experience the presence of this profile alone. While I only see the upper part of the tree, I can still experience the presence of the tree as a whole. Husserl explains the tension between these two points of view by having recourse to the structure of fulfilment: the absent (or co-given) profiles of the object nonetheless pertain to its meaningful structure; as such, they demand to be fulfilled. Therefore, perception is normative in the sense that perceived objects are lived as normal insofar as they fulfill the intentions of consciousness, e.g., fulfilling my expectations to find the lower part of the three when I lean out of the window (cf. Doyon 2021).[33] The question, at this point, is how, from a phenomenological perspective, we can define and explain the origin of the norm that establishes the criterium of fulfilment.

For some interpreters of Husserl, the meaning of perceptual content is specified by an ideal object that Husserl (1982) called "*noema*." Briefly, a noema, for these interpreters, is an internal representation that mediates between a sensorial profile (manifestation) and the real physical object

[33] As we shall see in section 3.3.2, perceptual objects never fulfill completely the intentions of consciousness (cf. Doyon 2021).

(Føllesdal 1969). There is thus a correspondence between internal contents and external objects. Consequently, the norm of perception is fulfilled as long as the perceptual profiles disclose a physical object that corresponds to the ideal representation that is the noema.

A deeper examination of Husserl's phenomenology shows us this interpretation is inaccurate (cf. Zahavi 2004; Crowell 2013). The noema is not a representation because a representation standardly describes the reproduction of an original object, like a physical object, within mind or consciousness (i.e., a mental object, see, e.g., Rescorla 2020). However, it is crucial to see that for Husserl, the noema is not a mental object. Phenomenology never assumes the existence of two different domains (a mental and a physical one) since the transcendental realm of pure consciousness is not a mental realm but an abstract domain of analysis (cf. Zahavi 2004). The only object intended by consciousness in perception is the worldly object itself.

According to the French phenomenologist Renaud Barbaras (2006), despite the transcendental character of the noema, Husserl's conception still describes the ideal conditions for an object to be given, and these conditions entail *the full presence of the object* (the object seen from everywhere). Although perceptual appearances never fulfil these ideal conditions, they still work as a norm for fulfilling the expectations generated by a manifestation. Thus, as long as the appearance matches the (ideal) norm, the lived object will persist as a meaningful object.

For Barbaras, the problem of defining the norm of perception as a noema that characterizes the full presence of an object is that consciousness becomes the active constitutor of the norm that gives meaning to a perceived object. The point is simple: since the perceived object never appears as fully present, the norm (full presence) must be given as an ideal constituted by consciousness. (cf. Barbaras 2006, 41). Furthermore, since such a description betrays our experience, Barbaras is critical of Husserl on this point.

Barbaras was not alone to see things this way. For many critics (e.g., Dreyfus 2000), Husserl's main error was to take the phenomenological *epoché* too far by placing in brackets the world's existence (Husserl 1982, §49). The real problem of Husserl's transcendental phenomenology, for Barbaras, is that it fails to correctly apply the *epoché*, which Husserl's characterization of the givenness of things as an ideal of full presence exemplifies. For this reason, Barbaras sees Husserl reiterating a mistake of modern philosophy in that it mistakenly conceives the indetermination of perceptual appearances as a *lack* that needs to be fulfilled by the full presence of the object. On this view, Husserl would have misunderstood the constitutive role of absence in perception—a sort of negativity that becomes positive insofar as this lack is precisely the condition of possibility for a perceptual object to be given (Barbaras 2006).

However, Barbaras' criticisms of Husserl's phenomenology apply only to his philosophical work during a period when he developed what is known as static phenomenology. Husserl's account of internal time-consciousness and the ensuing development of genetic phenomenology (Husserl 2001a, 1991) provides us with different tools to address the normativity of perception, while remaining within his phenomenological perspective.

3.3.2 Temporality and Horizonality

The temporal constitution of consciousness is the key to understand the interplay of presence and absence exhibited by perceptual phenomena. Husserl's (1991) analysis of time-consciousness departs from our perceptual experience of temporally extended objects such as musical melodies. Lived melodies are meaningful unities that make sense only insofar as they carry on their own past and look forward to a continuity of the present in the near future. A single tone without any previous or subsequent tones is not a melody, it is a mere musical note. Husserl realizes that the experience of temporal objects involves a constitutive "synthesis" of three different elements: (i) what is given at the present moment (*primal impression*), (ii) the immediate past moment (*retention*), and (iii) what is about to happen (*protention*) (Husserl 1991, §16). This synthesis does not simply involve juxtaposing three similar moments, nor are they three different objects superimposed. Instead, the synthesis involves an intertwining of different intentions, involving a normative interplay between presence and absence that gives us the experience of a transition of different aspects (manifestations) of the same object (appearance).[34]

Husserl elucidates the paradoxical situation of identity in difference and of presence in absence in his postulation of a *double dimension of intentionality,* where one dimension intends the transitional

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[34] It is a synthesis of identity (Zahavi 2003, 80), but it is also a transitional synthesis (*PhP*, 344/386).

phases (retentions and protentions). In contrast, the other dimension intends the actual living present. Thus, the extended temporality of objects is experienced by articulating the retentional and protentional phases, while the flow and the actual living present are *simultaneously* intended (Zahavi 2003, 84). The most relevant aspect of this description is that absence or emptiness plays a constitutive role in the experience of temporally extended objects. [35] That is, to acquire a normative status (meaning), these objects must be constituted not only by presence, but also by a lack, a hollow, or a constitutive absence.

This description of the tripartite structure of lived temporality is not exclusive of temporally extended objects such as melodies. In his late works, Husserl also considered the implication of this structure for the perceptual experience of *all* objects. Since the presence of any object involves the synthesis of multiple profiles into a single unity (putting aside the controversial concept of noema in Husserl's transcendental period), the link between the different profiles of any object is given by the possibilities for bodily action that the present profile motivates (Husserl 2001a).

One of the best means for approaching this later understanding of the relation of presence and absence, or the determinable indeterminacy of perception, is through Husserl's notion of *horizons*. Husserl defines a horizon of experience as follows:

> What is currently perceived, what is determinate (or at least somewhat determinate) and co-present in a more or less clear way is in part pervaded, in part surrounded by a horizon of indeterminate actuality, a horizon of which I am dimly conscious. I am able to direct the illuminating focus of my attention on it with varying success. (Husserl 1982, §27).

Horizons are thus those parts of appearances that are not explicitly intended but are nevertheless co-present with the explicitly intended objects, such as the back of my computer screen. It is worth noticing that horizons are not just marginal aspects of our experiences but also constitutive aspects. For example, when I am typing on my laptop, I suddenly turn my head and notice the presence of

[35] Absence and emptiness, nonetheless, does not mean a pure nothingness since they entail the presence of something that is missing or that is expected to be.

a cup of coffee. I feel the impulse to grasp the cup to sip from it, but my attention is on my writing. Despite this, I successfully grasp the cup and drink some coffee. In this situation, I never felt doubt about the shape of the cup or about the movement of the liquid inside when I brought the cup to my mouth. I just took the “right” hand position. My experience of the cup was never permeated by any kind of skepticism about the backside of the cup or the volume of the liquid inside. Yet, none of these visual profiles were currently given. All these co-present aspects are what Husserl would call horizonal. However, their relation to the manifestation of the cup is not only temporal but corporeal because the sense or meaning of the horizonal aspects of the appearance involves certain expectations that are related to my bodily skills and interests:

> Every visual sensation or visual appearance that arises in the visual field, and every tactile appearance that arises in the field of touch, is ordered with respect to consciousness. For each current situation, there is a horizon of further possibilities that are ordered together, creating a horizon of possible series of appearances belonging to the freely possible series of movement. (Husserl 2001a, §3).

Consequently, - and *pace* Barbaras - the spatiotemporal horizons of lived things are *not* abstract, ideal, or representational aspects of things because they cannot be given as positive contents of consciousness. There are at least two reasons for this. First, it is not reflective consciousness (cogito) that intends these horizonal aspects since, at the reflective level, perceptual (ready-made) objects are the intended contents of experience. Here, the horizons are best understood as pre-objective. This means that horizonal aspects of experience are given at the pre-reflective (*PhP*) and pre-objective or pre-noetic (Gallagher 2005) levels of experience. Secondly, and more importantly, the indeterminacy of perceptual appearances is inherent to the thing itself and not to consciousness because it is the thing itself that “hides” its profiles from my sight. The thing remains open to fulfill or not my protentions and expectations, and it is only thanks to this constitutive non-givenness of the thing that it can appear to me as a thing (cf. *PhP*, 341).

Nonetheless, the givenness of the thing itself is not referred to my consciousness as a reflective ego (cogito) but to my body, which makes sense of the situation without my reflective consciousness taking notice of this intentional relation between things and the body. Husserl called this pre-noetic level of intentionality *operational intentionality*. This intentionality describes the directedness of a *pre-reflective ego* (an embodied perspective) towards something that appears, not as a fully determined object, but as something impregnated by a form of meaning that Husserl and Merleau-Ponty called *sense* (*Sinn*).

Let us go back to the problem of perceptual presence, where the horizons of the thing are related to the motor skills of my body because the unseen profiles of the cup are, for example, senseful aspects for my hand to grasp, for my mouth to sip, and so on. Here, the operative intentionality is a *motor intentionality* (*PhP*, 112). However, this bodily form of intentionality is also determined by my interest in drinking coffee, since the motor signification of the cup can change if I shift the practice I'm doing (e.g., I will hold the cup differently if I'm going to wash it).[36] Therefore, the "bodily meaning" or the *motor signification* (*PhP*, 113) of the cup is founded on the protentions and expectations my body has of the perceived thing.

There are descriptions of these motor significations in Husserl's theory of perception. He posits that the unseen profiles of visual objects are given by a correlation between kinesthetic sensations and changes in the sensorial data (cf. Doyon 2018). Nevertheless, Merleau-Ponty made the most systematic phenomenological analysis of the role of bodily self-movement for the constitution of perceptual objects. The following subsection will consider his central claims in this respect.

3.3.3 The Body-World Entanglement

In his *Phenomenology of Perception* (*PhP*), Merleau-Ponty describes the constitutive role of the body for perceptual experience through his notion of the *body schema*. For Merleau-Ponty, the body schema refers to the capacity of the body to self-organize without the intervention of reflective consciousness for accomplishing a practical task (*PhP*, 103). As a phenomenological term, the body schema is more than this because it also points to the deep entanglement of the body and the world, which we cannot entirely separate, even in reflective analysis. This profound level of the body schema is expressed by Merleau-Ponty in the *Phenomenology* when he claims that "the

[36] Since this "interest" involves a deep subject related to attention and affectivity, I will not go deeper, in this chapter, on this aspect, but I will return to it in the last chapter of this dissertation.

theory of the body schema is implicitly a theory of perception" (*PhP*, 213).[37] At this pre-reflective level of the bodily constitution of consciousness, we cannot demarcate what is on the side of the body and what is on the side of the world because the bodily ego and the world are not originally independent unities. They are polarities that emerge from the self-movement and development of life and nature.

The notion of the body schema is nevertheless commonly associated with the sensorimotor unity of the bodily-ego pole and the *phenomenological field* with the worldly pole of *the body-world entanglement.*[38] Merleau-Ponty ambiguously uses the term body schema to describe the ego pole and sometimes refer to the body-world entanglement. For the sake of clarity, I will keep the notion of the body schema to refer to the self-organizing capacity of the body or the unity of the sensorimotor skills of the ego pole. From here, I will use the concept of body-world entanglement to denote the foundational sensorimotor unity of the body and the world.

The notion of the body schema is helpful not only to describe the protentional aspects of spatial objects by claiming that this body schema intends to the motor significations of things, but it also helps us explain the presence of the past in the perceptual disclosure of things. The body schema makes concrete the double dimension of temporality incarnated in a corporeal being that unfolds itself in time, entangled with a world that not only transcends the (bodily) self of lived experience, but also co-constitutes the bodily self. Although the body schema is an a priori, or a transcendental condition, for perceptual experience, the body schema is not purely transcendental (cf. Morris 2004). This is because its own constitution depends on the concrete temporal unfolding of the living body and its concrete developmental history. This is expressed by Merleau-Ponty when he describes how the acquisition of motor habits reconfigure the body schema to the point of

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[37] Further treatments of this concept in *Le monde sensible et le monde de expression* (Merleau-Ponty 2011) can offer support to this idea. The evolution of the notion of the body schema in Merleau-Ponty's thought may find its ultimate stage in the ontological concept of the Flesh.

[38] This notion resonates Heidegger's notion of being-in-the-world (1962) but aims to put the accent on the importance of the body for the factual existence of a *Dasein*, something neglected by Heidegger.

incorporating artifacts and tools to the biological constitution of the body, thereby generating new motor significations and even a new bodily self (*PhP*, 143).

This means that the body schema is an open-ended structure that remains subject to change in light of its encounters with things and others. In the case of humans, many of the habits we acquire, if not all, are mediated by our social interactions. The way we make sense of things is shaped by other people as they guide our attention, constrain our behaviour, or affectively motivate our actions (Gallagher 2005).

Given the open-ended nature of things and of the body schema, the intertwining of the body-world entanglement is dynamic, and our analysis of its unfolding represents a new way of approaching the mind and world relationship. From this perspective, the problem is not to find causal relations between the body and the world,[39] seen as separate, but to disentangle the thickness of their intertwining and understand the logic of their temporal unfolding.

3.3.4 Perception, Sense-Making, and Temporality

Merleau-Ponty's account of motor intentionality, along with his descriptions of the kind of norms at play in action and perception, has significant similarities with the descriptions of sense-making provided by autonomist enactivism. In both cases, the world appears to bodily subjects as already meaningful thanks to their bodily skills. From a third-person perspective, the body schema is the unity of the body that self-organizes according to sensorimotor norms; it is the task at hand that determines the body's articulation and the appearance of the world. From a transcendental perspective, the world appears before consciousness insofar as it affords possibilities for action to the body schema. There is thus a co-determination of the body and the world, says Thompson (*MndLf*). There is, moreover, an irreducible body-world entanglement.

This entanglement is, nonetheless, more than a phenomenological co-determination, and it is more than a causal coupling. The co-determination of the body and the environment refers to the process

[39] This does not prevent is from using empirical tools like dynamical systems theory to understand the causal complexity of the body-world entanglement.

by which a (systemic) self-identity is correlated to the identity of otherness (what falls outside of the system but is relevant for the system). For example, the grasping of my hand is co-determined by the grasp-ability of the cup. The causal coupling of the agent-environment system allows the system to co-evolve in multiple ways. The environment constrains the bodily activity of the agent, shaping its constitution and its dynamic interaction with this environment. The agent acts upon the environment and changes its conditions, transforming how the environment affects the agent's body. Therefore, there is a mutual co-determination and an intimate causal coupling of the agent-environment system, but the body-world entanglement is deeper than this.

The body-world entanglement is the necessary condition for any norm of sense-making or motor intentionality to appear.[40] As I mentioned before, Merleau-Ponty describes this entanglement when defining the body schema, but he also referred to this entanglement in its account of temporality, like when he talks about "the past that has never been present" (*PhP*; see also Al-Saji 2007; Marratto 2012).

The nature of the body-world entanglement is essentially temporal because it always entails a past (a previously given set of normativities) that can be actualized in the present thanks to the open-ended nature of the entanglement. That is, the entanglement is permanently open to its own

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[40] This statement does not mean that any new form of sense necessarily arises due to the historical past of the body-world entanglement. It rather means that any new form of sense needs to involve this past. For instance, archeologists and linguists cannot decipher ancient and unknown languages but using linguistic and symbolic schemas they already have at hand. The ancient language is for the scientist a new language, and it remains indecipherable and senseless unless a scientist can "relocate" this language in our current networks of meaning, although enacting this network in a whole new way that partially reconstitutes the ancient language (see e.g., the case of Olmec writing: Martínez et al. 2006). Similarly, a brain or bodily injury can abruptly alter the body-world entanglement and affect the continuity of the interactional system (e.g., leading people to lose skills and the correspondent perception of affordances). The transformation of the system to equilibrate the new situation needs to reorganize the system but from the remaining structures of the system. This is to say that in such cases patients need to create new forms of sense or new norms of interaction from the already existent forms of sense (cf. Toro, Kiverstein, and Rietveld 2020).

actualization due to the encounter of the unexpected events that characterize the nature of the world (cf. Dastur 2000).

However, the past is not a determination only due to the open-ended nature of the agent-environment system. The enactment of new norms can also transform the past incarnated in the body and the lived environment. I can, for instance, lose a bodily habit (e.g., smoking) that I have acquired in the past thanks to the acquisition of a new habit (e.g., jogging). The new habit set provisional or definite new constraints that can impede my body from re-enacting the old norm. In this sense, my body acquires a new orientation or sense that changes or reconfigure its own past instead of merely accumulating new norms in addition to the older ones.

Although the body-world entanglement is a transcendental claim (a condition of possibility for motor intentionality), it is not unfamiliar nor impossible to fit this concept in the framework of autonomist enactivism. The already given presence of the body-world entanglement is expressed in the existence of previous normativities that constrain and enable new forms of sense, like the dynamical account of Piaget's theory of equilibration, illustrates (Di Paolo et al. 2014).

The wrong picture for autonomist enactivism is to think that sense can originate at some specific point from laws of causality that abstract the organism from the environment or the environment from the organism. It could be argued that scientific models of sense-making must carry out this sort of abstraction to clarify certain aspects of this phenomenon and give greater explanatory power to the theories of autonomist enactivism. However, this should be seen as a heuristic resource only. It might apply to cases where our analysis of the cognitive phenomena is very general or where we want to illustrate the differences between a purely physical environment and a cognitive domain of significance. However, suppose we require to be more precise and offer more accurate and concrete models of cognition, as we often need in some areas of psychology and psychiatry (e.g., Kirmayer and Ramstead 2017). In that case, we need to stop thinking of sense-making as adding a surplus of significance to the physical environment and start thinking of sense-making as a process of norm development.

The thesis of norm development also implies a revision of our conception of the environment from an enactivist perspective. If agents never interact with a raw physical realm but with an environment that is already loaded by a pregiven set of normative relations, then we need to understand the environment as a field of normative forces and constraints that will be central to shape the path of living and cognitive agents. This will be the main subject of the next chapter.

Chapter 4 – The Ecological Dimension of Sense-Making: The Active Role of the Environment in Processes of Norm Development

Autonomist enactivism defines cognition as a form of sense-making (2.4). Sense-making consists of enacting norms of interaction between a living agent and its environment. These norms are initially motivated by the most basic biological needs of living organisms, such as metabolism, but new norms appear as organisms develop and evolve. For living organisms with sensorimotor systems, sense-making progressively involves norms of sensorimotor interaction. At this point, cognition begins in its minimal form. The original purposiveness of sensorimotor norms is also motivated by biological requirements. However, for complex organisms such as larger mammals with nervous systems, sensorimotor norms often become partially independent of any biological purpose (3.2). Sensorimotor norms play a foundational role in the cultural domain of human action (5.2 & 5.3).

In typical accounts of sense-making, the constitution of vital and sensorimotor norms has two fundamental sources: the living body and its physical surroundings (*Umgebung*) (3.1). The autonomous organization of the living body, as existing in precarious conditions, establishes the systemic requirements for enacting vital norms, which the organism can satisfy thanks to its adaptive behaviour. Hence living organisms partially determine the way they live by self-determining their course of action. Moreover, the agent has an active role in enacting norms of sense-making because the requirements of its autonomous organization determine the contents of norms. The *Umgebung*, by contrast, physically facilitates and constrains the processes of self-making and sense-making of the living body. Still, it does not determine positively the contents of sense-making norms. The role of the environment is crucial because it provides the material basis necessary for the existence of life. It is still essentially passive as far as it has no normative structure that *guide* the action of autonomous agents (4.1). For this reason, if we compare the relationship of the agent and the environment to one of a couple dancing (Clark 2009), enactivists say the agent would be the leader and the environment the follower (Thompson and Stapleton 2009). In my view, this metaphor is helpful to reveal the problematic assumptions of autonomist enactivism about the environment (4.1.1).

When a couple is dancing, the two partners actively constitute their performance, regardless of their roles as leaders or followers (4.1.2). However, if the environment is nothing but a set of physical constraints, the only active contributor to the body-world dance is the agent. I will argue that the metaphor of a solitary dancer that *handles* a non-living object fits better with the current view of autonomist enactivism. I will call this interpretation of the agent-environment relationship *the broom dancing metaphor* (as in a person dancing around with a broom as a partner). I will argue that this metaphor, showing the typical conception of the environment of autonomist enactivists, is misleading because it is grounded in a mistaken description of sense-making, which echoes the description alluded to in previous discussions of the thesis of significance as a surplus (4.1.3).

As I see it, what I would like to call the *thesis of the active environment* is more apt in capturing what autonomist enactivism should be after (4.2). Such a thesis maintains that the environment is not a mere material structure or a set of physical constraints. It is, instead, an active field of forces that embodies the already established normativities of the body-world entanglement (4.2.1).[41] Nonetheless, this field of forces maintains an ever-present disparity with the habitual past of the

[41] It could be appropriate to use the word "niche" in here as a reference to the local places that organisms inhabit, and which entails the historical (phylogenetic and ontogenetic) relation of organisms and their surroundings. However, I prefer to use the label "active environment" because it highlights the opposition of my description of the environment as a normative field to the common way of describing the surroundings of organisms as purely material and having only a relation of efficient causality with organisms. This is for instance the use of the term "niche" has in ecological theories of evolution such as niche construction theory (Laland, Odling-Smee, and Feldman 2000). Despite the relevance of this theory to biology and to radical embodied cognition, they describe a mutual co-determination of organisms and environment that can be put in terms of a dispositionalism (Heras-Escribano, Noble, and de Pinedo 2015) or as a statistical covariation of internal states of organisms and the features of the environment (Bruineberg et al. 2018). I am pointing in here to something else, to something more than these descriptions. I am arguing that the entanglement of the body and the world generates a normative structure in the environment that is not only material or statistical, but also formal or meaningful. This meaning depends partially on the autonomous organization of agents, as autonomist enactivism describes, but also on the past that transcends the autonomy of agents. A better description of the environment, from this standpoint, is the notion of enactive place that the next chapter will define.

agent (in the present) that opens the possibility of the self-transformation (the future) of the entanglement. That is, the active environment *normatively* constrains the agent and, as such, it also motivates the enactment of new norms. As such, it must be seen as *co-participating* in the creative process of sense-making (4.2.2).

The active environment, we shall see, is not a mere mirror of organisms' interests, concerns, and abilities. It is not a subjective projection. The environment is active precisely because it always surpasses agents' expectations, materially, dynamically, or even as a new organizational whole constituted by dynamical interaction processes with other agents (a communal space). The environment, from this standpoint, consistently exceeds the subjective realm, which does not mean that it is independent of the expectations of agents (based on their abilities, concerns, and interests) (4.2.3).

In support of the active environment thesis, I will argue that autonomist enactivism must stop conceiving the environment as purely physical. Instead, I suggest we should start thinking about it as an *ecological* realm, like the one found in Gibson's (*EcApVsPr*) ecological approach (4.3). In Gibson's view, the environment is an already meaningful landscape, an animal-environment relational field, one that plays the role of a necessary condition for any form of perception (4.3.1). However, I will argue that the meaningful environment is not a domain constituted by raw physical processes but is instead a normative field. This field is enacted in the historical past of the body-world entanglement but always remains open to further self-transformation (4.3.2). Although such position is contrary to the Gibsonian tradition (4.3.3), this claim has important coincides with Chemero's dynamical account of affordances (4.4.1) and with the phenomenon of excorporations described by Morris from a phenomenological perspective (4.4.2).

Finally, I will lend support to the claim that affordances and ecological information are constituted in the developmental path of the body-world entanglement, and not as an entirely predetermined set of ecological relations, by having recourse to Merleau-Ponty's (*PhP*; 2011) phenomenological descriptions of spatial levels (4.4.3). These levels precisely describe the development of perceptual norms of perception as involving both body and world, thus setting the grounds for the kind of enactive-ecological description of sense-making I defend.

4.1 The Broom Dancing Metaphor

Sense-making consists of an agent-environment system enacting norms of interaction. The classical description of enacting norms of sense-making describes the addition of meaning and value to raw physical aspects of the environment by living agents, thanks to their vital and sensorimotor activities. Chapter three argued extensively against this description that I called the thesis of significance as a surplus. There, I suggested that sense-making should be better understood as a process of norm development. This is because sense-making is a process of *re*shaping or *re*configuring an *already existent* normative entanglement of body and world.

Autonomist enactivists increasingly adopt descriptions and explanations of sense-making that can fairly qualify as norm development. Nonetheless, it is still common to misunderstand the role the environment plays in the constitution of norms of sense-making. This section analyzes this question and argues against the *broom dancing metaphor*. This metaphor, I recall, implies that the environment of a living organism is nothing but a set of physical constraints that both enable and limit the bodily actions of agents, as when a dancer uses a broom in her dancing performance. Much like the thesis of significance as a surplus, this metaphor wrongly assumes that a subject-independent world acts as the absolute foundation of processes of life and cognition. However, I will argue that the broom dancing metaphor is wrong-headed because it fails to capture the true essence of sense-making.

4.1.1 The Couple Dancing Metaphor

For autonomist enactivism, processes of life and cognition entail the systemic unity of a living agent with its environment. In the interactional dynamics of this coupled system, however, the agent and the environment play different roles because they maintain an asymmetrical relation (Di Paolo 2009; Thompson and Stapleton 2009; see also Barandiaran, Di Paolo, and Rohde 2009). This asymmetry is exemplified by the role they play in the constitution of norms of sense-making.

The purposiveness of norms, and the capacity to modulate the agent-environment coupling in favour of these norms, have their genesis in the systemic organization of the living body (Di Paolo and Thompson 2014). Vital norms arise from the biological needs of living organisms because these organisms *must* maintain the viability of their autonomous organization. Additionally, sensorimotor norms are also enacted thanks to the capacity of the living body to self-organize and perform actions that sustain a repertoire of bodily habits (*SmLf*). As we have seen, the processes of adaptivity that these interactional norms involve and the eventual emergence of new norms from older ones are possible because of the self-organizational skills of the living body (see 3.3). In its minimal form, agency precisely entails the capacity of living systems to modulate their behaviour and change environmental circumstances according to their own purposes (Barandiaran, Di Paolo, and Rohde 2009, see also 2.4.4).

The active role of agents in the constitution and development of norms contrasts nonetheless with the "passive role" that autonomist enactivists attribute to the environment, either as *Umgebung* (physical surroundings) or as *Umwelt* (meaningful world) (see 3.1). As *Umgebung*, the environment is conceived as a mere set of physical processes that can constrain, shape, and alter the causal constitution and development of the living body and its repertoire of sensorimotor skills. The *Umgebung* plays no active role in the constitution of norms and merely facilitates and limits the enactment of sense-making norms. As *Umwelt*, things are not much better. Described as the specific region of the physical world that matters for the activity of living organisms, the *Umwelt* appears as an *already constituted* world of significance. In other words, the *Umwelt* is the *result* of the enactment of norms, but it is not conceived as itself having any *constituting* normative force.

A metaphor can help us see the problematic conception of the environment that appears in many of the enactivist literature. Clark (2009) suggests that the relation of the agent and the environment can be compared to the relation of a couple dancing together, interacting and mutually constraining the movements of each other. The agent and the environment are in this picture like two equal partners. If we take this metaphor in the enactivist picture, Thompson and Stapleton (2009) ask us to conceive the agent as the one leading the dance precisely because the agent modulates the coupling to fulfill the norms guiding its behaviour. Although, I agree with Thompson and Stapleton on this clarification. I think there are still some problems that we can illustrate from this way of picturing the agent-environment relation in sense-making processes.

On the one hand, the environment is typically described by autonomist enactivists as a much more passive participant in the agent-environment interactive system than any real dancing partner is in a dance performance. Secondly, the agent-environment interactions cannot be compared to those that hold between two living agents. These latter interactions involve new and emergent levels of normativity that simply cannot be present in or emerge from a relation between a living and a non-living being. To capture these difficulties, I recreate the agent-environment relationship in the broom dancing metaphor. Dancing with a broom illustrates better the existing relationship between an agent and a non-living thing in bodily practices. It involves one person manipulating an object while dancing alone. A thing (the broom) is nothing but a physical constraint, the agent (the dancer) needs to deal with to perform her action (dancing). Autonomist enactivists frequently adopt this view in their explanations of sense-making (4.2.2).

4.1.2 Dancing with Others

Dancing in a couple requires that two agents must actively move their bodies. One of the agents might be on the lead, guiding the interactional coordination of the two bodies, but the other partner does not merely constrain the leader's movements; the follower is not a mere burden, nor a simple limitation for the bodily movements of the leader. The follower actively changes and alters the dance flow, and her contribution to the performance is no less important than that of the leader (cf. van Alphen 2014). A dance performance is, in this case, co-constituted by the interactive *normative* forces of the two agents.

Autonomist enactivism describes the normative behaviour produced by the interaction of two agents as *participatory sense-making* (De Jaegher and Di Paolo 2007; Di Paolo and De Jaegher 2017). When two or more agents interact, a new layer of collective normativity likely emerges. This emergent normativity involves the proper coordination of the participants' bodies. This collective coordination requires that individuals adjust their individual norms, which causes a primordial tension between two levels of normativity: the individual and the collective. This tension is permanent, no matter how adequate the level of coordination may be, because the participants remain autonomous. When the corporeal coordination of agents succeeds, a new type of norm, a basic social norm, is enacted (cf. *LngBod*).

Like any other norm that emerges from a process of sense-making, these norms are yet not crystalized. Instead, they involve a continuous process of actualization which may sometimes lead to the enactment of new norms. This precisely happens in dancing, where the bodies of the two participants constantly adjust their own behaviour to accomplish the right collective coordination. Significantly, these processes of adjustment and adaptivity happen so long as an interactional coordination exists, even if the dancers master the practice individually and constantly experience proper coordination with a partner. Indeed, the “right” coordination between two or more agents involves a *co-regulation* of individual and collective sensorimotor norms that allows agents to accomplish a good performance (cf. *LngBod*, see also 5.3.3).

The primordial tension, the emergence of collective norms, and the co-regulation processes are features of interactions between living agents that are not present in interactions between a single individual and non-living beings (cf. De Jaegher and Di Paolo 2007; Di Paolo and De Jaegher 2017). The problem with the dancing couple metaphor, which Thompson and Stapleton follow from Clark’s suggestion, is that the role of the environment as *Umgebung* is too passive. Conceived as a mere set of physical constraints, the world is a burden for the activity of agents, which are, in this story, the only active constitutors of their normative realm. For this reason, the picture one gets from this metaphor is more that of a single person dancing with a broom, or more accurately, swinging a broom around as they make dancelike motions. They are not strictly speaking engaged in a dance with the broom since the broom is not dancing at all.

4.1.3 Dancing Alone

In a performance consisting of a dancer with a broom, the physical constitution of the broom can enable or constrain specific bodily movements of the dancer, but the adaptive behaviour of the dancer handles these constraints. The capacity of the dancer to accomplish her performance correctly can be put in terms of the dynamic models of autonomist enactivism based on Piaget’s theory of equilibration.

According to the dynamical account of Piaget’s theory of equilibration (see 3.2), specific aspects of the environment are modelled as variables that either reinforce or perturb the dynamical behaviour of sensorimotor schemes. This means that the environment is a set of physical constraints that cooperates to sustain the autonomous organization of a sensorimotor habit, thus motivating the reconfiguration of this habit through processes of adaptivity or contributing to the enactment of a new habit that either co-exists with the older habit or replace it (Di Paolo et al. 2014).

Likewise, dancing with a broom can challenge the already existing repertoire of bodily movements of the dancer. The broom needs to be assimilated by the dancer, so that her movements acquire a new normativity when she accommodates her movements to the manipulation of the broom. In Piaget's language, the broom is incorporated into the sensorimotor skills of the agent.

There is, however, a more interesting phenomenon that may take place in the interaction between agents and non-living objects: tool-incorporations. This phenomenon has been described by Merleau-Ponty (*PhP*) and Bateson (1987), recognized by autonomist enactivism (Di Paolo 2009; Thompson and Stapleton 2009), and it is supported by empirical evidence (Bach-y-Rita and Kercel 2003; Froese et al. 2012). These incorporations do not simply mean that an agent can accurately handle a worldly object, as with Piaget's theory. In bodily incorporations, a tool such as the cane of a blind person, or the racquet of a tennis player, can be incorporated into the body's agency to extend its repertoire of bodily movements. Learning to dance with a broom entails the possibility that dancers incorporate the broom in the same way that the blind person incorporates a cane. In short: the broom can, in principle, flow all along with the bodily movement of a dancer, as if it were an extension of her body.

Here, the difference between both metaphors shines through, for dancing with another agent does not entail the possibility of incorporations, at least not in the way a tool or an object is incorporated.[42] One dancer cannot be incorporated by another simply because the autonomy of

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[42] Autonomist enactivism distinguishes between two types of incorporations: tool-incorporation and mutual incorporation (Fuchs and De Jaegher 2009). Tool-incorporation designates the sort of incorporation I have just described. Mutual incorporation rather refers to the way that two agents enact jointly a new meaning. In this sense, dancing in couple involves a mutual incorporation. The movements of each dancer make sense only insofar as the other is actually or virtually present. The smooth coping of a good dancing performance can get closer the phenomenon of mutual incorporation to the one of tool-incorporation. However, according to the dynamical model of autonomist enactivism, the sort of tension at play in an interaction between two autonomous systems and between an agent and a tool is not the same. The coordination between two agents is always more conflictive and harder to reach, although It could be easily to handle by a mutual coregulation (see 5.3). The feeling and effect of mutual coregulation is precisely what is always missing in tool-incorporation.

both agents causes an insurmountable tension that impedes the level of submission of the movements of one body to the movements of another body, as it can happen with a tool. Only if one of the bodies loses its autonomy is it possible, in theory, to become incorporated as a tool by the other body.

Although the interactions between a living agent and non-living objects are not the same as those between two agents, this does not mean that the environment needs to be as passive as Thompson and Stapleton have it. They rightly say the body-world relation is not symmetrical: if we accept the theory of biological autonomy, we must accept that living organisms are agents that unavoidably constitute their own purposes, and they can actively transform their interactions with the environment. Nevertheless, the environment also has an "active" role in *the agent-environment system's normative domain.* On the one hand, the environment, as sedimentation of bodily habits (individual and intercorporeal), demands from the body specific actions that can fulfill the purposes of the bodily task of agents. However, these demands can exceed agents' current purposes and organizational states (e.g., a bad habit [Ramírez-Vizcaya and Froese 2019]).

On the other hand, the environment also resists the expectations and protentions of the body based on its habits. There are always contingencies that partially break the skillful coping of agents (see, e.g., Hutto and Sánchez-García 2015). The tension between the past incarnated in both the bodily habits and the sedimented (meaningful) environment and the present condition of the environment causes the agent-environment system to move forward and trigger the temporal development of the system in a particular direction that is defined by the resolution of this tension. The task of skilled agents is to deal with and resolve this dialectical condition (see 4.2.2).

The enactive *Umwelt* is not enough to describe this "active" role of the environment because it describes nothing but the projection of organisms' goals, interests, and motivations onto their physical surroundings. The *Umgebung* does not fulfill this role either because it is the set of physical constraints that can determine the constitution of the agent but without considering the already established normative entanglement of the body and the world. We need, therefore, another conception of the environment, one that is not acknowledged by the broom dancing thesis. The broom dancing thesis assumes what I described in the last chapter as the thesis of significance as a surplus, i.e., the definition of sense-making as the addition of meaning (*Umwelt*) to the raw physical surroundings (*Umgebung*). The following subsection will consider the problematic aspects of the broom dancing thesis and offer an alternative interpretation of the role the environment plays in processes of life and cognition.

4.2 The Active Environment Thesis

The broom dancing metaphor does not adequately capture the agent-environment relation in life and cognition because it is based upon the same mistaken assumptions of the thesis of significance as a surplus. It looks at the environment as a purely physical and neutral value domain that we can conceive, at some point, as something separated or independent from the historical development and evolution of the body-world entanglement. Since autonomist enactivists are committed to a view of cognition and science that implies the fundamental circularity (2.1.2, 3.1.2), they must be aware that thinking of the environment as a purely physical world is nothing but an abstraction. Indeed, this abstraction could be a valuable and necessary presupposition of our natural attitude for doing science (3.1.3). The problem is that such presupposition obscures our understanding of sense-making. Chapter three argued that sense-making is a process of norm development. Such process implies that the body and the world are always entangled, which means there are always previous normative elements at work in enacting new norms, i.e., in sense-making. If so, the environment never appears as a raw or purely physical domain. It rather appears as a setting already constituted by some normative aspects that prefigure and constrains the sense-making of agents.

The *thesis of the active environment* that I defend can, however, better account for the role of the environment within the normative domain of the agent-environment system. This thesis describes the environment as an active field of forces that constrain, *normatively and not merely causally*, the development of the agent-environment system. As such, it also motivates the self-transformation of the normative domain of this system because of the ever-present disparity between the habitual self-organization of the body and the ongoing changes in the normative realm of the world. The active environment thesis fits better with the thesis of norm development and helps us understand the self-transformation of the body-world entanglement as an enactive-ecological process.

4.2.1 Causal Laws and Normative Constraints

The thesis of significance as a surplus describes the addition of meaning to a raw physical environment that doubles the references we can make of the surroundings of living agents: as *Umwelt* (or lived environment), and as *Umgebung* (or the subject-independent world described by sciences like physics and chemistry).

I argued in the last chapter that such a description does not entail any kind of traditional dualism that radically separates the subjective sphere of living agents from the theorized subject-independent world. Instead, it involves a phenomenological dualism that shows the environment from two different experiential-embodied perspectives of human beings. The error of the thesis of the surplus of significance is to hypothesize the origins of the subjective mode of experience and its counterpart, the lived world, in the contents of the intersubjective-enculturated mode of experience, understood as the objective world described by science. The same error undermines the broom dancing thesis. How so?

In the broom dancing thesis, the active role of the agent involves the superimposition of a normative layer onto a physical domain that is completely passive at the normative level. The active part of the environment is found at the causal or pre-normative levels of the agent-environment system. On this level, the environment enables and constrains the development of the living organism. However, once it is invested by meaning, the environment becomes nothing but a lived world with no influence or determination over the enactment of new norms of sense-making.

Think about the example of the infant that incorporates the sensorimotor habit of feeding on a bottle of milk instead of, or additionally to, breastfeeding (3.2). The bottle reshapes the normative domain of the agent-environment system, exposing the motor actions of the baby to a new set of physical constraints that differs from those of the mother's breast. The dynamical model offered by autonomist enactivism of this incorporation illustrates how the environment causally reshapes the sensorimotor dynamics of the baby and motivates the enactment of a new norm, a new sensorimotor contingency.

The environment as a causal determination (as a physical constraint) never disappears; it alters the agent's sensorimotor dynamics. As long as the baby consumes milk from the bottle, for instance, the weight of the bottle will change. As a result, the pressure and tension of the muscles in the baby's hands and arms will progressively change to accommodate her body and satisfy the sensorimotor norm that sustains her feeding. Holding the bottle in new environments, on the floor instead of on the bed, and taking different postures when feeding on the bottle, e.g., seated instead of laying down, will also alter the original sensorimotor norm. The environment never stops challenging us as an agent and remains causally active. However, as Thompson and Stapleton affirm, the agent keeps the leadership of the dance because it is the baby who adjusts the sensorimotor loops to fulfill the norm of her behaviour.

Understood as a meaningful aspect of the infant's environment, i.e., of her *Umwelt*, the bottle will never stop to motivate new sensorimotor norms. The bottle of milk first affords grasp-ability, suck-ability, and the opportunity for feeding. Later, for some babies, the same bottle can begin to afford new behaviours and satisfy new sensorimotor and vital norms, even without the necessity of an initial purposiveness of the agents.

While holding the bottle of milk, some babies can start hitting another object with the bottle, causing noises. They can also learn to throw the bottle away and thus bring the attention of their caregivers, finding a new practical use of its recently acquired sensorimotor repertoire. If such a thing happens, a new sensorimotor norm is enacted, and its enactment does not depend on the initial purposes of the agent or the raw physical constraints of the environment. The new norm is grounded on the already acquired sensorimotor repertoire (a normative framework) that finds its realization in a new and unexpected circumstance or situation. An unexpected normative attunement is achieved, and the enactment of a new skill is incarnated in the body as a new "I can" and in the environment as a new "possibility for action" (an affordance of the bottle), given the appropriate circumstances.

As we can see in this example, the environment plays a more active role than what the broom dancing thesis captures. As a motor signification or as a unit of affordances,[43] the bottle is an active

[43] I refer to the bottle abstractly, the bottle for the baby is not an object constituted as a unity, as it is for human adults that have already acquired language. It is not either a detachment of the bottle as a bottle from the proximate practical environment like the one describes by Di Paolo (2016) in the enactment of objects

contributor to the enactment of a new norm. Its role, in other words, is not merely causal. Grasping the bottle never occurs without a set of physical constraints, but the new behaviour of the baby does not merely arise from the incorporation of such constraints in a new fashion. Instead, it is the previous norm, the grasping the bottle for feeding, that works as a scaffolding that allows for the enactment of a new sensorimotor behaviour, a new sense-making norm.

From a phenomenological perspective, Morris (2004, 69-71), inspired by the development of motor skills in infants, offers a helpful metaphor of the self-transformation of the normative domain of the agent-environment system: origami. In origami, we make a series of folds on a piece of paper to create a determinate figure that can resemble an animal or a familiar object. An origami's correct performance consists in properly folding the paper to achieve a fold structure showing the figure we wish to represent.

Correctly folding the sheet of paper entails a specific sequence in which each fold (save for the first) is performed under the constraints of previous folds, which produce new constraints for subsequent folds, etc. However, we cannot say that one fold *determines* the next; instead, each fold limits the number of possible folds that may follow. These folds are not a mere limitation or negative result of the performance. Instead, they are open possibilities for making our wanted figure or improvising and creating a new figure (see Sawyer 1992; Montuori 2003). This leads us to another aspect of the environment, which is more than physical constraints and actively motivates the enactment of new sense-making norms: the situational field of forces.

When an infant realizes she can make noise and get attention from others, say by hitting a bottle of milk against another object or throwing the bottle away, it finds that her actions fit into a new field of forces that solicits her action. This field is not subject-independent since it is in her own interest to get her parent's attention. She does not constitute the field either; the field rather emerges from the new reconfiguration of the whole agent-environment system, which finds a new orientation or a new sense. The disparity of the habitual past (the bottle-feeding norm) and the newly enacted present (the bringing attention with the bottle) is not the result of incorporating something senseless

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thanks to the acquisition of a new level of perception that object perception. I refer to the bottle as an aspect of the environment that unit a *x* number of affordances.

into the agent-environment system's normative domain. Instead, it is a whole reconfiguration of the agent-environment system in a creative process that involves the self-transformation of the body and the world, all at once, where these self-transformations are also importantly informed by their past.[44]

Creativity and improvisation are some of the most important aspects of sense-making. The next subsection will argue that creative improvisation involves a dialectical movement of the body and the world akin to the situation I have described above.

4.2.2 Sense-Making as Creative Improvisation

Improvisation and creativity are fundamental aspects of life and cognition. Contrary to our common-sense view of these phenomena, they do not spontaneously bring forth something totally new but instead, consist in taking up something that is already done in a new way (Sawyer 1992; Montuori 2003). Jazz musicians create improvisations by adapting a traditional melody (a standard), a habitual repertoire of melodic phrases, and shifts of harmony, so that new combinations bring forth unique performances. The enacted performance of an improvisation brings forth the habitual repertoire into the field of forces constituted by the social and musical environment of the performance (cf. Walton et al. 2015).

Crucially, the improvisation does not originate from the intentions of the musician alone. Playing with a band in public causes a series of contingencies that alters any pre-established plan of the musician (Sawyer 1992). This means that improvising consists of working with these contingencies to bring forth the old repertoire anew, like creating a new figure by improvising folds from the already known sequences of folds in origami.

The accomplishment of good jazz improvisation, therefore, entails a new balance between the old and the new, between the habitual past and the unexpected contingencies of the present. The

[44] I agree that the environment involves a set of constraints, but these constraints are not based on the raw physicality of the environment. They are constraints for the particular path of an agent and its already established normative domain of interactions.

dynamics of agent-environment and past-present occurs at multiple levels. At the causal level, the physical constraints of the environment cause a constant tension that agents must mediate. In the practice of jewelry making, for instance, goldsmiths need to constantly adjust and adapt previously acquired techniques, depending on the type of "responses" the material sends back to their bodily actions (Baber, Chemero, and Hall 2019). This dynamic process of an endless re-adaptation of their actions designates the first set of tensions that force agents to reshape their acquired bodily habits to suit environmental conditions constantly. Consequently, skillful jewelry making is more a capacity to deal with the unexpected condition of matter than a matter of knowing in advance how to give form to passive matter.

Di Paolo et al. (*LngBod*, 141) have already recognized a primordial tension between the agent and the environment due to a permanent "messiness" of the materiality of bodies. Understood in this way, the world forces the agent-environment system to actualize its normative domain indefinitely, resulting in the unpredictable and unintended consequences of the body-world interactions.

4.2.3 Environmental Structures

There is another level of tension at the core of the body-world entanglement that is not well enough acknowledged in the field of enactive cognition. It is a tension where a habitual normative domain meets a new set of normative constraints and produces the enactment of a new whole field, like in the example of the baby finding a new whole context for her sensorimotor skills. This is like the creation of new personal and collective styles of playing music that I described elsewhere (Sepúlveda-Pedro 2020).

In jam sessions, improvisation entails a constant self-transformation of interactional norms, but this practice's dynamic "self-movement" goes further. In these sessions, musicians constantly and collectively create new structures of sense from previously given structures of sense (musical structures). Some of the new musical structures are felt as successful and become part of the habitual repertoire of one or more of the practitioners. The accumulation of this new musical repertoire can eventually transform each musician's current personal norms and the norms of the collectivity, either of a small group or a whole cultural society (Sepúlveda-Pedro 2020).

For musical creativity, the adaptive behaviour of the musician is undoubtedly crucial, but the creative process involves the participation of multiple forces. The most obvious is the contribution of the other musicians. This is why jazz improvisation involves participatory sense-making, similar to the practice of a couple dancing. However, in the case of music, there are not only bodies interacting directly in the performance, but also a whole environmental structure involved and co-constituted with other agents. The environmental structure creates "folds" or scaffoldings that enable and constrain the development of the improvisation, and eventually, of a whole new musical style.

These environmental structures can be musical patterns, co-constituted and co-enacted with other musicians that no longer play a passive role in music production. These structures do not merely constrain the musician; they rather solicit the action of the musician in a certain way (cf. Walton et al. 2015), leading the agent to find a new creation, a new field, or even a new musical *Umwelt*. Therefore, the musician navigates in the normative field of forces co-constituted, co-enacted by multiple agents, embodied in the network of meaningful environmental structures that enable and constrain her possible actions.[45]

It should be noted that the examples of both jazz improvisation and jewelry making involve a sociocultural dimension. The social dimension of cognition is a phenomenon that I will explore more carefully in the fifth chapter. Here, I wish to illustrate the presence of a normative field that is always present in the body-world entanglement, one that shows the real presence of the environment in cognition. For instance, in the example of the bottle of milk, the baby applies creativity and improvisation to enact new norms and finds new configurations for old norms in the new field of forces. The new norm does not come out of the intrinsic teleology of the baby, not

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[45] Collective jazz improvisation is not like the practice of a goldsmith that only needed to deal with the material contingencies of the object. The musician needs to deal with a whole network of normativities that includes the multiple material and formal dimensions of music. However, there are also cases of solo musicians that improvise under the normative constraints of their own instruments (i.e., the bodily skills-affordances relation) and the constraints of its own musical creation (e.g., the inertia of their own musical expression).

even from her sensorimotor habits. Instead, it arises from the re-enactment of old habits in a new situational field.

The situational field is the active environment, which is not just a subject-relative field. The *active environment* is the horizonal structure of the world, and it is constituted by a complex interrelation of things, agents, and the body itself, something I will name enactive place in the next chapter (5.1). As such, this active environment does not correspond to the abstract domains described by physics and chemistry; instead, the environment is a place of dwelling (Malpas 2004), or more simply, an ecological niche constituted by a web of interrelations between multiple agents, things, mediums, surfaces, and so on. As we will see in the following, this is exactly where the process of sense-making as norm development takes place.

4.3 The Ecological Dimension of Sense-Making

From a phenomenological perspective, the first dimension of our perceptual world is *depth* because the world is lived primarily not as an abstract set of physical determinations but as a place of dwelling (*SpPlc*; Morris 2004). Dwelling is, therefore, the condition of an agent situated in a setting of already pre-established normative relations that its body maintains with other living and non-living aspects of its surroundings. This scenario of the active environment assumes that the agent is situated in a relational field that I will call *the ecological dimension of the environment*. In this ecological dimension, any norm of sense-making is enacted, which is why we need to specify the fundamental characteristics of this dimension.

The ecological dimension of cognition has been recognized not only by phenomenologists but also by Gibson's ecological approach to visual perception. This section will briefly review Gibson's approach (4.3.1). Autonomist enactivism has been reticent to endorse some essential ideas of Gibson, like the theory of affordances and the theory of ecological information, because he claims that these elements of the ecological field are subject independent (4.3.2). This problem is surmountable, nonetheless, if we acknowledge that the ecological field is the presence of a past enacted in the history of the agent-environment system and not a set constituted by causal processes that are external to the concrete existence of this system (4.4).

4.3.1 Gibson's Theory of Direct Visual Perception

Gibson's ecological approach has significantly influenced radical embodied cognition because his theory offers a solid scientific framework for explaining perception without appealing to internal representations. For Gibson, our active exploration of the environment provides us with all the information we need to account for perception. Importantly, this information is not theoretical but practical because it concerns what the environment affords (for good or for ill) as possibilities for action on the part of the perceiver (*EcApVsPr*, 119). These possibilities for action are called *affordances*.

Although affordances are not, as such, physical properties of things, they are nonetheless objective features for Gibson in the sense that they exist regardless of the factual presence of any perceiver (*EcApVsPr*, 121). Gibson also claims, however, that affordances are neither objective nor subjective because they are beyond such a simple dichotomy (*EcApVsPr*, 121). This claim is based on the idea that affordances pertain to the relational domain of the animal-environment system. My coffee cup, for instance, has the affordance of grasp-ability. This affordance does not exist in my head but in the cup itself, yet this affordance is not a property of the cup as such but is also relative to the body that can grasp it. Consequently, the cup has the affordance of grasp-ability for a human or maybe some other primate, but it does not offer the same affordance for a dog or a snake.

For this reason, some ecological psychologists after Gibson claim that affordances are more appropriately understood as relational properties of the animal-environment system (see Warren 1984; Heft 1989, 2001; *RadEmCS*). These relational properties can be objectively studied from a scientific stance because they are, in principle, as observable and measurable as natural physical phenomena. The real challenge, for Gibson, is to explain how organisms can perceive affordances without representing internally any feature of the outside world. Gibson's hypothesis, in this regard, is that some kind of information in the environment facilitates the perceptual recognition of affordances. This is what Gibson calls *ecological information*.

Ecological information, like affordances, does not refer to intrinsic physical properties of the environment, such as sensorial data or physical stimuli. For Gibson, sensorial data do not convey any information about the environment. Although stimuli may cause sensorial impressions in our perceptual systems, these impressions can be structureless, in which case they would tell us nothing (*EcApVsPr*). Think about a well-illuminated room full of fog. The fog causes the reflectance of light in all directions, creating a uniform white colour all around the perceiver that impedes her to see the structural conditions of the room. As Gibson claims, the uniformity of stimuli is equal to the total absence of stimuli (e.g., a dark room).

Ecological information rather implies a "structure" of matter and energy typical of habitats on Earth. This structure exhibits variant and invariant elements but is relative to animals' locomotion (*EcApVsPr*). The ambient optic array is the most typical example of ecological information offered by Gibson. Usually, light does not impact our retinas directly from the source of light (e.g., the sun or a light bulb). Light is spread all over the places and landscapes we inhabit from the source, causing different effects of reflectance. The reflected light of a visual scenario, called by Gibson ambient light, converges to every possible standpoint that an observer can occupy (or not). When the standpoint is occupied, the observer can already perceive differences in the different zones of the visual scene. When the observer changes her standpoint, she can appreciate that the visual scene also changes. When she comes back to her original position, the first visual scene comes back again. We can observe some aspects of the environment remaining invariant in the transition from one scene to another, such as the corner angles of a table. The body itself can appear as one of these structural invariants, like our nose that is always part of our visual field. The invariants in the flux of the ambient optic array help us anchor the orientation of our movements and give a sense (a direction) to the visual scenes that we are perceiving. Gibson compares the role of these invariants to the presence of the Parthenon in Athens (Gibson 2002). The Parthenon, visible from every city's point, helps us know our position while wandering the city.

We should notice that the variant-invariant structure of the environment or ecological information is not something that our minds make up. We only need to disclose this environmental structure through our own locomotion. This is a process that Gibson called *information pickup*. Ecological information is there, outside individuals' heads, and it is, for this reason, observable and measurable by science. Although Gibson could not prove that ecological information is lawful, his followers later found in differential equations (Warren 1984) and models of dynamic systems theory (Turvey and Carello 1995) empirical solid support to Gibson's hypotheses.

Gibson's claims have important convergences with autonomist enactivism (*RadEmCS*) and other forms of enactive cognitive science (*EvoEn*). However, there are also significant differences, ones that have split the program of radical embodied cognition into two camps. The following subsection surveys these convergences and discrepancies, and proposes an enactive-ecological approach that can help us appreciate sense-making's ecological dimension.

4.3.2 Enactive or Ecological Information?

The meanings perceived in the enactive *Umwelt* of living agents are easily comparable to the descriptions of affordances. Glucose affords nutrition for E. coli bacteria, while other chemicals like gold can afford intoxication to the same organisms (Villagrán et al. 2020). Likewise, in sensorimotor habits, objects located in our surroundings afford possibilities for motor action. Stairs afford climb-ability, and the chair affords sit-ability.

However, for the thesis of significance as a surplus of autonomist enactivism, affordances imply the *addition* of value to things thanks to the vital and sensorimotor norms enacted by agents' bodies in their history of interactions with the environment. For Gibson, by contrast, affordances are located in the environment itself, so the factual presence of an agent seems to be unimportant. Organisms only pick up ecological information available in the environment and get access to the affordances available in it. These two opposite positions of autonomist enactivism about Gibson's ecological approach have thus far been the central point of difference between these two approaches (*EmMnd*). I will argue that both approaches have shortcomings based on their descriptions that presuppose a subject-independent world as the ultimate foundation of life and cognition. However, if we avoid such a presupposition, we can construct a joint enactive and ecological approach to sense-making.

To be fair, Gibson's claims are problematic and confusing because he describes the visual field as a meaningful domain that is nonetheless subject-independent. This claim does not seem to fit with physicalist ontologies of science that presuppose the subject-independent world as a meaningless world. Gibson's aim is nonetheless obvious: he wants to make ecological psychology an "objective" science (*EcApVsPr*). Gibson's unusual characterization of the perceptual environment has also motivated endless discussions about the ontological status of affordances. Without embarking on a lengthy discussion about this issue, I will argue that a subject-independent characterization of affordances is misleading. My argument will not address the ontological discussions of affordances but will focus on the empirical evidence that weighs against such an idea. Later, I will show that Gibson's conception of the environment as an ecological domain aims to a *sui generis* conception of objectivity that does not fit with the assumptions of physicalist ontologies.

Mossio and Taborelli (2008) compare the original theory of sensorimotor contingencies (O'Regan and Noë 2001) and Gibson's ecological approach. These authors conclude that Gibson's approach misses the central role the body plays in enacting sensorimotor information. For Gibson, the variants and invariants of sensorimotor information are in the environment and can be disclosed by an agent's locomotion. Nonetheless, for Gibson, the specific set of bodily movements needed to disclose such information seem irrelevant. By contrast, the theory of sensorimotor contingencies sees the self-organization of the body and brain as playing a crucial role in acquiring mastery of sensorimotor laws (cf. Hurley and Noë 2003).

Gibson emphasizes that we disclose the environmental structure of light thanks to locomotion. However, he does not acknowledge that such disclosure, in vision, depends on more than spatial displacements of perceivers. Rather the active movement of the body discloses visual information for an observer. From a phenomenological perspective, Susan Bredlau (2006) gives the example of how a person that has always been transported by car, but who has never learned how to drive a car, cannot perceive accurately the spatial information needed to accomplish this activity efficiently. The information needed for driving is accessible to drivers who have incorporated the correlations between the active motion of their bodies (handling the wheel, pedals, gear, etc.) and the correlated flux of sensory information. Notably, there are not only phenomenological arguments but also empirical evidence on this subject.

In an experiment with cats, two different groups of newborn cats are deprived of visual information (Held and Hein 1963). Eventually, they are allowed to move in an illuminated environment but harnessed to a carousel. One group of cats can move their legs along with the movement of the carrousel, while the second group is merely transported by the carrousel. After a period, both groups are allowed to move freely in an illuminated environment. The cats of the first group can move efficiently in this environment, while the cats of the second group are clumsy and unable to walk correctly. These results suggest that perception and its development depend on the active sensorimotor coordination of agents and not solely on the disclosing of information via locomotion. That is, the active self-movement of the body is necessary to acquire the necessary skills to interact appropriately with the environment (*EmMnd*; *SmLf*; Mossio and Taraborelli 2008).

This means that ecological information is closer to what the enactive approach defines as a sensorimotor environment (an abstract space of sensorimotor laws that are independent of the active engagement of any agent) than it is to sensorimotor habits (the sensorimotor correlations that involve the emergence of habits as autonomous systems in precarious conditions). If so, agency and subjectivity are indeed not relevant for Gibson's notion of ecological information, just as it happens in projects of weak enactivism (see 2.3).

Chapter two argued that weak enactivism's neglect of subjectivity and agency as constitutive aspects of cognition is problematic (2.4.4). From this standpoint, a criterion for distinguishing truly cognitive agents and mere responsive mechanisms like those of embodied artificial intelligence was missing. It is true that we can deduce ecological laws and that mechanical systems can exploit these laws. However, there is no meaning or significance at play for the artificial mechanisms in these types of sensorimotor interactions. This lack of meaning is not a problem for the operation of an artificial mechanism because engineers foresee the sort of ecological information relevant for the machines. The design of the machine, therefore, embodies the plan of the engineers.

However, according to the theory of biological autonomy found in autonomist enactivism, the relevant ecological information for a living agent is the one that is vital for its autonomous organization. This means that the autonomous organization of a living agent is not entirely determined before its concrete interactions with the environment. The specification of what is relevant for the agent cannot be given a priori. In the interaction itself, some aspects of the organism's surroundings become relevant, correlative to its self-organization processes that are not pre-determined. The enactment of a domain of significance or a normative domain corresponds to what we call sense-making, and this is what distinguishes living from non-living beings and cognitive from non-cognitive beings.

Ecological laws are, therefore, scientific abstractions. While helpful, these laws are not part of the phenomenon of perception itself. Sensorimotor correlations are enacted rather than picked up.[46] They are part of the self-movement and self-transformation of the body-world entanglement rather than intrinsic characteristics of a subject-independent world. I will later argue that this phenomenon is described by more contemporary accounts of affordances (4.4.1) and by Merleau-Ponty's spatial levels (4.4.3). In what follows, I will look at the problems arising from the claim that affordances are also subject-independent.

4.3.3 Are Affordances Normative?

For most ecological psychologists, affordances, like the structures of ecological information, are subject-independent. Affordances are relational and implicate the organism-environment system. However, these affordances are arguably constituted by causal processes that do not implicate the active engagement of agents. For Turvey (1992), for instance, affordances are like dispositional physical properties. Organisms can react lawfully to the presence of specific characteristics of the environment, like how two chemical compounds react when put together in the appropriate context. Similarly, Reed (1996) claims that affordances are relations that originate in processes of natural selection like adaptationism. Organisms respond to the affordances perceived in the environment not necessarily because they have developed a bodily affective sensitivity to the environment in their developmental unfolding in time. Instead, organisms are, for this view, designed by nature to

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[46] The notion of "information pickup," as well as others in Gibson's work (e.g., ecological information, affordances), is controversial an open to multiple interpretations. I am refereeing in here to the most common and maybe superficial understanding of "information pickup," which consists of the description of how perceivers obtain information from the visual flow thanks to their own displacements in space. This is exemplified in Gibson (1966) analysis of pilots handling information for landing a plane. Such analyses acknowledge the importance of self-movement for obtaining information in the flow but neglects the central role that self-organization processes of the body play to constitute as meaningful the information of the flow (e.g., the bodily skills required for piloting a plane). The difference between bare movements in space and self-organized movements of the body implicated in the acquisition of a body skill is what above Bredlau's example illustrates. The same distinction is made by autonomist enactivists in their differentiation between a sensorimotor environment and sensorimotor habits (see 3.3).

respond to the environmental affordances. Although affordances, in this case, imply the intimate ecological relationship between organisms and the environment, this relation can be determined by a causal determinism that autonomist enactivism rejects (see 2.4).

In a similar vein, Heras-Escribano and de Pinedo (2016) have argued that affordances are non-normative because, for them, normativity necessarily involves criteria of correctness that exist, as far as we know, only in the sociocultural practices of human beings. This claim is based on a Wittgensteinian account of normativity. Wittgenstein (2009, 2007) affirmed that sociocultural practices entail norms that have not only conditions of satisfaction but also conditions of correctness. A condition of satisfaction is when E. Coli bacteria find the glucose they need for their metabolic requirements. As we saw in chapter three, E. Coli can adapt its organization to metabolize lactose when the environment of bacteria is low in glucose. In this case, either glucose or lactose can fulfill the vital norm of E. Coli.

A condition of correctness implies that we need more specific criteria to satisfy the norm. This happens, for instance, when a human being determines as good or bad the quality of her food. This judgement can be based not only on the nutrients the food provides but also on other more specific criteria such as a specific taste, the origin of the ingredients, or the aesthetic appearance of the dish. The existence of conditions of correctness is a common feature of human practices. They imply indeed a new layer of constraints for human actions. We must notice that these criteria are not chosen by individuals but are the result of social conventions that individuals follow even to rule their solitary actions.

The main argument of Heras-Escribano and de Pinedo (2016) in support of a non-normative character of affordances is that affordances, as part of nature, are not as contingent as social norms are. For this reason, affordances depend on relations determined by causal processes of nature, social norms instead on conventions (Heras-Escribano 2019).

This sort of argument has pushed many ecological approaches to distinguish between natural and social or cultural affordances (Rietveld and Kiverstein 2014; Ramstead, Veissière, and Kirmayer 2016). Whereas bare natural processes can determine natural affordances, cultural affordances are more contingent and relative to the historical past of a given cultural group. While the distinction between natural and cultural affordances is certainly useful, I disagree with the suggestion that natural affordances originate in bare causal processes independent of the normative domain of the body-world entanglement. The last section of this chapter will argue that affordances, whether natural or cultural, are part of the enacted normativities that constitute the agent-environment system. Before doing so, the Gibsonian distinction between the environment as a realm of raw physical processes and as a relational ecological domain needs to be clarified.

The distinction between the purely causal realm of physics and the ecological dimension of visual perception is already at play in Gibson, who distinguished between two different kinds of science: physical optics and ecological optics. These two types of science look at two different aspects of the phenomenon. Physical optics analyses the physical composition of light and the causal effects of light on the visual system. Ecological optics, by contrast, studies the structure of light spread out in the different parts of the environment (medium, surfaces, and landscapes.) that cause different effects of reflected light (e.g., transparency, colour, and shape). The ecological realm, therefore, does not imply the analysis of light abstracted from the visual context. Instead, it analyses the presence of light in the wild, or how light is interrelated to the multiple objects and aspects of the environment (*EcApVsPr*). Consequently, it is the relational domain of light and not the abstract domain of physics that gives perceivers the information necessary to recognize affordances.

However, the relational field is not restricted to the relation between light and the environment because the perceiver is also immersed in the system of relations. The perceiver needs to occupy a location in the ambient optic array and move through different arrays to disclose the invariants of the structure of light. Likewise, affordances are relations between organisms and the environment. The environment affords opportunities for action only to those organisms capable of exploiting such opportunities. Water affords breathing to animals with gills but not to animals with lungs. Flat ground affords walking for legged animals and crawling or slithering for animals without legs.

All this suggests that the origin of the relational field can be found in the processes that constitute the bodies of organisms and in the intrinsic properties of the environment. As a result, an orthodox theory of evolution may explain the origin of the relational field, as Reed and others suggest. But things are more complex here, and the last section of this chapter will argue that the relational field described by ecological optics depends on developmental processes as much as in phylogenetical processes, so that affordances are revealed as subject-relative via the phenomenon of norm development.

4.4 The Self-Transformation of the Body-World Entanglement

Ecological approaches usually make philosophical assumptions that autonomist enactivism sees as problematic theoretical backgrounds for explaining cognition. These assumptions concern the existence of absolute foundations of cognitive phenomena (see 2.1). There are, for instance, subjectivist philosophical theories that find the foundations of mental phenomena in the constitutive power of the mind. In contrast, objectivist approaches and empirical sciences of mind find these foundations in the subject-independent world described by physics and chemistry. For autonomist enactivism, both tendencies are misleading, and they propose instead to maintain our analysis of cognition in a middle way between these two extremes. Autonomist enactivism embraces the philosophical thesis of embodied subjectivity (2.1.2), which claims that cognition, as well as any possible study of this phenomenon, already presupposes a body-world entanglement. This entanglement reveals that any cognitive act of agents implies a bodily immersion in the world and that the disclosure of the world is possible only insofar as agents are already immersed in it. Ecological approaches, however, tend to neglect the role of the bodily subject in the constitution of the ecological realm and to support, instead, the hypothesis that the environment, as a physical domain, is the ultimate ground of cognition.

The assumptions of ecological approaches force this branch of radical embodied cognition to find the causal bases of cognitive phenomena on processes that are external to the coupling of the agent and the environment in its developmental history. As a result, ecological approaches find support for their claims in orthodox theories of life and evolution that conceive organisms as machine-like systems constructed and determined by external processes. That is, ecological approaches take the same problematic route of weak enactivism (2.2).

One of the main characteristics of orthodox theories of life and evolution is a neglect of the central role that developmental processes play in the constitution of organisms' bodies and their behaviour

(2.4).[47] Autonomist enactivism, in contrast, describes a partial self-determination of organisms, thanks to their autonomous organization as well as to their adaptive behaviour that makes the relation of the agent and the environment more intimate. It is a relation that is concrete and singular and can only be understood if we acknowledge the central role of development in the constitution of the agent-environment system.

Consequently, the last section will argue against the standard conception of affordances as subject-independent environmental aspects. Instead, I will offer a series of arguments to the effect that *development* is a central aspect of the constitution of affordances. Affordances are enacted, not just discovered. Such a claim does not prevent us from saying that affordances are located in the environment. In short, then, I agree that the ecological realm is meaningful, as Gibson argued, but this is not because it is constituted by raw causal processes external to the agent-environment system. Instead, the ecological realm is nothing more than a web of normative interrelations that constitute the body-world entanglement in a more profound sense, one that temporally and spatially transcends the individual agent-environment systems, but that nonetheless describes the world agents genuinely inhabit.

4.4.1 Chemero's Dynamical Account of Affordances

Anthony Chemero has given one of the most influential interpretations of Gibson's theory of affordances, which he rightly conceives as relational. Interestingly, he does not see affordances as relations between intrinsic aspects of the organism and of the environment, but as relations between situational features and bodily skills (*RadEmCS*). This redefinition of affordances is welcome, as it gives this concept a dynamical character it previously lacked (McGann 2014a). Moreover, it

[47] The variability in the bodily constitution and behaviour of organisms due to developmental processes is much more relevant in multicellular than in monocellular organisms. Ontogenetic processes can be therefore omitted in our theories and models for explanatory purposes. There is still a variability in the expression of genes in a population of bacteria due to variations in their developmental niches, like in the case of E. coli (see 3.2.1).

facilitates our understanding of the central role of development and the concrete interaction between an agent and the environment for the enactment of affordances.

Chemero first tells us that what matters for an agent for perceiving an affordance is not merely to have the appropriate physical body to accomplish an action but to have the *ability* or the *skill* to accomplish such an action. For instance, I have never learnt to play soccer as many of my friends have. Once, two of my friends and I were walking in the park, and when a soccer ball appeared, my friends immediately start playing with the ball. They passed the ball one each other, walked and dribbled with the ball with their feet, and finally kicked the ball back to its owners. They perceived many affordances in the ball that I could not, given that I am barely capable of kicking the ball in a straight line. Therefore, it does not matter if I have the same type of body as my friends do. As long as I do not possess the necessary skills, I cannot perceive what the ball affords.

Our bodily skills change all the time, from the moment we are born (and maybe before but see Gallagher and Meltzoff 1996) to the moment of our death. This means that our perception of affordances is constantly changing, and for Chemero, this is what Cesari, Formenti, and Olivato's (2003) experiments prove. For example, in certain experiments, it was demonstrated that people change their perception of the climb-ability of stairs insofar as they lose their skills for climbing due to factors like ageing. A high stair, for instance, was perceived as climbable by young people but not so by older people (*RadEmCS*).

Therefore, it is not enough to have a particular type of body or for there to be specific characteristics in the environment to perceive an affordance. An agent needs to have the necessary skills to complete an action and to perceive the correspondent affordances. Changes in the body occur all the time, either because we get injured or because we lose the sensorimotor habits of a practice, with the result that we cease to recognize affordances. We can also start perceiving new affordances by acquiring new body skills or incorporating artifacts into our natural bodies. The cane of a blind person, the car of a driver, the boots of an alpinist, these things and others can change the layout of affordances (*RadEmCS*).

The ecological realm, for Chemero, is, therefore, a highly dynamic field that changes constantly and at multiple temporal scales (see also Gastelum 2020). At the behavioural time, affordances are differently perceived if we are tired or full of energy. In the developmental time, we can change according to fluctuations in our sensorimotor repertoire, our use of artifacts, or changes in our physiology. At the evolutionary time, changes in our genomic and extra genomic heritage can also transform the available affordances of our species.

Material changes in the environment also alter the layout of affordances, destroying and creating new sets of possibilities for action that can change our behavioural, developmental, and phylogenetic paths. On the side of the environment, however, many other dynamic and relational aspects can contribute to the perception of affordances.

For Chemero, our perception of affordances depends more directly on the situational context of the environment than it does on the properties of the objects that comprise the environment. In the example I gave earlier, my friends passed each other the ball, so that they perceived in the ball an opportunity to kick it and pass it. These affordances are not intrinsic to the roundness, weight, softness, etc., of the ball. There is a context where the ball exhibits its kick-ability and pass-ability; the flat floor of the park, the ball approaching the leg with a certain velocity, another person able to receive the ball, as well as the fact of being in a park on a sunny day in Montreal. What is more concrete and directly perceived by my friends is something like "it is the right time to kick the ball and play" more than any judgment about whether the ball has the characteristics necessary for playing.

This redefinition of the environment can transform our conception of affordances and the environment where affordances appear, probably more than has been recognized by other followers of Gibson. Chemero's description of the environment as an ecological field is close to Merleau-Ponty's (*PhP*) description of the phenomenal field. The notion of field in Merleau-Ponty's comes from Gestalt psychologists, who borrow this term from physics. A standard definition of a field in physics describes an abstract space containing an x number of quantitative values or vectors representing a series of concrete forces at play in such a spatial domain. In perception, we also face a spatial domain where different forces can attract our attention, afford possibilities for action, constrain our actions, or solicit a determinate action from us. The classic example of this is a soccer field that appears for a player as a field of forces that constantly change. The limits of the field, the other players, and the ball are just the most evident forces that constitute the lived soccer field of a player (Merleau-Ponty 1963, 168-169).

Moreover, Chemero's description tacitly introduces the idea that many aspects of the sort that Husserl would call horizonal are needed to determine the enactment of an affordance. Following Husserl, a horizon can be seen as something that codetermines the objects that our consciousness intends. In the above example, the park, the sunny day, the bodily skills, and the ball's velocity are all part of the co-determinations of ball affordances. The same ball in a sports shop or in the hands of a child does not reveal the same affordances.

Suppose Chemero's interpretation of Gibson's theory of affordances is correct. In that case, the ecological dimension of cognition is a field constituted by multiple contingent components, and that cannot be entirely determined in advance of the convergence of the body and the world in the taking up of an action. For this reason, it follows that *it is in action itself that affordances are enacted* and then appear as correlations of motor habits. These correlations are nonetheless enacted in a broader context that evokes the bodily action, bringing forth the required affordances of the current situation (e.g., the demand for kicking the ball). For all that, affordances are not the sheer mirrors of these habits. Although enacted in the history of the agent-environment system, affordances become sedimented in the environment. They complement and interact with the body, creating tensions and disparities that motivate the self-transformation of the body-world entanglement.

4.4.2 Ex-Corporations: The Horizons of the Ecological Field

Chapter three argued that Merleau-Ponty's notion of the body schema cannot be reduced to the self-organization of the body in relation to a bodily task (e.g., Gallagher 2005). We should rather conceive the body schema as implying the body-world entanglement. The point here is that the unity of the body and the world precedes any distinction we can make of the agent and the environment.

Phenomenologically, the bond that unites body and world is often understood as a relation of co-determination: my motor ability for climbing stairs is codetermined by the climb-ability I perceive of these stairs, and in turn, the motor action I need for climbing stairs is codetermined with the way that stairs afford to my body the possibility for climbing them. Nevertheless, the body-world entanglement is more than a co-determination of the body and the world because neither simply mirrors each other. There is a constant possibility of discrepancy between what my body aims to do and how the world responds to these aims (cf. Beith 2018). I have already mentioned these discrepancies in section 4.2.2, where I described how materials resist flowing smoothly with the habitual actions of the body. On some occasions, body-world discrepancies become so insignificant that some aspects of the environment can become incorporated as part of the self and cease being lived as part of the environment. I described this phenomenon as bodily incorporations in section 4.1.2.

Although we can incorporate many features of the environment, the world is inexhaustible, and I cannot expect to become one with it. The gap between ourselves and the world, between us and the other, between us and ourselves, is intrinsic to our cognitive lives (*PhP*). There is always something that cuts across the flux of my actions and aims, just as there is always something unexpected and unintended that becomes part of our lives at every moment (Dastur 2000). The disparity between the body and the world means that we continuously update our acquired habits and perceptions, thus reconfiguring our normative domain of interactions with the environment. When new norms or new normative domains are enacted, it is not unusual that the older norms stay present in the lived world, even if they become increasingly unnoticed.

When my friends learnt to play soccer, they already had a repertoire of bodily skills. They knew how to walk, run, and jump. The different ways to handle the ball in the game became an additional set of norms to the habitual sensorimotor repertoire of my friends. Now, when they play, they no longer need to worry about how to run or to walk. Their attention is on the ball and the situation on the field. Playing soccer, nonetheless, would be impossible without the previous existence of more basic sensorimotor norms.

The normative background of playing soccer is not reducible to the habits of the body. Such a background is also sedimented in anchorage points of the field that my friends use as points of orientation for their practice (see also Merleau-Ponty 1963; Talero 2017). When attacking, soccer players run towards the goal of their contenders, and their movements are intrinsically oriented to put the ball in that goal. The field thus appears as oriented, as structured with positive and negative forces for the players' actions. Likewise, when I walk from the metro to my house, I do not ask myself if the floor is flat and solid, if I need to take the stairs, or I should turn left or right after the exit. In the bodily practices we master, many aspects of the environment become invisible to our sight, but they are nonetheless constitutive of our actions and perceptions. Without the many overlooked aspects of the visual field, it would be impossible for me to know where my house is or for the soccer players where the other team's goal is.

All those aspects constituting our lived experiences, but that remain in the background and topologically are located on the side of the environment and are called by Morris (2004) *ex-corporations.*[48] They are not intrinsic features of the environment; they are related to my bodily habits but located outside the body's boundaries, so they are not incorporated but excorporated. They are no less relevant for our actions and experiences than those objects that we bodily incorporate. In the same way that a blind person can no longer perceive a distant object without her cane, I would not know where my house is if I cannot see the pharmacy and the hospital outside of the subway. Indeed, when there is a large amount of snow, the sidewalks vanish from our sight, and we can easily lose our sense of where the road ends and where the sidewalk begins.

Ecological information is not different from these anchorage points. However, we must acknowledge that its function as vectors of orientation is not determined by an intrinsic correlation between movement and sensory feedback, or between the properties of the environment and the properties of the body. All these aspects matter for the constitution of the ecological field, but they are not enough. Ecological information depends on the active bodily engagement of an agent in a situational context, and it is in the constitution of the situation that we must look for the ultimate

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[48] Contrary to incorporations, which are portable aspects of the environment, (e.g., the cane of a blind person) ex-corporations are not portable and remain situated in places (e.g., the door frame of my bedroom). As a result, they appear to be subject independent, but they are not. They are the counterpart of bodily habits, or, better yet, bodily habits are the counterpart of the places a body inhabits (cf. Casey 1984). As an example, Morris (2004) describes how Earth ex-corporations are constitutive aspects of the way we inhabit our planet as bodily agents. A further analysis of ex-corporations can be revealed by examining the notion of spatial levels in Merleau-Ponty's phenomenology (4.4.3).

source of the norms of sense-making. The fifth chapter will address the situated normativity of action and perception. In what follows, I shall describe, from a phenomenological perspective, the origin of ecological information as spatial levels and show how the shift of these levels describes the self-transformation of the body-world entanglement.

4.4.3 Spatial Levels and the Self-Transformation of the Body-World Entanglement

Merleau-Ponty's *Phenomenology of Perception* has been one of the most influential philosophical works of embodied cognition. Nevertheless, little attention has been paid to the concept of spatial levels that has more recently emerged as relevant for the contemporary ontological interpretations of Merleau-Ponty's phenomenology (e.g., Marratto 2012; Beith 2018; Morris 2018). The description of levels (*niveaux*) is also relevant for our discussion about the ecological dimension of norm development for many reasons.

First, the concept of spatial levels designates the implicit normativity at play in ecological fields since these refer to the anchorage points that orient our bodily actions. Second, these levels are not subject-independent like ecological information. On the contrary, they imply the entanglement of the body and the world. The normativity of levels depends on the interactional habits, incarnated in the body and sedimented in the environment. Third, levels are temporary open-ended structures that can evolve and shift from one level to another, so they also describe the development of norms in the interactions of an agent-environment system. Finally, since levels denote the sedimentation of the norms at play in the agent-environment system, on the side of the environment, they can create tensions with bodily habits that propel the agent-environment system to its self-transformation. In short, the concept of levels can bring together the claims of autonomist enactivism, ecological psychology, and phenomenology around a definition of sense-making as norm development.

In his *Phenomenology of Perception*, Merleau-Ponty describes the general notion of space from a phenomenological standpoint, which includes the body as a constitutive part. Merleau-Ponty highlights that our experience of space usually implies a particular orientation (e.g., up, down, left, right). This spatial orientation is given to us without the need of our conscious reflection (*PhP*). The primordial sense of space is not the spatiality described by the abstract geometrical dimension of Newtonian physics, a form of space that works as a sort of container for the objects and events in the world (*SpPlc*). Merleau-Ponty calls this conception *positional spatiality* (*PhP*). For Merleau-Ponty, the primordial form of spatiality is a *situational spatiality*. It involves the active engagement of the body in the accomplishment of motor tasks and the horizonal domain of all our possible bodily actions (*PhP*). Therefore, the orientation of space we directly perceive cannot be grounded on something external to the body-world link established by motor intentionality (see chap.3.3). Instead, it is a deeper manifestation of this primordial relation.

In this context, the more concrete or delimited regions of space that we call *places* (cf. Casey 1998) offer *anchorage points* that allow our bodies to situate themselves in (*PhP*). The anchorage points give places a sort of stability, thus establishing what Merleau-Ponty called *spatial levels* (*PhP*; Merleau-Ponty 2011). These levels are norms of perception because they point to the optimal ways our body interacts with the environment (Talero 2005). Namely, the lived orientation of a spatial level implies the anticipations or expectations of our motor actions. These expectations can be satisfactorily fulfilled by the actual conditions of the environment that show at once further possibilities to explore and manipulate this environment. All these happen according to the norm of the perceived level. Perception of places, like the perception of things, involves perceptual norms.

Places, unlike things, however, are not usually the focus of our attention; instead, they serve as stable backgrounds for our everyday activities. They form, one could say, the horizonal aspect of our perceptual intentions. The ubiquitous presence of some spatial levels (the more general ones) requires that we alter the ordinary conditions of our sensorimotor interactions to recognize them. This is what Merleau-Ponty (*PhP*; 2011) did through his interpretation of some classical experiments.

Merleau-Ponty refers, for instance, to Stratton's experiment where a subject uses goggles that inverse the visual field for eight days. The visual field is perceived upside down at the beginning. After a couple of days of use, the subject starts to live the visual field normally but starts feeling that her body is inverted. After eight days of use, the whole sensorimotor interaction is finally readapted, and the new visual field is lived normally (*PhP*; Noë 2004, 2012). Merleau-Ponty also discusses Wertheimer's experiment, where a subject is put in a room, where she can perceive only through a mirror that distorts what she sees; in optical terms, what she sees deviates by 45 degrees from vertical. The subject initially sees everything obliquely, and even the movement of objects in the visual field is perceived with a similar deviation. However, after a few minutes, the subject starts to perceive the scene vertically once again (*PhP*).

These examples allowed Merleau-Ponty to argue that some spatial level exists (according to which things seen count as vertical or deviated from verticality) in our habitual sensorimotor interactions that can be, nonetheless, altered if we modify the usual sensorimotor correlations. However, these experiments also show that new levels can be established despite these changes, and, more importantly, these changes are not arbitrary. The anchorage points and the whole structure of the original level are transposed into the new level. Consequently, it seems that the visual structure, constituted by levels grounded on sensorimotor interactions, is a formal structure that can be transposed into another level structure, just as when we transpose a melody from one tonality into another (cf. Merleau-Ponty 1963, 87).

If this interpretation is correct, it means that perceptual norms are not intrinsic to the specific conditions of sensorimotor correlations, as ecological laws predict. The sensorimotor loop is altered, but the same form is perceived. From a phenomenological standpoint, this can be explained by the fact that our perceptions are based on anticipations of potentialities for motor actions, which are themselves grounded on the sensorimotor habits previously acquired by the perceiver. This amounts to saying that bodily habits constitute the body schema (*PhP*). These habits are correlated to the motor significations perceived in the environment as anticipations and motivations for motor action. Therefore, when a level is forced to shift into another level by changes induced in the sensorimotor loops, the body tries to use its habitual sensorimotor coordination but is forced to reorganize it according to the new circumstances. Since it is possible to find similar anchorage points in the emergent sensorimotor dynamic, the habitual form can indeed be transposed into the new level.

Merleau-Ponty offers a less dramatic change of a level by describing what happens when an organist plays in a new keyboard (*PhP*, 146-147). The structure of the new keyboard makes sense thanks to the interactional structure previously acquired with the habitual keyboard. Initially, the disparities between the anticipations of the body and the current conditions of the environment provoke readjustments in the action-perception cycle. However, after an hour or so, the organist assimilates the new conditions, establishing a new level.

One of the crucial aspects of this description of levels is that perceptual norms have an open-ended character, exhibited by the examples above. This open-ended character of norms also seems necessary to explain why the interactions between the body and the environment constantly remain open to readjustments that nonetheless follow predictable paths inherent to the normative frameworks (levels) previously enacted. The description of levels is ultimately a description of an endogenous developmental process of the sensorimotor coupling of an agent and the environment. This process entails reconfiguring the already existent normativities that result from resolving a conflict between the body and the world, having both a normative status. The new keyboard is not a senseless aspect of the environment for the piano master; it is a level that has a non-coincidence with her bodily habits. It is a level because the pianist's hands recognize the piano structure. However, the body needs to alter its sensorimotor norms to grasp it more thoroughly and make sense more adequately, as in Stratton's experiments.

Spatial levels can offer a new path for interpreting Gibson's notion of ecological information. The invariants that structure the visual field are ultimately the anchorage points of a level that enables the perception of more complex affordances. Ecological information does not consist of intrinsic structures or mere correlations between raw movement and sensory feedback. Instead, they are best understood as more primitive forms of affordances correlated to more basic motor skills. This is like acquiring new bodily skills, as when we begin to play soccer, based on older already acquired skills such as running and kicking.

The notion of levels also reveals that the past of the body-world entanglement constitutes every cognitive act. The past becomes invisible in our sensorimotor habits (body schema) and in the anchorage points of orientation that constitute the sense of an experience (cf. Merleau-Ponty 2011, 143-144). This invisible past becomes visible in the perceptual field but as a resumption (*reprise*) or a re-enactment born in the disparity between the habitual and the unexpected (see figure 7).

This role of the past in the constitution of sense-making norms can raise some further questions about its influence on the constitution of a concrete autonomous system. Such a question should lead us to embed the dynamics of the development of individuals in a dynamic of transgenerational lineages or in a natural and cultural history that transcends any singular individuality.

The next and last chapter will delve deeper into how levels imply norms of places and how the development of these norms more properly describes sense-making. This will lead me to consider the embedded nature of agents in their social and natural history, one that is always shared with other agents and that constructs the tangled web of the world we inhabit.

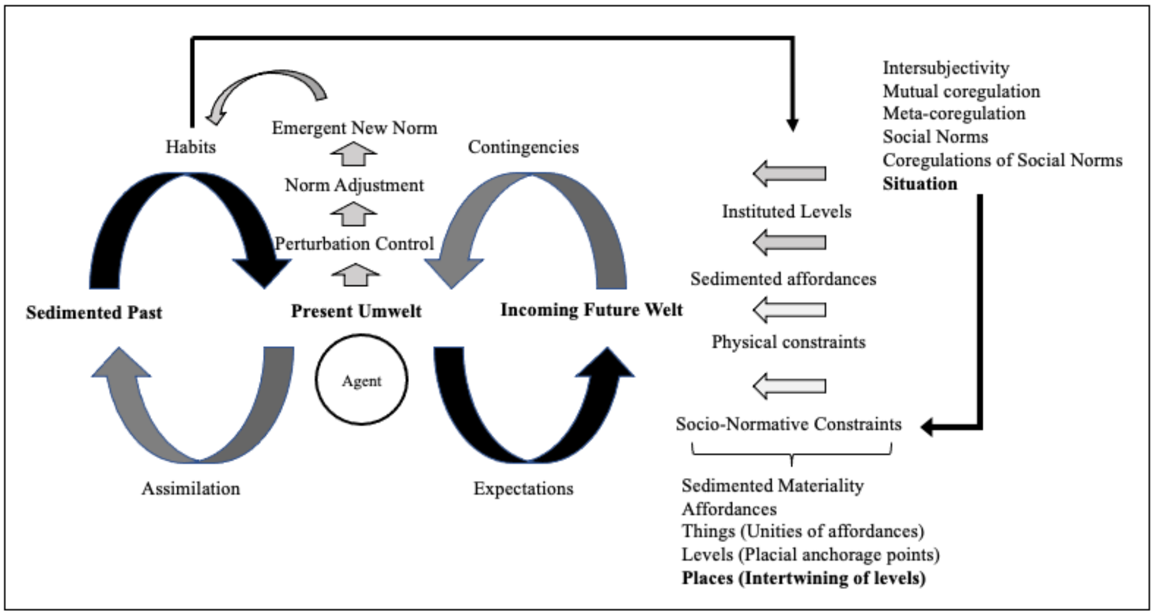

Figure 7. – The temporally nature of the active environment

The lived environment or the present Umwelt is motivated by the disparity of anticipations constituted in the past of the body-world entanglement, sedimented in the body (habits) and the environment (ex-corporations), and the current conditions of the environment. This encounter can produce perturbations that are usually handled by agents' skills. If the perturbation is more substantial, it leads to a readjustment of the existing norms of interaction. Piagetian processes of assimilation and accommodation can explain these phenomena. Occasionally, the disparity is even more significant, and new norms are enacted owing to the past-present encounter. This chapter argued that the agent-environment encounter does not involve only physical but also normative constraints. These constraints can be primitive levels of affordances, intercorporeal coordination with others, and proper sociocultural norms. The intersubjective dimension of this encounter will be more appropriately addressed in the next chapter.

Chapter 5 – Sense-Making as Place-Norms: Inhabiting the World with Others

In the previous chapters, I have claimed that sense-making consists of norm development. This means that sense-making involves the reconfiguration of the already existing normative domain of the body-world entanglement. This entanglement implies that an agent and the environment are never totally alien to each other. Instead, they are always connected by norms of interaction enacted in the history of the agent-environment coupled system. However, the body-world entanglement does not mean that the agent and the environment are totally fused or fully coordinated. There is always a disparity between the norms already enacted at the core of the agent-environment system and the new circumstances of the world that challenge the agent's expectations. In this picture, the environment is not a purely physical realm that acquires meaning due to the activity of agents; instead, it is a normative force that remains in constant tension with them. This tension is what motivates the ongoing self-transformation of the body-world entanglement.

This chapter aims to improve our understanding of the self-transformative movement of the body-world entanglement through the enactment of norms of sense-making from within the situatedness of agents. I conceptualize this situatedness as *enactive place* or simply *place*. However, this conception of situatedness is part of my effort throughout the thesis to emphasize that the agency and autonomy that autonomist enactivists describe is insufficient to explain sense-making. As I will show, place is a concept that enhances our understanding of norm development (chap.3) and the active role of the environment (chap.4) in sense-making. Place gives a name to the metastability of the interactional field that gathers the multiple aspects that constitute a situation, and it is within this situatedness, or within the emplacement of agents, that sense-making really occurs. Therefore, this chapter argues that sense-making essentially consists of enacting of norms of place or *place-norms*.

In support of this claim, I will first define the central characteristics of place from an enactive perspective (5.1). Following Edward Casey's historical analysis of place, I will argue that the constitution of place cannot be found in blind causal mechanisms occurring in a subject-independent world, nor in the activity of a subject's disembodied mind (5.1.1). Place is rather constituted by the bodily actions of multiple agents and the materiality of local environments, entangled in an ecological web that unfolds in time as a systemic unity (5.1.2). Phenomenological descriptions support this definition of place in Casey's work, but it also has significant coincidences with the non-foundationalist principles of autonomist enactivism.

To illustrate the concept of an enactive place, I will use as an example the Mexican *Chinampas*. These are raised fields built in lakes and marshes, initially created by the Mesoamerican population in the Basin of Mexico for farming and inhabiting the lacustrine environment of this region. *Chinampas* –I will show- possess characteristics that exhibit more explicitly than other places the ecological and dynamical relations at multiple levels of entanglement between agents and the environment. The dynamic and metastable characterizations of place drive us to conclude that the constitutional force of place is a *situated normativity.* This normativity gathers altogether an individual living agent with others and with non-living things around coordinated actions with different levels of normativity (5.1.3).

To build a definition of situated normativity proper to an enactivist account of place, I will first consider situated normativity as advised by the skilled intentionality framework. This notion names the set of norms that guide the action and perception of human agents in sociocultural practices and emphasizes that such norms are sedimented in the local materiality of sociocultural places (5.2.1). For this concept to be helpful to an enactivist account of place, however, it must still be refined. This is mainly because the skilled intentionality framework neglects the participation of agents in the constitution of situational norms (5.2.2). This contradicts the evidence I have offered in favour of the thesis of norm development (5.2.3). I will therefore suggest that, for an enactive account of situated normativity, we need first an enactive account of social norms.

We can find an enactive approach to social norms in the latest works of autonomist enactivism, which can help us understand the enactive processes that constitute situated normativity (5.3.1). An enactive account of this normativity must nonetheless include processes of sedimentation and self-transformation in the local materiality of agents. These processes have been neglected by autonomist enactivism (McGann 2014a). Place norms, contrary to bare enactive social norms, must then acknowledge the entanglement of normativity and materiality in the transformative processes of norm development. It is the joint movement of norms and material structures that properly designates place-norms. By this account and as Casey (1998) suggests, place constitutes the fundamental matrix of sense, and consequently, for my analysis, one necessary condition for sense-making (5.3.2).

My arguments for an enactive account of place are primarily founded on characteristics of sociocultural places. Nevertheless, I think it is possible to find similar characteristics and processes in natural or pre-cultural places. A situated normativity of nature exists in places that we commonly refer to as ecological niches (5.3.3). These niches can entangle human and non-human agents into the same ecological-enactive web that continuously evolves as a resilient unity, as it is showed in the example of *chinampas*. However, this argument does not ignore significant differences between the sociocultural and the pre-cultural bodily interactions of agents that both autonomist enactivism and phenomenology recognize. I will briefly mention some of them at the end of the chapter (5.3.4).

5.1 An Enactive Theory of Place

In previous chapters, we have already seen that from the perspective of autonomist enactivism, our common-sense conceptions of the environment, as a subject-independent domain, are not adequate to describe the proximate surroundings of living agents. We have also seen that a twofold meaning of the term 'environment,' as both *Umwelt* (the subject's relative meaningful world) and *Umgebung* (the physical surroundings), was needed to understand life and cognition from the first and the third-person perspective respectively. This section introduces another aspect to describe the immediate environment of living agents that I call *enactive place*, or simply *place*.

The enactive place is neither *Umwelt* nor *Umgebung* because the description of place, we are reaching for, aims to overcome any traditional dichotomy, including that between the first and third-person modes of experience. In its communion with the living body, place is the original matrix of sense, and when these two are together, they constitute the most concrete description of what I have called the body-world entanglement. For a basic definition of place as enactive, I appeal to Casey's phenomenological descriptions of place. These descriptions reveal that place, from a phenomenological perspective, has no absolute foundations. Rather, place is part of the complex normative field that living agents enact in the temporal unfolding of their interactions with local surroundings.

5.1.1 From Space to Place

In his analysis of the history of Western thought, Casey (*SpPlc*; Casey 1998) distinguished between modern, premodern, and postmodern characterizations of place. From a phenomenological standpoint, Casey argued that the premodern and postmodern characterizations more accurately define the local spaces we inhabit. They can also guide us to a more profound philosophical account of bodily existence than the modern characterization. Here, I will refer to the modern characterization of place as the absolutist theory of place, denoting the premodern and postmodern as part of an enactive theory of place. In doing so, I go beyond Casey while still drawing from his thought, all the while pointing to certain resonances with issues of enaction that I have traced from the beginning of this work.[49]

These two theories, absolutist versus enactive theories of place, are in radical opposition. Whereas the absolutist theory assumes that a general and highly abstract notion of space is a precondition (substantial or formal) for the existence of place, the enactive theory holds that place has primacy over any general conception of space (and time). The absolutist theory of place tends to coincide with the usual views of scientists and philosophers, inasmuch as they adopt what Husserl called the natural and the naturalistic attitudes of experience. However, an enactive theory of place coincides with definitions proper to a phenomenological (although not necessarily a transcendental) attitude.

In our natural attitude, we usually talk about places as delimited spatial areas where objects, people, and narrower spatial areas are localized and contained. In each room of my apartment, for instance, objects and people are occupying a spatial area. However, these rooms are contained within the outer spatial boundaries of the apartment (i.e., the walls, the floor, windows, and the celling). The apartment is at once part of a building that is located in a block of buildings. We may continue to describe wider spatial regions that contain this block, this neighbourhood, this city, or even the entire planet Earth. If we think more widely, we can imagine that a bigger spatial container for our

[49] This proposal also regards to suggestions by figures such as Gallagher (*EnInt*) that enactivism requires a new philosophy of nature, we can, in effect, find this via Casey's insight into place as an insight into a sort of field of normativity in nature.

planet is needed. We may therefore conclude that the universe is the largest spatial container for any physical object. This intuitive conception of place as a spatial container comes close to that given by Aristotle (cf. Casey 1998, 50-64).

Seen from the point of view of the naturalistic attitude of modern science, place, as a subregion of space, is less concrete than a spatial container, while at the same time founded on the abstract characterization of space as an absolute dimension. For instance, Newton's (1999) classical physics describes space and time as absolute dimensions where all physical events such as the motion of substantial objects occur. Space, for Newton, is just the setting or the background of all physical events, but one that remains independent of these phenomena (*SpPlc*). Therefore, in this context, place is a specific region of absolute space and seems more concrete because it contains both objects and events, but as a mere spatial portion of an absolute dimension, places remain pieces of the abstract void (cf. Casey 1998, 147).

Newton's characterization of space and time as absolute dimensions prompted Kant to understand that space and time are not phenomena that can be experienced but the conditions of possibility for experience itself. That is, space and time are transcendental manifolds of intuition instead of dimensions of nature as such (Kant 1998). As subjective categories, space and time work once again as absolute foundations, but this time for experience and consciousness, for possessing a world of sense and meaning (Casey 1998). For both Newton and Kant, space and time are the ultimate and absolute foundations of the world of nature. They logically precede any concrete event or the existence of any physical object we perceive. Therefore, place is secondary and only possible thanks to the abstractions of space and time.

As we have seen in previous chapters, both autonomist enactivism and phenomenology have rejected the claims of modern philosophers and scientists that see cognition and consciousness as having absolute foundations, like that of the subject-independent world or, similarly, the transcendental constitutive mind. These lines of thought hypothesize that either substances or formal structures ground the appearance of any phenomena we experience. However, we have seen that such hypotheses are often based on mere theoretical constructions and naïve presuppositions rather than on observation and analysis of what experience shows.

Like the anthropologist and the phenomenologist, the enactivist should become immersed in the world to disclose how things show themselves to our different modes of experience. This is contrary to the methodology of the classical sciences of nature that isolate phenomena in a lab or in abstract scenarios where things can show themselves in an altogether different manner (cf. Hutchins 1995; Smolin 2013). Although these scientific methods can be helpful for specific purposes, the same methods can obscure our comprehension of phenomena such as place. From our alternative perspective, we can follow Casey's conclusion that place is primordial and that existentially precedes the general regions of space and time (*SpPlc*). The following subsection surveys the most relevant characteristics of place and its constitutive norms.

5.1.2 An Enactive Description of Place

It is not easy to define place because place, from this perspective, implies a complex interrelation between parts and wholes, or between the objects situated in place and the place where these objects are situated (Malpas 2004). This prevents us from carrying out a clear-cut differentiation between matter and form, two aspects traditionally held as separate in conceptual analyses but that converge in the concreteness of place. Therefore, one of the main characteristics of place, from a phenomenological perspective, is that place is a unity or a whole that cannot be defined independently of the parts that constitute it (cf. Morris 2018), like in the interpretation of place as a container of things. At the same time, however, the definition of place cannot be arrived at by the sum of its parts because its materiality does not exhaust its definition (cf. *SpPlc*). The constitution of a place rather depends on the already established normative field of interactions between multiple agents and the sedimented materiality of the local environment (cf. Casey 1998, 206, 207; see also McGann 2014a). For example, let us look at the traditional raised fields in the Valley of Mexico called *Chinampas.*[50]

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[50] Although less visible and thick, all sort of places should possess characteristics similar to those I will describe in the *Chinampas* example. Our contemporary cities, buildings, and houses, for instance, also have a temporal unfolding that entangles with the history of interactions of human and non-human populations (cf. Norman 2013). However, I think that *Chinampa*s show more evidently the ecological and dynamical relations of a place, because, in *Chinampas*, human agents aim on purpose to sustain the ecological balance

Chinampas are beds of earth and mould surrounded by hedges and sticks. They are part of a technique of Mesoamerican agriculture to form solid surfaces above the water of lakes and marshes (Frederick 2007).[51] Although these surfaces were made initially to cultivate crops and flowers, they have also served as grounds for houses and buildings (de Ruiz 1973; Calnek 1972). A significant aspect of the *chinampas,* for our discussion, is that *chinampas* constitute a highly visible web of ecological interrelations at multiple levels of agent-environment interactions (i.e., biological, sensorimotor, cultural interactions) (Gliessman, Garcia, and Amador 1981; Torres-Lima, Canabal-Cristiani, and Burela-Rueda 1994; Eakin et al. 2019).

Chinampas are places that their material constitution cannot fully define. The sum of the land, the human and non-human agents, and the material resources provided by nature and culture, both inside and outside of the *chinampa,* do not exhaust its definition or fully explain its unity. Instead, we must look to the emergent interdependence of multiple agents in relatively coordinated cycles of action, an interdependence that entangles a community of agents and material resources in a shared history, to define place more properly (see *SpPlc*; Casey 1998).[52]

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of place, and their way of life is significantly guided by this purpose. It is also important to note that places are not only places of dwelling in a literal meaning. The example of *Chinampas* is very concrete thanks to their materiality. Nonetheless, there are –in my view- enactive places that can be more virtual and metaphoric. Merleau-Ponty (*PhP*), for instance, described the emergence of a musical dimension of space when skilled musicians play. This musical space can play the role of a more virtual structure that helps agents to share a communal ground for habitual patterns of interaction (e.g., by dancing). Only those agents familiarized with this musical place can inhabit the virtual space and smoothly interact with others *in* it. The case of social media is another interesting case to explore more virtual types of places.

[51] The name *chinampas*, means in Nahuatl (Mexicas' language) surrounded by canes and hedges (*chinánitl*) and above the surface of water (*pan*) (Frederick 2007, 110).

[52] This sort of description of place resonates the proposals of ecopoiesis or the constitution of unities of co-evolution that resemble the autonomous unity of an autopoietic system (see e.g., *MndLf*, 118-122). Although there is evidence in favour of a theory of ecopoiesis, it is still highly controversial, and we need further argumentation to support it. Since this subject is out of the scope of my thesis, I chose the notion of enactive place to describe the ecological unity of localities that nonetheless can later connect with a theory of

The human intentions to build *chinampas* are certainly indispensable in determining the ecological entanglement of *chinampas*. However, other living agents and the sedimented materiality of *chinampas* are also active participants in their ecological constitution. Animals and plants motivate and constrain the action of humans and co-participate in the construction of the material landscape of the *chinampa*. Non-human agents not only alter the environment, as when they contribute to the chemical composition of the land, they also interact in a coordinated way with humans to build the shape of *chinampas.* For example, certain kinds of animals nourish from the *chinampa* crops and provoke farmers or *Chinamperos* to cultivate flowers and crops that serve to attract these animals (Gliessman, Garcia, and Amador 1981, 182).

The entanglement of culture (as a human bodily practice) and nature (as the organic life of *chinampas*) is not unfamiliar to the more intuitive perception of *Chinamperos* (Cox, Martins, and González 2020). They are highly sensitive to the problems caused by disease and lack of fertility in the earth or the contamination in lake's waters. This is undoubtedly the case for the few *chinampas* that still float on the lake of Xochimilco, south of Mexico City (Eakin et al. 2019).

A second relevant aspect of place is that it consistently exceeds its boundaries (*SpPlc*, 42). For instance, we can say that the spatial limits of *chinampas* are the canals that surround them, but processes happening inside these boundaries often depend on processes happening outside. For instance, as fields of cultivation, *chinampas* do not depend directly on rainfall. However, the water from the lakes surrounding chinampas is needed to provide the organic matter and minerals for cultivation (Torres-Lima, Canabal-Cristiani, and Burela-Rueda 1994). The sticks and hedges employed to surround *chinampas* are also found in the milieu of the lake or within other *chinampas*. *Chinamperos* also plant a particular type of tree found in the local environment, called the *Ahuejote*, which gives more stability to the ground of the *chinampa* (Torres-Lima, Canabal-Cristiani, and Burela-Rueda 1994). Therefore, the construction and self-maintenance of *chinampas depend* on the resources found within *chinampas* themselves and in their local environment. These

ecopoiesis. We can also relate this definition of place to the niche construction theory (Laland, Odling-Smee, and Feldman 2000). Although this theory provides significant evidence and arguments for a theory of enactive place, there are certain shortcomings that need to be addressed before. I will mention this issue later in section 5.2.3.

constitutional aspects of *chinampas* are not merely local. In fact, agents that participate in the living processes of *chinampas* arrive seasonally from far distances. These agents include birds that migrate from North America in winter, thus transforming the cycles of interaction within *chinampas* every season and contributing to maintaining the ecological balance in the lake (Merlín-Uribe et al. 2013). Therefore, we can say that *chinampas* constitute an *existential unity* because the establishment of its specific way of life entangles participants and material structures in an ecological web (see, e.g., Crossley 2004; Eakin et al. 2019).

In the same way that the permeability of place allows the local environment to affect it, a place may also contribute to the constitution of the local environment (Calnek 1972). This back-and-forth entails cycles of reciprocal causality that reveal the relational constitution of one place in relation to others,[53] as described by Casey (*SpPlc*) from a phenomenological perspective. When Mexicas or Aztecs made use of the construction of *chinampas* to build their entire city, for instance, thousands of houses and prominent pyramidal temples such as the *Templo Mayor* were built on the grounds of *chinampas* (Aveni, Calnek, and Hartung 1988). This constituted a significant transformation of the regional landscape, as well as of the historical development of the *chinampas* environment, ending in the current constitution of Mexico City.

The permeability of place is therefore not simply material, as this sketch of the ecological interdependence of *chinampas* and lake reveals. The permeability of place also concerns dynamic and transformative aspects. For instance, the change of one aspect of place can drive a transformational shift of place itself, as seen in the movement of *chinampas* into a whole city. We can say that place exhibits norm development and *norm envelopment* since it reveals the entanglement of different dimensions and levels of normativity that determine the experience (cf. Morris 2004), the behaviour, and the interaction of agents in places. Similarly, the normativity and materiality of place transcend its immediate temporality as well (*SpPlc*; Casey 1998). The

[53] There is also evidence that human agriculture can alter the phylogenesis of plants and the composition of soils that can lead in exchange to changes in the practice of agriculture (O'Brien and Laland 2012).

materiality of places constantly changes over time, sometimes due to external aspects of the practice that place envelops.

The severe transformation of the environment in the case of Tenochtitlan caused a further transformation of *chinampas* as fields of cultivation. New crops were cultivated in *chinampas* during the colonial period (Torres-Lima, Canabal-Cristiani, and Burela-Rueda 1994). New tools were introduced for the practice of farming. In the twentieth century, most of the few *chinampas* remaining south of Mexico City resorted to growing flowers since they were economically more valued (Narchi and Cristiani 2015). Due to the economic pressures and the degeneration of the lake ecosystem, *chinamperos* are increasingly changing their modes of existence as well. They often become part-time farmers because they must work at urban occupations to maintain a minimal economic income. This fact is breaking the relation of farmers with the land, and new generations are leaving the *chinampas* (Narchi and Cristiani 2015), sometimes choosing to build houses there instead of agricultural fields. This is, of course, causing a new ecological disequilibrium in the lake region (Charli-Joseph et al. 2018).

The transformation of a place such as a *chinampas,* one that yet resists dramatic change at multiple levels of interaction in the environmental region, underlines the *resilience* of places and the constitutive force of their unity (see Barker 2017). The supporters of niche construction theory (Laland, Odling-Smee, and Feldman 2000) have suggested that ecological niches. such as *chinampas* environment, are the fundamental unit of evolution, and not merely genes (Dawkins 2006) or organisms (Lewontin 1983). Although this claim may be exaggerated, as it ignores the autonomy of biological processes happening in species, groups, and individual organisms, it rightly points to the entanglement of organisms with the local environment and their co-determination from an external point of view. This causal co-determination of ecological niches resonates with the experiential co-determination of place. Individuals are normatively attached to the active life of their surroundings and to the material structures that constitute this life. They exhibit a peculiar sensitivity and a behavioural dependency to the structures of place (cf. Heft 2018). Place is, therefore, a dynamical unity that is in constant self-transformation, materially and normatively, and it is the result of both internal and external factors.

In sum, places are temporally open-ended units, permeable, and flexible in many ways. However, they incarnate the stability of the bodily practices of our lives as individuals, as cultural groups, and I will argue in 5.3.3, as natural species. Things in the world can be replaced or disappear, while the identity of places remains, not unlike how our bodies replace their material components while preserving a fundamental kind of organization. As with the case of the living body, the identity of place is not intrinsic to its material structure. Instead, it is the normative structure that makes a place what it is, and to fully understand this, we must be aware of the entanglement of situations and place.

5.1.3 Place and Levels of Situated Normativity

In Casey's account of place, here illustrated by the example of *chinampas*, we have seen that the unity of a place does not simply depend on criteria we impose from our external observations.[54] There is instead an internal web of ecological relations that constitutes a resilient system, one that evolves over time in relation to internal and external components, as well as to other places that surround and envelop its systemic unity. Earlier, I said that the unity of place is existential because such a unity entangles different levels of normativity in close coordination but also in tension and thereby constitutes a particular way of life. This way of life gives a particular *style* to the locality and its inhabitants (*SpPlc*), not so different from the self-organization of the body that gives a particular style to our movements (cf. *PhP*, 329). This existential unity of a local environment more properly defines a place and characterizes the whole set of normative constraints and affective motivations that trigger the self-transformation of an agent-environment system (see table 4). As experienced from the inside (i.e., as an inhabitant of place), the unity of a place is determined by the sense of the situations that occur in place. These situations are not mere events or causal

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[54] This affirmation does not exclude the fact that the unity of place still implies our focus on a particular phenomenon. From a systemic point of view, we can observe systemic unities at some scale of observation and conceive them as partially independent unities. However, from another scale, we can see them differently. For instance, when we observe at cells as autonomous systems, we can also see them as components of another autonomous system, e.g., the nervous system, or the sensorimotor system of a multicellular organism.

processes; they have a meaning that is experienced only by those that inhabit a place. Situations and places are thus deeply entangled (Casey 2000, 184; see also McGann 2014a; McGann 2014b). Situations significantly determine the being of place, and the being of the situations must be embodied in place.

Chinampas as Place	
Way of Life of Chinamperos Existential Unity : Nature-Culture Intertwining	
Body-world entanglement	**Ecological Intertwining**
• Bodily Habits: nourishing, farming, commercializing • Perception: discrimination of edible crops, plagues, and weather; sensitivity to the conditions of the land and the lake • Cognition: strategies for farming and commercialization, creating new places like houses and cities • Human intersubjectivity: teaching and learning skills, ecological ethics, nourishing habits • Interanimality: Axolotl, birds, plagues • Niche Construction: Ahuehotes, lake mould, rain Fall	**Natural** • Bird migrations from North America • Water provided by mountains and rainfall • Ecological unbalance due to urbanization **Cultural** • Political pressures like wars and invasions • Economical pressures: decreasing value of crops in the market, emergent jobs opportunity • Technological changes: new tools and pesticides. • Cultural Pressures: new cultural archetypes

Table 4. – Chinampas as Place

This table summarizes the main features of Chinampas as an existential unity or as Place.

Although situations are necessarily emplaced, it does not follow that place and situation can simply be identified with one another. The field of relevant aspects in the environment determined by a situation does not exhaust all the richness of place. Place is sedimented by different levels of normativity, enacted in the history of an agent-environment system. Some of these levels may not appear relevant for a current situation and may remain in the background. However, they still function as horizonal aspects of that situation. For instance, a room located in the philosophy department and where seminars *take place* can also be used for a cocktail party. In this situation, relevant aspects of the room as a classroom disappear, and new aspects appear instead. My behaviour and that of my colleagues changes as a result. We may talk and laugh louder, joke, drink wine and beer, and listen to music. I can no longer read or take notes, while discussions of philosophical matters have different nuances and rules. We can say that many norms of action and perception have changed with the shift of the situational context of the room.[55]

Despite the changes of these two situations, there are normative layers of the room that persist and give us perceptual clues about more general aspects of the room. This is the case with the flatness of the floor I walk over, the colour of the walls, or the illumination provided by the lamps of this room. There are also endless external horizons of the room. For example, I need to climb three flights of stairs to get to the room, regardless of its activity. Even if I do not know the number of the room, or if I do not have a name for the room, I can perceptually recognize the room as the same in different situations thanks to external horizons that envelop it as a place. This constancy of place is, in my view, due to the different levels of generality of the norms of action and perception. While some norms pertain to more specific aspects of a bodily practice that can change with the situational contexts of places, other norms are more general and give to places their more persistent identity.

There is another aspect of place that exceeds situations. As a metastable structure, place embodies the recurrent dynamics of interaction between agents and the environment. However, this structure is labile and suffers transformations not necessarily determined by the purposeful intentions of agents or by the recurrent dynamics of the metastable structure. It is possible to find in places new configurations due to internal or external disturbances that may transform the bodily practices of agents, along with the interrelation of these agents with the environment. For example, urban development in our contemporary cities can be planned by governments and social organizations, but traditionally this development occurred due to changes in societies and their practices that gave a new shape to places. Here, it is evident that the transformation of such places may lead to the development of new practices. For example, the lake environment and the practical knowledge of

[55] The supporters of the skilled intentionality framework refer to these changes as changes in the set of *relevant affordances* (solicitations), while the available affordances in the same place but not currently relevant are part of the *landscape of affordances* (see 5.2.1).

the people inhabiting the basin of Mexico allowed ancient Mexicas to build an entire city in the middle of a lake (Morehart and Frederick 2014). The appropriation by Mexicas of this place involved adapting agents to the environment, thereby transforming their own way of life.

Consequently, the unity of place is significantly determined by the situations occurring in a place, but it is not exhausted by them. The unity of place has different levels of normativity, and it is the interweaving between the different levels of normativity that designates the concrete unity of place. The actual activity of living agents and their interaction with living and nonliving beings in a particular environment contains all the multiple aspects that constitute a place (*SpPlc*). Therefore, the gathering force of place is expressed in the networks of normativities that constitute a place and entangle multiple horizons of experience in a specific but permeable or partially unbounded location. Given this, we will need to understand the norms that constitute place in more detail.

5.2 Ecological Situated Normativity and Norm Attunement

Roger Barker was an ecological psychologist who studied how social environments influence the behaviour of human beings. Barker (1968) and his team studied the behaviour of people in a small town in the Midwest United States. In this study, the team expected to find regular patterns of behaviour in individuals across different social places. They were surprised to learn that individuals showed less regularity in their behaviour in different places than different people showed in the same place. In the drug store, the park, and the public plaza, different people behaved similarly. On the contrary, the same individuals behaved differently in all these different places. Barker concluded that sociocultural environments were a determining factor for explaining the social behaviour of people. Barker (1968) called these social places *behaviour settings.*[56]

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[56] The relation between the theory of behaviour settings and an enactivist account of place has been already suggested by McGann (2014a). He acknowledges that such settings involve a new set of constraints for sociocultural practices of individuals and that the constitution of places involves the active engagement of the participants. He lacks however a deeper examination of the normative field of places and their dynamic self-transformation. This can be better done – I think- thanks to my redefinition of sense-making as norm

The relation between patterns of behaviour and a specific material environment can be put in terms of what the more contemporary ecological approach of the skilled intentionality framework calls situated normativity (5.2.1). This normativity involves explicit and implicit social conventions that rule the interactions between people and between people and the material environment. According to the supporters of this ecological approach, agents' bodies become affectively attuned to the sociocultural norms of practices thanks to what they call skilled intentionality (5.2.2). I will describe this intentionality as a process of norm attunement and argue that it is problematic and less viable than the processes of norm enactment entailed by sense-making (5.2.3).

5.2.1 Situated Normativity

The skilled intentionality framework coined the notion of situated normativity. It is derived from the analysis that Wittgenstein made in his *Philosophical Investigations* (2009) and *Lectures of Aesthetics* (2007) of the lived experience of subjects while performing sociocultural practices. Agents like tailors and architects have a feeling of discomfort and discontent if they find the conditions of their practices unsatisfactory. If they have enough expertise, they can be moved to take a specific action that improves these conditions (*EcEvAf*). This experience of discomfort and the action itself can happen with or without the agent's conscious reflection (Rietveld 2008). Skillful agent's sensitivity to the contextual demands of the practice reveals that their bodies are already attuned to the normative framework of that practice. For the skilled intentionality framework and Wittgenstein, this framework is not individual or private but social and public (*EcEvAf*). Sociocultural practices have standards that are explicitly or tacitly accepted by the community to which participants of these practices belong. Thus, feelings of dissatisfaction and solicitations of action are grounded on public standards. This analysis led scholars adhering to the skilled intentionality framework to adopt the idea that situated normativity does not refer to norms enacted by individuals but to norms that rule the habitual patterns of bodily practices of a sociocultural group (see also 4.3.3). After Wittgenstein, these patterns were called a *form of life* (Rietveld and Kiverstein 2014; *EcEvAf*).

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development, the environment as an active normative field, and a phenomenologically informed description of place such as Casey's.

A form of life is entangled with material structures or physical constraints that help to constitute and shape the normative character of certain practices. For this reason, the scholars of the skilled intentionality framework designate the environmental conditions of human practices as a *sociomaterial environment* (van Dijk and Rietveld 2017). The paradigmatic case of a form of life is a human sociocultural group, but the notion of a form of life is not exclusive to human beings. Human and non-human animal forms of life inhabit spatial regions called *ecological niches* (Rietveld and Kiverstein 2014). Again, these niches do not simply refer to the raw material composition of a spatial location but to the entanglement of the materiality and the form of life that inhabit such location. The skilled intentionality framework names this niche a *landscape of affordances* (Rietveld and Kiverstein 2014; *EcEvAf*).

The skilled intentionality framework distinguishes between two different sets of affordances: the first being a *landscape*, and the second, a *field of affordances* (Rietveld and Kiverstein 2014). Whereas a landscape of affordances represents all those affordances available to a given form of life, a field of affordances refers to a subset of this landscape, one composed of affordances deemed relevant to a skillful agent. As Chemero (*RadEmCS*) has argued, it is not enough to have a particular type of body for perceiving affordances; an agent also needs to possess the appropriate bodily *skills* to exploit these affordances just to perceive them (see 4.4.1). Likewise, the practice context makes us see some affordances and not others, thereby setting forth the actions required for the concrete happening of a situation. A field of affordances can thus be seen as a domain (or set) of *solicitations* that move an agent to act in a bodily practice (*EcEvAf*).

In sum, whereas a field of affordances is concrete and subject-relative, a landscape is abstract and subject-independent. In the case of non-human animals, an ecological niche is the relation between the patterns of behaviour of a species and the material conditions of their environment. In the case of humans, the ecological niche is the relation of patterns of behaviour of a sociocultural group that is embedded in a material environment. In both cases, the normative framework of practices (the landscape) is defined in reference to a group of individuals and not to individuals themselves; these only become attuned to the pre-given frameworks, thereby perceiving a field of affordances in the environment around them (*EcEvAf*).

We can now better appreciate the relation between the concepts of behaviour settings and situated normativity. The ecological niche of a natural form of life, including us, is tantamount to all the potential affordances that our natural species can exploit. As a sociocultural domain, a behaviour setting constrains the number of available affordances for human agents because the situated normativity of that setting imposes a new layer of constraints on the affordances of the natural environment. Following the community's standards, agents limit the number of their possible actions and the correspondent affordances (Bruineberg, Chemero, and Rietveld 2018). In the example of *chinampas*, we see it affords multiple actions for human and non-human animals. As a behaviour setting, *chinampas* has a more reduced number of affordances available than as an ecological niche, e.g., inhabiting instead of cultivating *chinampas*.

5.2.2 Skilled Intentionality

The skilled intentionality framework explains the acquisition of norms of action and perception by individual agents as the result of a process of attunement with the environment. This is called *skilled intentionality* (Bruineberg and Rietveld 2014). This concept has two sources for its definition: Merleau-Ponty's (*PhP*) phenomenological description of the maximum or *optimal grip* and Friston's (2010) theory of the free-energy principle.

Phenomenologically, skilled intentionality is the tendency of the body and the environment to reach for an optimal equilibrium in any practical situation (Bruineberg and Rietveld 2014). This optimal equilibrium can reveal perceptual objects at a maximum of visibility and solicit actions from our bodies to reach such a maximum (*PhP*, 315-316; Dreyfus 2002).

According to the skilled intentionality framework, the notion of the optimal grip designates the set of conditions that are deemed best for perceptually disclosing the affordances of an object or exploiting these affordances in acting appropriately towards it. Since our actions, as socially enculturated beings, are determined by public standards and not merely by individual goals, our bodies are sensitive to sociocultural norms, i.e., to situated normativity (*EcEvAf*). While the constitution of this optimal grip depends on a subject-independent normative framework, the body can become sensitive to the situated normativity of a practice and respond adequately to its solicitations. The body learns how to attune to the demands of a practice (*EcEvAf*). This process of bodily attunement to normative ecological frameworks is skilled intentionality.

Skilled intentionality has important similarities to sense-making (Kirchhoff and Froese 2017) but significant differences also exist. While skilled intentionality describes a phenomenon of *norm attunement*, sense-making describes one of *norm enactment* (Sepúlveda-Pedro 2020). In the first case, the body attunes its physical structure and behaviour to pre-given and subject-independent normative frameworks. In the second case, the norms are enacted individually or jointly with other agents in the historical development of the agent-environment system.

The naturalization of skilled intentionality follows Friston's account of the free-energy principle (see 1.2.2). This principle offers a statistical and dynamical model for understanding how the brain-body-environment system organizes itself to reduce uncertainty or free energy. Uncertainty causes an organizational disequilibrium in the brain-body-environment system that is affectively felt by cognitive subjects as a bodily tension that needs to be reduced (Bruineberg and Rietveld 2014). The organizational composition of the body and the brain allows subjects to modulate their coupling with the environment to reduce uncertainty. This is possible thanks to a process called active inference. Active inference produces changes in the system that reorganizes the brain and the body, e.g., transforming the subjects' bodily skills and perceptual field. Active inference also produces changes in the organization of the environment through motor action (Bruineberg and Rietveld 2014). Therefore, the tendency to reduce uncertainty, from a dynamical and statistical point of view, can explain the lived affectivity of the body to reach the optimal grip described by Merleau-Ponty (*PhP*). The affective tendency to the optimal grip is the tendency to reach an equilibrium between the internal states of the brain-body-environment system (i.e., the current self-organization of the system) and the external ones (dynamical changes in the landscape of affordances) (*EcEvAf*, 61).

5.2.3 Norm Attunement

Although situated normativity can account for the gathering force of place in behaviour settings, its current ecological analysis possesses at least two problematic aspects. First, situated normativity portrays a set of norms proper to sociocultural practices, but it does not consider the role that participants can play in the constitution of these norms. This role, I will argue, is not only necessary for explaining the origin of social norms (*LngBod*); it can also explain how the body manages to cope with the contingencies of situational contexts that constantly change in bodily practices (Baber, Chemero, and Hall 2019). Second, situated normativity seems to exclude natural places from the type of community-relative and contextual-relative constraints that characterize sociocultural places, suggesting that general ecological laws rule the relation between an isolated agent and the environment (Bruineberg, Chemero, and Rietveld 2018). This, I will argue in 5.3.3, implies an abstraction that falsely presupposes that living organisms can exist in isolation and that norms of behaviour are unaffected by the contingencies of the material contexts that organisms inhabit.

Ecological normative frameworks do not emerge from external processes to the interactional field of the agent-environment system. Whether the interactions of the agent-environment system are between an agent and its physical surroundings, or they include multiple agents, these ecological frameworks originate principally in the interactions taking place at the core of the system. The main features of interactional norms can be seen, from a third-person perspective, as constituted previously to the participation of agents in a practice with a historical tradition. This fact does not mean, however, that agents blindly follow traditional norms or that they merely get attuned to them. The very nature of bodily practices demands from participants creativity, spontaneity, and managing contingencies in the environment. This condition forces agents to transform already established normative frameworks constantly.

The transformation of norms might seem unnoticeable, but every agent must cope with their individual circumstances and adapt her behaviour and bodily organization according to the new situations. Therefore, situated normativity necessarily involves certain stability revealed in patterns of behaviour observable across the community. However, this normativity also entails lability, allowing for the introduction of new members to the community while partially transforming the already established norms.

Chapter four described how jazz musicians manage the contingencies of improvisation by re-enacting habitual patterns of music into a new order that incorporates these contingencies, thereby affording the possibility of creating new habitual patterns (4.3). These patterns can institute new personal and shared styles that change the established normativity of playing jazz. We can see this in the development of music styles in any genre and other arts like painting, literature, sculpture, and architecture. Improvisation and creativity are, however, not exclusive to artistic practices; they are required in all sociocultural practices.

The anthropologist Tim Ingold (2010, 2011) claims that many, if not all, social practices consist of adapting constantly our actions to the unceasing flow of materials and (normative) forces the becoming of the world compels. For Ingold, the paradigmatic example of bodily practices is textile weaving, whereby weavers use available materials to design a unique path of becoming, one that embodies the context of the weavers.

However, it is essential to notice that the dynamic development of norms is not restricted to the sociocultural aspect of the bodily practices. Chapter four described how goldsmiths need to manage the contingencies of the material they handle to give the right form to jewellery (4.3.2). Indeed, the norms that dictate what counts as good jewellery involve a sociocultural normativity. However, the material's resistance to the habitual sensorimotor skills demands adjustments of the body, independently of the social norm. Animals also manage contingencies in their environment, and in their developmental paths, they learn to adapt their bodies and behaviour, thus implementing their vital norms (cf. Oyama 2000). Bodily practices, sociocultural or not, are therefore highly dynamic processes of interaction. For this reason, the situatedness of actions needs to be seen as a highly dynamic field that the analysis offered by the skilled intentionality framework misses.

As we have seen, the skilled intentionality framework recognizes the dynamism of the causal processes that alter the environment materiality, and, consequently, the behaviour and perception of agents. The Bayesian models of the free-energy principle explain the constant adjustment of the statistical space caused by these dynamic causal processes (Bruineberg et al. 2018). However, the concept of skilled intentionality does not explain how the interactional norms we observe in these practices were originated. It does not explain either why some norms and not others were created if the materiality of the environment allows more than one sociomaterial configuration. Even worse, the notion of skilled intentionality does not explain the logic of the self-transformation of interactional norms. At best, the skilled intentionality framework appeals to the capacity of reflective human consciousness to induce changes in the current field of situated normativity (see, e.g., Rietveld, Rietveld, and Martens 2017).

The dynamical account of sense-making as a process of norm enactment, on the contrary, concerns the norm development and norm envelopment of bodily practices. This situates the normativity of agent-environment interactions in a highly dynamical (and conflictive) field. However, it is one with enough stability to sustain regular processes that gives habits, situations, and places their particular style.

As the last chapter argued (4.2.3), the dynamic self-transformation of normative frameworks is not only motivated by the materiality of the environment, but it also involves the tension between different levels of normativity at play in one single action. The enactive theory of sensorimotor habits, for instance, describes how multiple sensorimotor skills self-organize to coordinate the action of the body. However, sensorimotor normativity may become partially independent of biological normativity. This produces a tension between the two normative domains, to the point of becoming opposite tendencies, as in bad habits and addictions (Ramírez-Vizcaya and Froese 2019). Within the networks of sensorimotor habits and schemes, there may also be tensions that produce a discoordination of bodily actions. This happens, for instance, when we learn a new bodily skill and our habitual repertoire of movements is challenged. Learning to swim, for instance, involves, for human adults, a new way to equilibrate their bodies in the water. However, the new bodily equilibrium diverges from the more usual bodily equilibrium when they stand on the ground. In order to learn to swim, a human adult needs to modify her habitual tendency to move her body; only then can she begin to float and progressively acquire new bodily coordination that allows her to dive in water (cf. Cappuccio and Ilundáin-Agurruza 2020).

Situated normativity is a valuable concept for an account of enactive place. It provides accurate descriptions of the normativity that guides the coordination of agents in bodily social practices and the connection of practical norms to the material locality of places. Nonetheless, the current definitions of situated normativity are not appropriate for the theoretical view of autonomist enactivism. From their ecological approach, the supporters of the skilled intentionality framework presuppose the existence of normative frameworks that are independent of the active engagement and participation of agents. This is contrary to evidence we have of the active transformations of norms and the material structures of places that occur due to the active participation of agents. We need an account of situated normativity that acknowledges the dynamic processes happening at the interior of places and practices. We need an account of situated normativity in terms of norm enactment (sense-making) rather than norm attunement (skilled intentionality). Fortunately, recent work by autonomist enactivists on social cognition can help us build an enactivist account of situated normativity.

5.3 Place-Norms as Enactive Situated Normativity

In chapter four (4.1.2), I described participatory sense-making as the type of sense-making that characterizes social coordination between two or more living agents (De Jaegher and Di Paolo 2007). The original model of participatory sense-making has been moved one step forward by autonomist enactivists to describe the emergence of a new form of agency besides that of the biological, sensorimotor, and intercorporeal agencies. This new model embodies the sociocultural normativity that is a fundamental part of linguistic agency (*LngBod*). As such, this model describes the emergence of expressive and linguistic utterances that work as tools for the regulation and co-regulation of bodily actions and interactions between agents. These utterances appear due to dialectical tensions at different stages of metastable processes of interaction and co-regulation between participants of intercorporeal practices. Section 5.3.1 summarizes this model to clarify the dynamic constitution of different levels of social normativity that characterize sociocultural practices from the standpoint of autonomist enactivism.

This enactive account of social norms will help us recognize that social normativity is enactively constituted and not ecologically pregiven, as the descriptions of the skilled intentionality framework suggest. Nonetheless, from the arguments I have been positing in this thesis, it follows that enactive social normativity is also situated (i.e., they are place-norms). The constitution and self-transformation of social normativity (i.e., norm development) also involve the norms enacted in the past of the body-world entanglement (i.e., the habitual body and the active environment), which is sedimented in the spatial localities of agents (i.e., places).

Although my descriptions of place in this thesis have been fundamentally based on sociocultural places and behaviour settings, situated normativity is not a phenomenon exclusive of human culture. In 5.3.2, It is hard to think of any biological agent constituting its realm of interactions with the environment without the intervention of social processes with other agents. There are many processes of social interaction occurring in nature that are intercorporeal and might involve activities of participatory sense-making. They do not reach the complex levels of co-regulation and meta-coregulation of human societies. Still, they count as processes that constitute a shared or communal normative field for multiple organisms and species. Therefore, it seems reasonable to imagine there is a socially situated normativity in nature as well.

Finally, section 5.3.3 shows that although we can claim that situated normativity is at some general level characteristic of all forms of life on Earth, there are significant differences between the enacted normative domains of humans and those of the rest of the living organisms.

5.3.1 The Emergence of Linguistic Bodies

The original model of participatory sense-making already exhibits a permanent tension between two levels of normativity, one relevant to the individual and the other to the social or interactive. In the updated model, this tension remains constant through different stages of conflict (*dissonance*) and harmonization (*synergy*) between the two levels of normativity (*LngBod*, 143). Initially, these tensions force individuals to adjust their sensorimotor norms (sensorimotor regulation), but the adjustment must eventually be carried out jointly (sensorimotor co-regulation), creating genuine *social acts* (*LngBod*, 146). The sensorimotor co-regulation of social interactions eventually produces social acts that help agents to make the coregulatory acts more efficient (*LngBod*, 152). This is a process of meta-coregulation that will be present across the following stages of the model.

The meta-coregulation of social acts implies a new sort of social interaction where a new tension between two different levels of normativity is at play (*LngBod*, 156). On the one hand, there is the normativity of the practice intended initially by the participants. However, there is a second normativity that involves using partial acts to coregulate other partial acts. As with any other social practice, coordination of social acts implies the sedimentation of habitual patterns of interaction and creative improvisation with new patterns necessary for the adaptation to the contingencies of all practices. Therefore, there is a *normativity of social interactions* at play in social practices and a *normativity of social acts* that governs how one participant can use patterns of behaviour to influence the behaviour of other agents (*LngBod*, 157).

The regulatory acts that emerge in concrete interactions are used first locally. Some of these acts can reinforce the interactional links between a closed group with a reduced number of members (*local pragmatics* [*LngBod*, 161]). In contrast, other acts are strongly normative and can regulate acts in a community with a wider number of members. These acts can also be portable among different communities (*portable acts* [*LngBod*, 161]). As the number of portable acts increases in a community, a mutual reinforcement of social acts establishes a network with closure that comprises *a shared world* for the community members. The recurrent use of portable acts produces what autonomist enactivists call *strong normativity* (*LngBod*, 167). This normativity produces an asymmetry in the roles of different members in a social group. Some members take the role of active regulators, and others play the role of passively regulated actors (*LngBod*, 168). The roles of *regulator* and *regulated* are constantly interchangeable, though only if the interaction remains social (an interaction between autonomous agents [*LngBod*, 170]). This interchange of roles of regulator and regulated creates a dialogic dynamic in social interactions. Recognizing the roles of both the active regulators and the passive regulated allows for recognizing others as agents. The member taking the role of the active regulator in a dialogic dynamic makes use of *utterances* (gestural and vocal) to lead and regulate the interaction (*LngBod*, 173). These utterances are intrinsically social since their use depends on the relational complementarity between the producer and the audience.

The efficiency of social acts of co-regulation and meta-coregulation leads agents to the mutual recognition of each other as agents (*LngBod*, 175). This becomes evident in the emergence of a dialogic interaction where the roles of an active regulator and a passive regulated member are interchangeable. At this dialogical level, agents use utterances to regulate social interactions, and there is a progressive construction of dialogical networks of utterances shared by a community in particular contexts of bodily actions. Di Paolo et al. (*LngBod*,178) call these networks *participation genres*.

Participation genres resonate with the notion of microworlds at the sensorimotor level of autonomy. However, in participation genres, the normative structures of interaction involve the networks of dynamic sensorimotor processes and a network of utterances (*LngBod*, 179). These networks are constantly regulated by processes of *mutual interpretation* between multiple participants (*LngBod*, 183). However, these regulations can take the form of self-interpretation when producers of utterances become aware of the impairment between the pragmatic and expressive aspects of her utterances, such as when the utterance does not produce the expected responses in others (*LngBod*, 181). This moment is crucial because the model incorporates a new level of reflective and dialogical dynamics to the intersubjective skills of an agent (*LngBod*, 185, 187). The successful utterances become regular patterns of dialogical practices, either for interactions with other agents or for interactions with themselves. The norms, co-enacted with others and embodied in networks of utterances (participation genres), now play a more explicit role as a tool for self-regulation. Agents incorporate utterances as regulatory tools for their expressive and pragmatic goals. As tools for self-reflection or *self-control*, these new dialogical networks afford the possibility of both questioning and making explicit the already existing normativities that agents can now reshape and move forward in a dialogic manner (*LngBod*, 189).

5.3.2 From Social to Enactive Situated Normativity

Autonomist enactivism has been traditionally criticized by defenders of ecological approaches for being incapable of explaining social normativity. The critique targets their account of vital, sensorimotor, and intercorporeal forms of sense-making, which would exclusively refer to the normative domain of individuals (Heras-Escribano 2016; Heras-Escribano, Noble, and de Pinedo 2013, 2015). In response, autonomist enactivism has developed a theoretical sketch of the emergence of social norms as arising from tensions inherent to the social interactions of autonomous agents. It is possible to recognize in this model how individual agents progressively acquire new regulatory processes that emerge from social interactions. While it is only at the final stages that agents' actions are more explicitly guided by social and public norms, it is since the early stages of participatory sense-making that norms jointly enacted by more than one individual constrain the embodiment of individual agents.

The model of norm attunement of the skilled intentionality framework assumes that ecological normative frameworks are pregiven or constituted by processes external to the bodily interactions of practice participants. The enactive model, by contrast, explains how sociocultural frameworks are constituted by the participation of agents in both local and wider communities of individuals. The participation of agents at the different levels of constitution of shared processes of regulation and co-regulation implies that an internal dynamic tension is always present in sociocultural practices. These tensions can explain the self-transformation of the normative frameworks, not only because of the changes in the materiality of sociocultural environments but also due to the dynamical interactions happening in the "inside" of the sociocultural practices.

Recall the example I gave above of jazz musicians co-enacting musical patterns that institute new personal, group, and genre styles (4.2.2 & 5.2.3).[57] The temporal unfolding of collective jazz improvisation is affected by the process occurring at the interior of the interactional domain between musicians and by the spatial and temporal surroundings of this practice, e.g., the public, the hall, musicians' mood historical events, etc. The interaction determines the sense of the practice. The self-transformation of the practice at different temporal scales is reached thanks to these internal and external dynamics. There is a metastability necessary for the communion of agents in a shared practice and involving different levels of normativity from the biological affectivity of agents to sensorimotor and sociocultural norms.

A careful and detailed analysis between this linguistic model and practices like jazz improvisation remains to be carried out, but. The linguistic theory of autonomist enactivism seems to miss again the environment, which seems to be only in the background of the interactional space of agents and not entangled within the intercorporeal practices. The entanglement of communal interactions and the materiality that flows both out from and inside the interactional space of musicians requires a complex and detailed explanation that exceeds the scope of this thesis. There are, however, already clues as to the potential that autonomist enactivism carries for explaining the role of music creation, learning, and appreciation (Schiavio and Cummins 2015; Schiavio and De Jaegher 2017; Van der Schyff et al. 2018).

[57] Although music is not linguistic as such, it involves expressive communication and processes of creation and expression that have important similarities with language (cf. Cummins 2013).

These are also essential characteristics of the dynamic constitution of place that I have previously shown in the ecological web of *chinampas* (5.1.2). Interaction of agents and nature sediments material and normative structures that constrain and motivate the self-transformation of chinampas, e.g., from agriculture fields to gardens and foundations of imperial cities. The temporal scale and consequently the dynamicity of *chinampas* are different from the jazz musical space. The complexity of *chinampas* also increases since the interactions with non-human agents are also involved in the constitution of these places. However, we can see general affinities in their constitution that help us define places due to dynamic and enactive processes.

Both *chinampas* and collective jazz improvisation are, however, sociocultural places. According to my arguments, autonomist enactivism can explain situated normativity at the sociocultural level. However, it remains unanswered if there is a situated normativity that applies to pre-cultural bodily practices or a sort of situated normativity that can characterize natural places. The following section will address this subject.

5.3.3 Intersubjectivity, Intercorporeality and Interanimality

Ecological approaches recognize the situated normativity involved in sociocultural places. Nevertheless, these approaches usually deny that similar forms of normativity can explain the constitution of the local domains of non-human animals, which they refer to as ecological niches. For ecological approaches, these niches are constituted by genomic and extra-genomic processes of inheritance, where the individual development of agents still seems to be unimportant (e.g., Bruineberg, Chemero, and Rietveld 2018; see also Heras-Escribano and de Pinedo 2018). This vision contrasts with the conception of life supported by autonomist enactivism and with the definition of cognition as sense-making (see 3.3.3). I have argued that the process of norm enactment and sense-making offers a better account of norms of action and perception than the one of norm attunement and skilled intentionality. It remains to see if the process of norm enactment is also a better or at least a viable approach for defining the enactment of a situated normativity in natural places.

The claim that situated normativity exists in natural places can challenge the belief that ecological niches and living agents are constituted by mechanistic processes alone. From a retrospective look and at an evolutionary timescale, mechanistic explanations seem plausible and sufficient for explaining the adaptation of organisms to their niches. Still, we can also hypothesize that such adaptation could involve the creative improvisation of the ancestors of a species and processes of constitution for joint action between multiple agents that co-evolve as phylogenetic groups all along with the resilient unities of place. The proper treatment of this subject requires an independent analysis that confronts traditional conceptions of evolutionary biology and the enactive perspective, based on a conception that focuses on development as the key to understanding life and evolution. In this section, however, I want to show that we have reasons to think that normativity in pre-cultural forms of life and natural places also determines their interactions.

Cummins and De Jesus (2016) have criticized autonomist enactivism for defining life based on agents' autonomy alone. Heras-Escribano, Noble, and de Pinedo (2015) have also questioned whether autonomy can constitute the norms of animal behaviour. According to my redefinition of sense-making as norm development, it should be clear that I am also against the idea that the autonomy of life *alone* can constitute the norms of interaction in an agent-environment system. In contrast to the traditional criticisms on autonomist enactivism, I think that autonomy and agency are constitutive aspects of life, but these must be complemented by an account of the emplacement of agents.

The body-world entanglement transcends both spatially and temporally the history of any agent-environment system because the enactment of norms depends on the presence of already established normative frameworks or levels. Archeologically, we can unearth the past and question what transcends the constitution of an autonomous system and its history of concrete entanglement with the world. We can start by saying that there were other living agents because life, like sense, cannot come from anything. Life implies a variety of reproductive processes or *a transgenerational self-transformation of the body-world entanglement* that makes the birth of new agent-environment systems possible.

There is, therefore, a natural history, one that cannot produce a narrative on its own until beings like us started to make use of symbolic language. There is, however, a temporal connection at the level of life and nature that we can study with the help of contemporary theories of life and evolution (*MndLf*) but reframed by a new philosophy of nature (*EnInt*).

Human history is characterized by social processes that imply significant interactions among different social groups: economic, political, and behavioural. It is common to believe that natural history involves different sorts of temporal processes. These processes concern neutral physical compositions, complex systems like genomes, or cellular and multicellular organisms. From the perspective of autonomist enactivism, I think it is more proper to think that natural history resembles human history. Nature is also inhabited by individuals that participate in societies that constitute natural places and whose participation actively transforms the course of their natural groups, first locally and eventually globally.

Participatory sense-making is the sort of description that can help us to understand the emergence of a situated normativity at the level of nature that is also socially determined. That is, socially constrained behaviour might not be a feature exclusive to human beings.

Ants interact socially and participate in collective actions to maintain the stability of an emergent social system: the anthill (Gordon 1996; see also Stapleton and Froese 2015). There is a distribution of labour in the hill where ants interact to sustain what is sometimes called a superorganism (Canciani, Arnellos, and Moreno 2019). The definition of a superorganism is controversial, but the emplacement of ants' society should not be. The life of individual ants depends on the self-sustaining processes of the collective system. The constitution of the collective system depends on the action of the individual members of the collectivity. The collective ant system is more than its parts since the self-sustaining processes of the system do not depend on each individual in a specific manner (Detrain and Deneubourg 2006). However, the behaviour of individual ants is constrained by the systemic equilibrium of the hill (cf. Anderson and McShea 2001). We still need more evidence, but we might be talking about processes of participatory sense-making at work in the interactions of ants working in a society that an ant colony represents.

Most importantly, the hill as the place of social interaction is central to regulating the collective systems' behaviour. Suppose the hill suffers damage due to natural causes or to human interventions. In that case, ants will behave differently and start self-organizing to reconstruct their society and the place where this society lives. Ants and their habitat are also entangled by a normativity that involves the self-organizing processes of their societies. These processes very likely involve a participatory sense-making of colony individuals.

An anthill and a beehive are just paradigmatic examples of ecological niches that involve processes of niche construction or the active transformation of the material surroundings by living agents, making the entanglement of organisms and the environment more evident. However, sociality and niche construction are common processes of nature (Odling-Smee, Laland, and Feldman 2003; Turner 2009). Ecological niches are, in the end, natural places.

Natural places involve the inter-relational web of living and non-living things in a locality that maintains normative co-regulation processes. These processes do not only involve interaction between members of the same species, like in the case of ants and bees but across different species that maintain a systemic equilibrium in a delimited spatial area or location (Ingold 2011). This area is a place, and like social places, it does not have clear boundaries and depends on processes that transcend the locality of the ecological niches. There are, however, interrelated processes that help for the self-sustaining processes of equilibrium of the niche (cf. Scheffer and van Nes 2006), so we can talk about the same place, like in the case of *chinampas*. The complexity of the constitutional process of this ecological niche is enormous to be more than intuited at this point. However, we can observe the interdependence of species in the interactions that the different organism maintains in the *chinampa'*s niche.

From all that has been said thus far, it should be clear that natural places are not meaningless realms that acquire form or meaning thanks to the organizational interiority of the living body. On the contrary, the enactment of the (minimal) self of the lived body (interiority) and the *Umwelt* (exteriority) occurs as a result of dynamic and dialectic processes that occur within and outside the boundaries of the operational closure of the living body. Therefore, it is not only the autonomous organization of a living being that cognition requires but also the emergent constraints that shape the unfolding of this autonomous organization—and this involves the environment as well.

If these interactional emergent processes are effectively a requirement for life and cognition, we must reject the idea that an *Umwelt* is a mere bubble-like domain, the most common metaphor used to describe *Umwelten* (3.1.1). Instead, *Umwelten* are more accurately represented by the metaphor of rings that overlap each other (Merleau-Ponty 1995, 227; Buchanan 2008, 136). The idea is that the life of organisms is always interrelated with many other organisms of the same and different species. These organisms and their interactions shape and reshape the place that all of them inhabit. At this point, we can use an analogy that in social cognition is described as an *intercorporeality*, and one named by Merleau-Ponty, at the level of life and nature, as *interanimality* (Merleau-Ponty 1995, 374). Interanimality expresses how animals are entangled in a complex system of relations constitutive of their own being (cf. Toadvine 2009).

There is another helpful metaphor to depict these *Umwelten*. Merleau-Ponty (1963), following Uexküll, described living beings as melodies or as temporally extended wholes that sing themselves. This metaphor fits perfectly with descriptions of living organisms found in autonomist enactivism (*MndLf*). However, we must aggregate that these melodies are played over an underlying harmony that interrelates the melodic organisms,[58] producing a symphony that has no director nor any *ready-made* score to follow. Rather, like jazz improvisation, these melodies unfold under the current dialogue of music, creating new structures or scaffoldings that disclose new paths for the continuity of the musical intercourse.

The construction of the musical interwoven of nature is not reducible to the developmental history of organisms. As I said, it necessarily involves a phylogenesis and an embryogenesis that constitute very likely the first kind of social relationship between organisms, a transgenerational relation.[59]

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[58] We usually associate harmony with the smooth coordination of multiple components in a systemic whole. However, musical harmony underlay many synchronic and diachronic tensions between its components (e.g., chords and progressions). These musical tensions resonate with the conflicts described by autonomist enactivists in the processes of coordination, breakdowns, and recoveries of autonomous systems and social interactions (*LngBod*).

[59] Di Paolo et al. (*LngBod*) think that reproduction is probably a mechanism related to biological autonomy. Despite the metabolic activity of organisms to avoid thermodynamical equilibrium, they may still suffer from a systemic decay. If so, to fully restore their organizational equilibrium, organisms would undertake

We can, for now, speculate that the relation between a progenitor-organism and a newborn organism can be crucial to shape (and reshape) the bodily constitution of both organisms. Such a relation could trigger constitutive changes in the sense-making of both organisms as well. That is, reproduction may imply some basic form of participatory sense-making. Cummins and De Jesus have a point when they insist that sociality is pervasive in life, from bacteria to insect colonies, from flocks of birds to primates' tribes, and from the human microbiome to the constitution of multicellular organisms (Dupré 2012). The most important conclusion is that forms of life depend on their mutual relations, and it is hard to see how the picture of a solitary organism is an accurate depiction of life.

The example of chinampas is, for this reason, illustrative of an enactivist theory of place. In *chinampas*, as described in 5.1.2, there is a deep entanglement in the life of human and non-human agents. The mould in the bottom of the lake, necessary for the agriculture, depends on the water provided by the *Cerro de la Estrella*, the microbes of the soil, and the activity of the almost extinguished axolotls. The *ahuejotes* give support to the borders of *chinampas*, but farmers need to plant these trees in a specific location to maintain the stability of the bed of earth. Bugs and birds threat the harvest of crops. However, since they give balance to the organismic population of the lake, the farmers avoid the use pesticides and use other useful techniques to control their activity. The *chinamperos* constantly change their life in order to resist to the damages caused by industrial capitalism and fight to preserve the increasingly fragile ecological balance in the lake of Xochimilco. Thus, *chinampas* compose a melodic symphony; one full of harmony, rhythms, breaks, and tensions that evolves as a resilient systemic structure and gives shape to the landscape we currently observe in Xochimilco.[60]

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reproduction processes to avoid this decay, engendering themselves into entirely new autonomous systems. More evidence is needed to support this claim in any case.

[60] A place is only meaningful to the observer that can comprehend its existential unity. The eye of the bourgeois, for instance, can look differently and see nothing in *chinampas* but opportunities or impediments to make his profits. The politician looking indifferently to the population's way of life cannot see the richness of the lacustrine environment of Xochimilco; the fertile land, the colourful festivals, the ancient

A complete account of sense-making as place-norms needs to keep inquiring further about the processes of birth, genesis, and self-transformation of individuals, groups, species, niches, and habitats, at the different temporal scales of life and nature. Despite its complexity, I am convinced that we need to study living and cognitive phenomena within the historical entanglement of places and the living bodies that inhabit them.

5.3.4 A Jointly Enacted Objectivity

A situated normativity in nature does not impede us from recognizing that significant differences exist between the world lived and dwelled by human agents and the local regions inhabited by non-human organisms. Our bodies and brains' complexity and the surplus of culture and language radically transform our normative domain of interaction with the world. From the point of view of multiple enactive and ecological approaches (*LngBod*; *EnInt*; *EvoEn*; Kiverstein and Rietveld 2018), social interactions, along with the development of the human brain, are the main sources of the sophisticated forms of cognition humans possess. This last section briefly surveys some of the differences between the situated normativity of nature and the one that is more proper of human culture.

The capacity to constitute an objective world separates human cognition and experience from that of other living agents. Merleau-Ponty already acknowledged this fundamental difference in the *Structure of Behaviour* (1963; see also Merleau-Ponty 1995). Perceptually, for instance, we can detach objects from their immediate practical context as well as from an ego-centric orientation of the world (i.e., how the environment is situated in reference to our own body), whereas non-human animals cannot. Despite the proximity of their intelligence to ours, chimpanzees are unable to solve problems that require an appreciation of the standpoint of the object, and not simply from the ego-centric perception of the chimpanzee (Kohler 1999; Merleau-Ponty 1963; Moss-Brender 2017).

For autonomist enactivism, intersubjective interactions in humans also produce the development of more abstract perceptual attitudes. Intersubjective interactions between caregivers and children

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rituals, the history, and the significance of the many forms of life that inhabit this place. Hence, place is a unity, but we cannot see this unity if we do not comprehend, make sense, and take care of place as a precinct of life and culture.

enable the latter to understand the perspective of an object from a different point of view than their own (*SmLf*). Here, intersubjectivity decentralizes the contents of perception away from the ego pole, making it possible to see an object independently of our immediate pragmatic concerns.

This kind of abstract object perception also involves complex forms of social processes of co-regulation (Di Paolo 2016; *SmLf*). For autonomist enactivists, the perception of an object is always (at least implicitly) shaped by actual or possible intersubjective interactions. Hence, the meaning or the normative value of the object is not simply determined by the history of the agent-environment coupling but also by the history of coordination and conflicts (through corporeal interactions) with others (Di Paolo 2016, 246-250). The meaningful environment or the interactive space of two or more agents is thus signified according to the mutual co-regulation of multiple agents and by the social autonomous organization that emerges from their interaction (*LngBod*).

It appears that most animals are also incapable of transposing from the perceptual level of an object to the imaginative level of cognition. This happens, for instance, when human children start using objects as if they were another sort of object. In order to conceive of imagination, from an enactive perspective close to that of autonomist enactivism, Gallagher (*EnInt*) proposes to follow Gilbert Ryle's account of imagination as simulation and pretense, albeit in the form of an expansion of the affordances available in the environment.

For Gallagher, human cognitive activities like imagination expand the realm of affordances from concrete situations, in this case, to imaginary situations (*EnInt*, 194). This idea becomes more precise when Gallagher uses the example of a child playing with a banana as a substitute for a phone (Sainsbury 2009). Gallagher sees this action as involving the child finding similar affordances in the banana and the phone, thereby allowing the child to be physically engaged in a similar manner with both objects, applying thus a metaphoric switch from a real situation to an imaginary one. It should be noted that, for Gallagher, this metaphoric switch occurs in terms of the whole brain-body-environment system since the substitution occurs in the concrete perception-action organization (a Gestalt) and not just in the interconnection of brain states (*EnInt*, 195).

The importance of Gallagher's account of imagination lies in his overall redefinition of imagination as embodied action and the manipulation of environmental resources, including ideal objects such as concepts. For Gallagher, concepts are objects that offer us new affordances. That is, they open new possibilities of acting with and manipulating the environment. Concepts, however, are not mere abstractions taking place in the head; instead, they are embodied in language, images, and symbols (*EnInt*, 196). Indeed, the active manipulation of the environment helps us develop our most sophisticated cognitive skills, such as mathematical thinking. The use of our bodies and tools, for instance, is helpful and necessary for developing mathematical reasoning (*EnInt*, 210-212). Using our fingers or an abacus to count are simple illustrations of this idea.

In short, these arguments suggest that humans can detach specific aspects of the environment from their proximate spatiotemporal locations, relocating them in abstract situational contexts. Symbolic language and culture undoubtedly enable many other ways of reconfiguring the horizons of our perception to create new normative levels of cognition that nonetheless remain entangled with the lower levels, keeping attached ourselves to the world of nature.

Conclusion

Since the 1990s, there has been an ongoing transformation of cognitive science. Much of this transformation concerns the roles we grant to the body and the environment in our scientific explanations of cognitive phenomena. While this transformation should, in some scholars' eyes, consist of a reform of the already established theories and methodologies of brain-centred cognitive science, others argue that this transformation needs to be revolutionary and shift cognitive science into a new scientific paradigm. This radical enterprise requires a radical replacement of the main theoretical assumptions, mathematical tools, and observation methodologies in the field. If successful, the new paradigm should be capable of producing more accurate explanations of cognition that overcome many of the traditional problems of brain-centred cognitive science.

This dissertation has explored this possibility by focussing on some theoretical aspects of autonomist enactivism. This approach is one of the most radical forms of enactive cognition because it pushes us to reassess our presuppositions about the definitions and explanations of mind, body, and environment in cognitive science. The theory of *biological autonomy* and the concept of *sense-making*, the elements that make up the theoretical core autonomist enactivism, are controversial and provocative for this exact reason. These ideas are incompatible with the mechanistic, reductionist, physicalist, and functionalist views, at least as these are understood in mainstream scientific thought. The enactive view leads us to adopt a new vision of life and evolution (*MndLf*), of nature (*EnInt*), and even of being and matter (*LngBod*).

The paradigm shift of autonomist enactivism has thus far focused on our conception of the body and its biological nature. From a dynamical perspective, autonomist enactivists have defined the living body as autonomous, adaptive, and existing in a precarious condition. These characteristics of the body have made agency and development two fundamental aspects of life and cognition. Agency is the ability of living systems to determine their bodily constitution and behaviour *partially*. Development is the temporal unfolding of this partial self-determination constrained by the specific conditions of the environment. The agential development of the body is based on norms of interaction enacted in the concrete history of living agents. The enactment of these norms is the living activity of sense-making that causes certain aspects of the environment to appear meaningful for agents and biases the orientation of their actions.

As we have seen, for autonomist enactivists, cognition is a form of sense-making proper of organisms with sensorimotor systems. From this standpoint, all forms of cognition are rooted in the sensorimotor interactions of a living organism and its environment. This new conception of the body and cognition allow us to see cognitive agents as deeply entangled with their environments. This entanglement is causal because the constitution of the living body and its actions are determined by its concrete interactions with the environment, establishing processes of circular causality all along the extensive brain-body-environment system. However, within the original project of autonomist enactivism, the entanglement of the body and the world goes even deeper. Here, the world is never disclosed to us as it is in itself, i.e., as something radically separated from our own understanding of it, but only by virtue of our own bodily constitution and cultural history. Science, as one of our most sophisticated cognitive and cultural activities, is also determined by this history. Therefore, any scientific and philosophical analysis is part of a *fundamental circularity* that makes cognitive science an exercise of self-reflection as much as observing the world itself.

Although the entanglement of the body and the world lies at the base of our own constitution and actions, reflectively disclosing this entanglement is a difficult task for our philosophical and scientific inquiries. Autonomist enactivism represents one of the most significant scientific efforts to disclose this entanglement, but it still falls short of recognizing its full depth and thickness. This thesis has aimed to look further into the body-world entanglement and thus to strengthen the claims of autonomist enactivism. To carry out this work, I have proposed three central theses.

The first is the thesis of *norm development*, which I used to redefine the concept of sense-making. According to its classical description, sense-making consists in the emergence of significance in a value-neutral physical world, thanks to the autonomous activity of living organisms. This description, I argued, is based on highly abstract scenarios that successfully illustrate the normative-oriented behaviour of organisms but falls short of illustrating the full extent of the phenomenon of sense-making, thereby giving rise to numerous misinterpretations. To address this issue, I proposed an alternative definition of sense-making as the enactment of norms of interaction within the already established set of norms that have previously entangled the body and the world, the agent and the environment. In this sense, I defined *norm development* as the *enactment of new norms from already given norms*. By this account, sense-making is, therefore, a process of norm development. Admittedly, this phenomenon is partially illustrated by the sensorimotor account of autonomist enactivism (sensorimotor habits). However, I have argued that autonomist enactivism still needs to recognize more explicitly a related idea, namely that the local environment of cognitive agents is not a mere set of physical constraints, but also and more fundamentally a *normative field*, similar to the realm of ecological information and affordances described by ecological approaches. This led me to my second thesis: *the active environment* thesis.

In defending this second thesis, I argued against the typical explanations of autonomist enactivism that conceive the environment, cognitive agents find, as nothing more than a set of physical constraints, a purely material environment. By contrast, I argued that the environment plays an active role in the interactional system of life and cognition because it is a field of forces that constrains and demands actions from agents in a way that a purely material realm could not. Significantly, these forces are constituted by norms enacted in the past of the agent-environment system and are sedimented in habits of the body and layers of affordances located in the environment. Understood as a normative field, the environment is relational, as ecological approaches rightly point out. Nevertheless, contrary to the claims of ecological approaches, the norms of interaction between agents and the environment are not fully predefined by causal processes independent of individuals' autonomy and development.

Norms of sense-making are norms enacted by agents in light of the specific contingencies of the world they find. The normative domain of interactions of the agent-environment system always remains open-ended to small or almost insignificant reconfigurations. These insignificant reconfigurations nonetheless allow agents to readapt their behaviour to the ever-changing circumstances of the world. The normative field may also be transformed into a whole new interactional domain that allows agents to increase their repertoire of bodily skills. From this perspective, the body-world relation is a dialectical tension between the inherited past and the contingent present that looks normatively forward to a possible future. The tension inside the system fuels its change and transformation and motivates the enactment of new norms of sense-making.

One way of describing the transformative process of the body-world entanglement proceeds from Merleau-Ponty's phenomenological description of levels. In contemporary terms, levels are ecological norms enacted in the history of interactions of an agent-environment system but still open to new transformational processes. These levels are also like scaffoldings that support the enactment of new norms. Levels are not like affordances or things because they are not specific features of the environment that afford bodily action. Instead, levels are structural aspects of the environment that characterize the support and background in which our perception of affordances and things occur. Phenomenologically speaking, levels are horizonal aspects constituting the normative field experienced by agents.

The third thesis I put forward suggests that sense-making, understood as the development of norms that include the environment as a normative field, consists essentially of enacting of place-norms. From a phenomenological perspective, place is a multi-horizonal structure that stabilizes and makes possible the emergence of specific contents of consciousness like things and motor significations (i.e., affordances). From an enactive standpoint, place consists of the metastability of ecological niches that embody the web of normativities relevant to agents' interactions and things in a local environment.

The enactivist notions of microworlds and participation genres are currently the closest descriptions of an enactive place we have. However, these notions are more focused on the dynamical constitution of the metastable network of interrelated processes of place than on the sedimented structures of this network in the material localities of agents. I have argued that the enactive and ecological descriptions of place are the sedimented structure of material localities that disclose the normative field in the agent-environment interactions. This structure is constituted by normativities enacted at some point in the past of an agent-environment system. Although all these norms are enacted in the temporal development of agents, the normative past transcends the individual history of agents. From an external point of view, this past is found in the phylogenesis of organisms and, in the case of humans, the cultural traditions of societies.

An enactive account of place also goes farther than the notions of microworlds and participation genres given in the enactive perspective. As a sort of metastable structure, place has a degree of resilience that sustains agents' individual and collective habits against the tendencies of their autonomy. Places, for instance, sediment the emergent autonomy of participatory sense-making and support a dynamical organization that can result in a heteronomous determination for agents. Places can even function as pivots or hinges for the transition from one microworld to another. That is, places are localities for more than one microworld. At some level, they can have a unity and identity that surpasses the concreteness of one particular set of actions.

Sense-making consists of enacting place-norms because norms of interaction in the agent-environment system are constrained and motivated by the structure of place. The transformation of these norms also entails a certain degree of transformation of place. The resilience of place sustains an identity and a continuity in the normative field, so much so that it is only when the normative transformation process is dramatically changed by an event disrupting the continuity of the agent-environment system that a place transforms or even breaks its own unity and identity.

Theoretically, an enactive theory of place could be a rich field of research for enactive cognition. The sketch I have offered here scarcely shows the multiple dimensions that must be more carefully drawn from both dynamical and phenomenological perspectives. Here, it is worth mentioning that differences between sociocultural and natural places need to be addressed. Sociocultural places became an object of study by scholars of ecological approaches (e.g., Barker 1968; Rietveld and Brouwers 2017; Heft 2018), but these ecological accounts still need to be assimilated and adapted to an enactivists framework for a proper study of enactive place. The question of natural places is also a subject advanced by ecological theories of development and evolution (cf. Laland, Odling-Smee, and Feldman 2000; Griffiths and Stotz 2018), but these theories tend to put aside any claim about the biological autonomy of agents. For all these reasons, I think that Thompson's proposal of a research project for enactive evolution would involve finding an adequate theory of natural enactive places.

Any study of the richness and complexity of place from an enactivist perspective faces the challenge of meeting up the standards of cognitive science. Admittedly, I constructed my approach to place on a holistic standpoint that might not fit easily within the current practices of science. If we are to produce operative and predictive models of cognition, this challenge must be addressed.

While operative frameworks may not directly model the holistic description of place that I defend, I think it can at least establish a theoretical framework against which more simple models can be created. For instance, Di Paolo et al. (*LngBod*) propose that concepts like sense-making, autonomy, and agency should work as heuristic resources. Therefore, a general and abstract definition of these concepts can guide the research in concrete fields of science (e.g., psychiatry, developmental phycology, musicology, etc.) and become adapted to the concrete aspects of those fields. More specific applications of the general concepts can, in return, give us feedback from concrete cases of study and forces us to re-accommodate and refine our general concepts. I believe the same sort of strategy can work for an enactive account of place. A more general definition of place can work as a guide for our research in multiple fields without requiring that research to model all the dimensions of place at once. In exchange, concrete results in a given field can enrich and expand a general theory of enactive place.

The enactive theory of place can also play a significant part in helping us reconsider the type of scientific endeavour pursued by enactive cognition. Cognitive science has traditionally sought to produce highly formal, measurable, and predictive models of cognition. However, this is not the only way to carry out science. Hendrick-Jansen (1996), for instance, recovering Nagel's (1961) categorization of the four types of scientific explanation, writes that cognitive science has indeed attained formal-universal, probabilistic, and teleological-functional explanations of cognition but has failed to attain more genetic explanations.

The goal of genetic explanations is not to state universal laws that can explain phenomena once and for all. Nor are such explanations intended to produce inferences based on probabilistic models or to explain the behaviour of a system based on its mechanical functionality. A genetic explanation looks for the historical origins of a phenomenon, unveiling its main causes. One of the advantages of this type of explanation is that they focus less on the abstract statements and general theories that science can produce and more on the detailed and careful observations of a phenomenon as it occurs in the field.

Situating our study of cognition in place from such a perspective would resemble the work of anthropologists, ethologists, and archaeologists. These fields understand human agency in the wild, using mainly abductive types of reasoning. However, it is essential to note that qualitative analyses and genetic explanations are not exclusive to the humanities. For Hendrick Jansen, Darwin's theory of evolution consists precisely of this type of genetic explanations. Darwin and Wallace were indeed biological scientists who observed phenomena in the field, unveiling the ecological relations of the landscapes they observed, revealing the processes that might originate these ecological fields.

Adopting such types of explanations in enactive cognition does not mean that formal and predictive models are not helpful for our scientific approaches to cognitive phenomena. It is the complementarity, the dialogue, and the mutual enlightenment of different levels and types of explanations that can guide our understanding of the tremendously complex phenomenon of cognition and its underlying existential structures of the being-in-the-world.

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