Bringing forth a world, literally

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Abstract: Our objective in this paper is twofold: first, we intend to address the tenability of the enactivist middle way between realism and idealism, as it is proposed in *The Embodied Mind.* We do so by taking the enactivist conception of *bringing forth a world* literally in three conceptual levels: enaction, niche construction and social construction. Based on this proposal, we claim that enactivism is compatible with the idea of an independent reality without committing to the claim that organisms have cognitive access to a world composed of properties specified prior to any cognitive activity. Our second goal is to show that our literal interpretation of bringing forth a world not only sustains the legitimacy of the middle way, but it also allows us to revive the conception of evolution as natural drift—which is perhaps the least examined aspect of the original enactivist theory and is central to the understanding of cognition in an enactive way. Natural drift focuses on how structural couplings between organism and environment trigger viable pathways of maintenance and reproduction, instead of selecting the most adapted trait to a pregiven environment. Thus, although enactivists typically do not explore the consequences of their views regarding evolutionary dynamics, we show how natural drift provides a suitable starting point.

Keywords: enactivism; evolution; niche construction; social construction; natural drift.

1. Introduction

Enactivism was originally proposed in *The Embodied Mind* (henceforth TEM) by Varela, Thompson and Rosch (1991/2016) as a novel way of understanding cognition and life by advancing a dialogue between the investigations about the mind and human experience. Their original idea is that a cognitive agent is an autonomous system, that is, an operationally closed, self-organizing network of components that dynamically connect to each other in multiple ways. As organisms enact their autonomy, they establish patterns of correlation between movement and sensory stimulation that simultaneously distinguish the agent from its environment and identify meaningful relations within it. Cognitive structures thus emerge from enaction, that is, 'the recurrent sensorimotor patterns that enable action to be perceptually guided' (Varela et al., 2016, p. 173). As the authors of TEM put it, a cognitive agent *brings forth a world* as it acts.

Enaction is at the core of an ambitious project with three related goals. First and foremost, enactivists aim to present a viable alternative to cognitivism, the view that cognition can be sufficiently understood by describing the cognitive system's computations over internal representations. Adherents to cognitivism typically assume that this project can be carried out in abstraction from the organism's bodily morphology, its actions and its environmental setting. Enactivists, on the other hand, reject positing mental representations and computational procedures in explanations of cognition. Instead, they aim to explain cognitive performances by the organism's sensorimotor engagements in its environment. Accordingly, organisms continuously re-organize themselves to maintain their own viability, given their constant exchange of matter and energy with the environment. Broadening the scope of enactivist (and enactivist-inspired) explanations of cognitive performances has been the one of the main aims of subsequent literature on embodied cognition (Di Paolo et al., 2017; Gallagher & Allen, 2018; Hutto & Myin, 2013, 2017; Hutto & Peeters, 2018; Kirchhoff & Robertson, 2018; Kiverstein & Rietveld, 2018).

A second goal of TEM is to address a renewed version of the metaphysical and epistemological dispute between *realism* and *idealism* (or as the authors sometimes call it, the "chicken and egg positions"). Noticeably, the authors of TEM do not focus on the many varieties of realism and idealism and on how these positions are logically related to each other. Instead, they put forth a very general picture of this dispute as it occurs in the context of contemporary cognitive sciences. Realists assume that there is a *pregiven world* that we can access or recover through our cognitive apparatuses. In this context, the notion of 'pregiven' is an epistemological one, according to which the world has 'features that can be specified prior to any cognitive activity' (Varela et al., 2016, p. 135). Idealists, on the other hand, claim that cognition is a projection of our own *pregiven inner world*. Accordingly, 'the apparent reality of this world is merely a reflection of internal laws of the system' (ibid., p. 172), where such internal laws are mental representations. With this picture in mind, one of TEM's major aims is to find a middle way between realism and idealism, for both assume that cognition happens essentially through (or is constituted by) an interface between mind and world, which currently goes by the name of mental representations (formerly known as 'ideas', 'sensations', 'sense data' and the like). As we will see below, the tenability of a middle way here is a controversial subject, even among enactivists themselves.

A third goal in TEM is to provide an enactivist alternative to adaptationism. Adaptationism is the received view in evolutionary biology according to which the main evolutionary mechanism is the selection of traits by environmental pressures over generations. Given the enactivist emphasis on autonomy—on how organisms are the authors of their own organization—, it is expected that an enactivist interpretation of evolutionary dynamics finds a central place for action, which in turn critically challenges the adaptationist orthodoxy. For this, the authors put forth the notion of *natural drift*, which was first presented by Maturana and Varela (1987), going through significant modifications in TEM's version.[1] Despite its ambition and centrality, it is perhaps the least explored topic within post-TEM enactivist literature. However, because living beings bring forth their worlds over large time scales, as we explore below, the enactivist take on evolution cannot be neglected. Accordingly, the idea of natural drift (or enactive evolution, as Thompson, 2007, later puts it) provides a starting point to situate enactivism in current evolutionary debate. In particular, it allows us to understand how organism and environment determine each other, and this is crucial for the enactivist alternative to idealism and realism.

In this paper, we aim to explore the relation between the latter two original goals of TEM in light of recent developments of the enactivist literature and evolutionary biology. We find that much of the controversy surrounding the alleged idealism of enactivism relies on an inadequate understanding of what it means 'to bring forth a world', and we argue for a literal interpretation of that phrase. In the next section, we present in further details TEM's attempt to ground a middle way between realism and idealism, as well as the pessimistic reception of that project. In the third section, we present our literal interpretation of 'bringing forth a world', according to which enaction is the coupling between organism and its environment which leads to the organism physically altering environmental structures in order to make them advantageous for its survival. In some cases, ours for instance, those processes may lead to the construction of a social world too, that is, an environment characterized by sociocultural practices and institutions. We claim that enactivism is compatible with the idea of an independent reality of physical structures and relations without implying a pregiven world. A world brought forth by us is the *literal* outcome of our cognitive doings, it is our *environment* (Varela et al., 2016, p. 174). Finally, in the fourth section, we show how a clear understanding of what it means to bring forth a world allows us to reclaim the much-neglected idea of natural

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[1] It was further developed by Maturana and Mpodozis (1992) and published as an extended revised English version in Maturana and Mpodozis (2000). It was also considered by Thompson (2007), whose version of natural drift is called 'enactive evolution'. We return to it in section 4.

drift, the programmatic view on evolution presented in TEM as an alternative to adaptationism. An enactivist account of evolution is necessary for taking seriously the idea of a codetermination between agent and environment over large timescales, and this is crucial in order to understand the middle way proposed in TEM.

2. The realism/idealism divide and the tenability of the middle way

Before examining the proposed middle way between realism and idealism as it is advanced in TEM, it is important to notice that the authors do not offer an extensive account of the many varieties of realism, idealism and the in-betweens, as we mentioned above. They only present a general picture of this dispute in the cognitive sciences, according to which realists assume that we have a representational access to a pregiven world. Idealists, on the other hand, take cognition to be the outcome or the projection of our own cognitive processes, that is, relating exclusively to the agent's internal representations, which are decoupled from the environment. It is in this epistemological framework that the promise of a middle way between realism and idealism is put forth in TEM through enaction and organism-environment codetermination.

The authors explore the case of color perception as a paradigmatic case of enaction, according to which color perception is 'neither pregiven nor represented, but rather experiential and enacted' (Varela et al., 2016, p. 171). With this they mean that their account provides a different outlook on cognition compared to traditional (representationalist) approaches. Thus, a proper understanding of color perception supposedly provides a distinctively enactive account which is neither realist nor idealist. It is not realist, they claim, because it does not construe cognition as the representational access to a pregiven world, i.e., a world with structure and properties that are specified previously to any cognitive interaction. On the other hand, their enactive account of color perception is not idealist because perceiving colors is not the outcome of the organism's internal representations.

This enactive account depends on the premise that color experience is not reducible to a single physical property or cluster of properties, for different organisms perceive color differently. Accordingly, color vision depends on the coupling between organism and environment. So, as organisms develop a history of interaction with certain environments, over large time scales, they develop the biological traits that are necessary to detect certain physical properties as specific colors. A colorful world is brought forth, so to speak. But, as Shapiro (2011, chapter 4) points out, this simply means that color perception depends on the organism's cognitive apparatus, a claim that falls short of the alleged novel way of theorizing about cognition as advertised in TEM. After all, traditional cognitive scientists would easily agree that organisms develop particular ways of accessing the environment—so there is nothing new, or philosophically interesting, about the idea that color perception depends on the specific abilities, dispositions and bodily constitution of cognitive agents. In response, the authors of TEM could aim for a more controversial claim that color perception is a product of the organism's mind. Organisms would bring forth an *internal* world. But, besides the fact that this strategy is explicitly denied by the authors, it would lead enactivism right back to the idealist trap instead of providing the desired middle way between realism and idealism.

On the other hand, if enactivists aim to avoid the charge of idealism, they may insist that the color vision—and all other kinds of cognitive activity, if color vision is in fact a paradigmatic example of cognition—is a matter of accessing a world through specific cognitive apparatuses. However, this would reveal a commitment to what De Jesus (2018) has identified as a form of *epistemic perspectivalism*. According to that view, organisms do not have access to a world in itself; they only have partial access to a certain perspective of the world, as afforded by their cognitive constitution. But this entails that there is a pregiven world, *contrary* to what TEM claims.

So enactivists face the following conundrum: either they accept idealism—which not only goes against their proposed alternative, but, more problematically perhaps, also goes against a naturalistic outlook of mind—or they accept realism through implicitly accepting epistemic perspectivalism. The second prong of this dilemma, despite being sympathetic to naturalism, also defeats their claim that there is no pregiven world.

The issue is not restricted to TEM, for it is not clear what is the official enactivist stance on this matter in the subsequent literature. Some enactivists, especially those that Ward et al. (2017) classify as *autopoietic enactivists*, follow TEM more closely and build on its original claim that cognitive systems are autonomous, which means that they individuate themselves by self-determining how they behave in a given environment (Di Paolo, 2005; Di Paolo et al., 2017; Di Paolo et al., 2018; Thompson, 2007). Thus, cognition emerges from patterns of correlation between sensations and movement, as these patterns are enacted by the organism. Because sensorimotor patterns are developed *by the organism's own activities*, it may seem that at least some enactivists lean towards anti-realism. So conceived, cognition would be a product of the organism's actions, thus recasting in enactivist terms the idealist *motto* that the world is a product of the agent's mind.

However, other varieties of enactivism advance a realist framework. Alva Noë (2004, 2012) defends a direct realism in the context of his sensorimotor account of perceptual consciousness, for perception is not mediated by mental representations (although it is mediated by what he labels "sensorimotor understanding"). The case for realism is also clear in the work of self-proclaimed radical enactivists (Hutto & Myin, 2013, 2017). In their 2013 book, Hutto and Myin argue that a naturalistic approach to the concept of mental representation is not forthcoming because physical entities (such as patterns of neuronal activity) do not have semantic properties. Semantic properties, in turn, are needed for grounding the accuracy conditions that distinguish mental representations from mere covariation. This alleged impossibility of naturalizing mental representations, known as the Hard Problem of Content, comes with a realist flair. For it shows that there are no grounds to say that some *preexisting physical entities* have certain properties, namely, semantic ones. Note that, as Hutto and Myin foresee, proponents of representationalism could in principle assume an anti-realist point of view in order to vindicate mental representations without aiming for describing a preexisting reality. However, Hutto and Myin (2013, p. 46) argue, it is not clear how fictionalist explanations of that kind would actually help in explaining anything. The fact that radical enactivists consider (and reject) an anti-realist rebuke to their Hard Problem of Content shows that, for them, any view other than realism is out of tune with naturalism.

So, to the extent that we understand enaction and the bringing forth of a world internally, it doesn't seem like the middle way between realism and idealism as advertised in TEM is tenable. Moreover, enactivists themselves seem to be located on both sides of this issue, which further obfuscates the viability of a middle way in enactivist terms. In the next section, we counter these issues by arguing for a literal interpretation of the idea of bringing forth a world. In fact, despite TEM's focus on the structural coupling and codetermination of organism and environment, the enactivist literature has focused on the *organism's side* in its coupling with the environment (Baggs & Chemero, 2021), but not enough has been said about the environmental side, and herein lies the issues and misconceptions highlighted above.

3. Bringing forth a world

There are two ways of bringing forth a world that are common for all living beings. When these two ways of bringing forth a world happen under very specific circumstances, a third way of bringing forth also takes place. In this section, we explore each of these three different ways of bringing forth, and relate them with other current theories and conceptual frameworks. Note, moreover, that this division is conventional, conceived in order to provide a heuristic device to understand certain cognitive dynamics—but in practice these different ways of bringing forth worlds can be intertwined and hard to distinguish.

3.1. Bringing forth as enaction

The first sense in which organisms can be said to bring forth a world refers to the selection and refinement of patterns of sensorimotor engagements they exhibit. The fundamental idea, as expressed originally in Maturana and Varela's work on autopoiesis (1980) is that living organisms determine their viability conditions by creating their own boundaries and normativity. This first way of bringing forth therefore directly refers to the core enactivist claim that we have developed certain biological traits that allow us to make sense of our surroundings by reliably engaging with environmental structures. Naturally, our actions are enabled and constrained by our embodied nature, which starkly distinguishes enactivism from the varieties of cognitivism targeted by TEM. In the macroscopic level of organisms endowed with nervous systems, we can refer to the exercise of sensorimotor capacities as the emergent basis of cognition. It is due to these exercises, and not to a pregiven world, that perceive certain wavelengths as colors, certain smells as repelling or inviting, certain shapes as containers or paths, and so on. We literally bring forth a world full of meaning through our actions, provided that these actions are integrated in our developmental history.

Admittedly, the first way of bringing forth a world, taken in isolation, may lead us back into the realist/idealist trap that enactivists aim to surpass. In particular, it may seem to carry some anti-realist undertones, for the explanatory work on cognition focuses on the organism side. To say, for instance, that cognitive agents are autonomous is to emphasize that they determine their systemic features in cognitive performances, thus mitigating the relevance of their environmental settings. Accordingly, this way of expressing the enactivist claim puts the organism at center stage, for it aims to account how *organisms* create patterns of sensorimotor engagements. This is fundamental for the enactivist explanation of cognition from the ground up, for cognition takes place as organisms assign meaning to environmental encounters through their own doings, which naturally depends on their embodied nature. But even though it is an important story, it is still an incomplete one—for, as such, it leads to the idealist interpretations of enactivism, where ideas are replaced by sensorimotor structures (Heft, 2020; Villalobos & Dewhurst, 2017; see also Vörös et al., 2016). Rejecting the realist claim that we have access to a pregiven environment is a first and critical step—but, taken in isolation, enactivists risk falling prey to a revamped version of idealism. Thus, another step is needed, namely, accounting for how agent and environment determine each other. This happens over time, and presumably involves evolution. Taking this step is taking seriously the idea that cognition emerges from a dynamic coupling involving brain, body *and environment over short and large timescales*, as we explore in the remainder of the paper.

3.2. Bringing forth as niche construction

The second way of bringing forth, we suggest, refers to how our actions transform our environment in order to counter environmental pressures, thereby enhancing our chances of survival in ways that feed back to us and fundamentally change who we are and what we can do. So stated, it is a matter of *niche construction* (Laland et al., 2016, 2000a; Odling-Smee et al., 2003) which is one of the basis for the extended evolutionary synthesis (Laland et al., 2014, 2015, Pigliucci & Müller, 2010). The extended synthesis is a conceptual framework for thinking of evolution that aims to expand on traditional (or modern) evolutionary synthesis, the orthodoxy in evolutionary biology which combines adaptationism with Mendelian genetics. We return to criticism of adaptationism (and, *a fortiori*, of modern synthesis) in the next section. For now, it suffices to say that, whereas the traditional view on evolution claims that populations of organisms transmit genes across generations under the direction of natural selection, the extended synthesis acknowledges that there are more factors in play at evolutionary dynamics than those considered by modern synthesis.[2] One of these factors, which is of our main interest here, is how organisms not only undergo environmental pressures that ensue their adaptation, but also change their environment, thus provoking ecological changes that can become non-genetical inheritances of their offspring. Which means that if these changes are sufficiently stable, they become new environments for subsequent generations, thereby offering new possibilities of engagement and opening up new evolutionary pathways. Laland et al. (2000b) characterize niche construction as:

> When an organism modifies the functional relationship between itself and its environment by actively changing one or more of the factors in

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[2] Because the extended evolutionary synthesis is essentially pluralistic in its approach, and because it challenges central assumptions of traditional or modern evolutionary synthesis, one can argue that it is neither a *synthesis* nor an *extension* of the traditional view (dos Reis & Araújo, 2020). We, however, do not take a stance on that issue.

> its environment, either by physically perturbing these factors at its current address, or by relocating to a different address, thereby exposing itself to different factors. (Laland et al., 2000b, p. 165)

The idea that humans modify their environments in substantial ways is of course not new. As Laland et al., (2000a) emphasize, however, niche construction is not a rare or special case that occasionally impacts on selection, it is rather 'general and pervasive' (ibid., p. 132). Thus, although human action offers paradigmatic cases, niche construction happens with many other animals, such as earthworms, spiders, beavers, cuckoos, termites and hermit crabs. Niche construction is arguably even registered in microbes, fungi and plants (see Laland et al., 2016 for an overview). Therefore, organisms have an active part in their selective process by creating phenotypically modified habitats that are transmitted across generations, in addition to genetic inheritance, and which may impact the selection of future generations.

There are two further important points about the notion of niche construction. Firstly, *how* and *which* niches are built essentially depends on the organism's bodily morphology and abilities, in a way that closely relates the first and second ways of bringing forth worlds. Secondly, building a niche is not a 'mental activity', where 'mental' is construed internalistically. As Laland et al. (2000a) emphasize, 'construction refers to a physical modification of the environment and not to the perceptual processes responsible for constructing *a mental representation* of the world from sensory inputs' (2000a, p. 145, emphasis added). As such, the first two ways of bringing forth a world are not internal nor subjective. They do not refer to an idealistic interpretation that leaves out the material exchanges that happen between agent and environment. Bringing forth a world through enaction and niche construction involves *physically* engaging with the environment, which mutually determines both agent and environment. *This* environment, as it is brought forth by us, is the only world with which we engage. We hereby use 'environment' exclusively in this sense, as a lived world which is determined by the organisms' doings and which determines the organisms in turn.[3]

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[3] A similar view has been put forth by Konrad Werner (2020). Werner's idea of construction of a cognitive niche is based on the distinction between metabolism and meta-metabolism (Moreno et al. 1997), where metabolic processes enable organisms to survive, and meta-metabolic ones guide organisms towards attractors and away from repellents, therefore aiding and enhancing metabolic processes. Werner argues that organism and niche are codetermined in two ways. First, the construction of a metabolic niche produces a stable, operationally closed, tenant. As organisms develop the capacities to act in their metabolic niches, they construct cognitive niches, which marks a second step of codetermination. Given Werner's reliance on a distinction between metabolic and meta-metabolic processes, and given that cognition is understood as a process of the latter type, it follows that the conditions for the emergence of life are not the same as the conditions for the emergence of cognition. This seems

3.3. A special case of bringing forth: social niche construction

Finally, there is a third literal way of bringing forth a world. As mentioned at the beginning, this third way happens under very specific circumstances, and we call it *social niche construction.* Although there is a clear sense in which non-human animals also develop social activities—as observed in other apes, birds and insects, for instance—, humans excel in social practices and provide the most paradigmatic cases of social cognition.[4] Plausibly, this is due to two distinctive features that characterize what Tomasello (2014) calls the *ratchet effect* (see also Tomasello, 2009). The first feature is cumulative cultural evolution. Humans develop artifacts in order to perform or facilitate certain tasks, and not only others can learn how to use them, but artifacts can also be improved across generations, thereby ameliorating inherited tools and even creating new uses from them. The second distinctive feature of our social behavior is the creation of social institutions. In the last 50,000 years, behaviorally modern humans have developed institutionalized norms that serve to guide, explain, sanction or reprehend the behavior of others. Thus, we inherit not only genes and environmental changes from our forebearers, we also inherit artifacts, information about their usage and possibilities of improving them—and, perhaps more distinctively, we inherit social norms and institutions. The combination of these elements characterizes a third way of bringing forth a world, namely, the construction of a highly normative[5] social environment that guides and constrains our behavior.[6] Accordingly, we perceive a hammer not only as graspable but as a tool, or someone's tool, maybe a valuable or cheap one; we perceive books not only as something we can flip through, but as readable, enjoyable or boring; we perceive warning signs not only as objects with which we can collide, but as forbidding us from following a path or doing certain things in a specific area and so on.

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to be incompatible with a strong construal of the life-mind continuity thesis, as it is defended in TEM and perhaps more notoriously by Thompson (2007) and more recently by Di Paolo et al (2018).

[4] Whether or not this is a difference of kind or degree depends on whether other animals have a "theory of mind" like we do, that is, whether they are capable of ascribing intentional states to other animals. Research on the subject of animal cognition has been live yet controversial (see Heyes, 2015, for a historical overview and a methodological critique). In this argument, we do not rely on whether non-human animals have a theory of mind. We do rely, however, on the less controversial claim that there is something about human social behavior that sets us significantly apart from other animals.

[5] We use 'highly normative' to distinguish it from the normativity present in non-human animals (see van de Waal, Borgeaud, & Whiten, 2013 for an example of socially inherited norms in apes).

[6] Naturally, satisfactory explanation of how behaviorally modern humans came to existence is much more intricate than what we explore here.

What is interesting here is that the distinctive features of human social cognition—cumulative cultural adaptation and the creation of social institutions—are plausibly correlated. And this correlation suggests that the construction of a social niche is in continuity with the other two ways of bringing forth a world. If that is the case, social construction fundamentally involves environmental and interpersonal engagements—it is not, therefore, a mere abstraction that we project onto the world. The work on cognitive archeology in the framework of Material Engagement Theory (Ihde & Malafouris, 2019; Malafouris, 2013, 2014, 2019) provides interesting examples on how artifact manipulation scaffolds and transforms our thinking thus becoming intertwined with social niche construction. Consider the case of symbolic numerical counting (for an in-depth discussion, see Malafouris, 2013, chapter 5). Symbolic numerical counting is a sociocultural practice by excellence, and it is grounded in artifact creation and manipulation. It took place from 7000 to 3000 b.C. in ancient Near Eastern civilizations with the manipulation of clay. The first major developmental stage involved using clay tokens circa 4000 b.C. to record quantities of commodities (food, oil, grains, etc.). Later, hollow clay envelopes containing clay tokens were used to the same end. These envelopes were impressed with said tokens on their surface in order to make the quantities and types of commodities indicated by the envelope visible from the outside. If an envelope registered three jars of oil, three signs of the oil-token were impressed on its surface. This eventually led to the creation of solid clay tablets on which tokens were impressed. Subsequently (circa 3200-3100 b.C.) token impression on tablets was replaced by inscribing schematic icons, in which symbols were then used to indicate the quantity of commodities represented instead of a repetition of signs.

For our purposes, the take-away from this description is that symbolic numerical counting, which only exists in highly social creatures, initially took place through clay manipulation. Importantly, using clay depends on which actions humans of that time could perform (which is a case of ‘bringing forth a world’ as enaction), but it also depends on using, transforming and changing environmentally available elements (‘bringing forth a world’ as niche construction), which were transferred across generations. These inheritances came with shared rules of usage which in turn allowed more complex mathematical engagements (‘bringing forth a world’ as social niche construction). At some point, markings on clay meant more than mere markings on clay, they signified instead who owes whom, or how much they own, and so forth.

Notice, first, that socially based cognitive performances such as symbolic counting have material, historical, embodied and enactive roots. We can, of course, evaluate an exercise of symbolic counting in abstraction from these roots, but that would not tell the whole story.

Indeed, isolating this kind of cognitive performance from its phylogenetic and socially based cumulative developments may lead us astray in theorizing about how it works, so that actions that appear decoupled from environmental factors are thus mistakenly taken to be exclusively internal mental capacities. Secondly, and relatedly, each of these processes of bringing forth a world literally alters the environment with which we engage, sometimes altering ourselves in open ended loops.[7] Accordingly, there is no 'pregiven' world, or simply 'the world' which serves as the ultimate ground of our experiences. Rather, there are many environments surrounding and containing us, i.e., worlds continuously built by our doings and which constrain our actions, but also offer a multitude of engagements. Consequently, we do not access portions of a pregiven world, and that is why our literal interpretation of 'bringing forth' avoids the epistemic perspectivalism that De Jesus (2018) rightfully criticizes—because the worlds we bring forth by our doings are literally brought forth by us. This includes, in our case, the social world as well.

3.4. Pregivenness, mind-independence and reality

We follow TEM in rejecting that we can access a world whose properties are specified previously to any cognitive interaction. But this is not to say that there is no real, mind-independent world for the enactivist. Features of the environment are real, and some of their properties (say, physical ones) are mind-independent in the sense that they would persist in the absence of human minds—even though, historically, they may have been affected by human actions (see also Lewontin, 2000). In fact, nothing forbids us from describing, for various scientific purposes, a world existing independently of any human activity and experience. For instance, we can describe the Earth as an astronomical object subject only to physical forces, with no explicit mention of humanity at all. And, insofar as these descriptions are proven fruitful, we can accept them as true. Earth conceived as an astronomical body is mind-independent in that sense, but it is not the world we directly engage with, it is not a lived world. And despite its mind-independence, it is not pregiven—after all, it is described through the laws of a *human* made discipline, which is cumulatively brought forth by many before us.

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[7] Consider again the example above: at the neural level, Malafouris hypothesizes that manipulating clay tokens lead to a reorganization in the neural connectivity of the intraparietal area, specifically linking the anterior intraparietal area, which is responsible for manual tasks, with the horizontal segment of the intraparietal sulcus and the angular gyrus, which are areas associated, respectively, with semantic associations and metaphorical thinking (see Malafouris, 2013, p. 115).

Notice that, if we come to engage with things that were hitherto beyond our reach, they do become part of our environment. Consider another astronomical example: the first Moon landing by the crew of the Apollo 11 mission. The astronauts did bring forth a new environment by landing on the Moon—which obviously is not to say that they have built a celestial body. But the fact that the Moon is since then available to direct, hands-on investigation and the socio-political consequences of the space race show that the Moon became part of our lived world in a new way. After all, the lunar environment *was* altered after the Apollo 11 landing. To begin with, there are footprints and a flag. And, due to the many missions that happened after 1969, at times it also contained human beings in their space suits, lunar rovers, space crafts and debris from failed missions and crashes. Naturally, that is a far cry from the way humans altered the Earth (and continue to do so), but the Moon has traces of human action on it nonetheless. It became part (albeit an extremely marginal one) of our lived world in a new way.

As for reality, it is clear that the worlds we bring forth are real, tangibly real, even if their reality is codetermined with our actions. In fact, the idea of codetermination allows us to happily dismiss familiar skeptical worries about the reality of the world. For, if organism and environment are codetermined, and if the organism's actions are unquestionably real, then there is no ground to put into question the reality of our lived world.[8] This goes to show that reality is not an issue for the enactivist, even if it is codetermined by us.

Therefore, we must be careful to distinguish 'pregiven world', which is an epistemological notion in TEM's usage, from 'mind-independent' and 'real', which are metaphysical categories. We have no qualms about the idea of there being a mind-independent reality, for it does not entail a pregiven world. Alternatively: rejecting epistemological realism does not imply rejecting all sorts of metaphysical realism. To say that certain things (structures, relations, what have you) exist is not to say that their features are specified independently of our engagements with them. And yet, they are real. Some of them are engageable for us, which makes them part of our environment, and some are not. A literal construal of what it means to bring forth a world, therefore, offers a viable epistemological alternative to realism and idealism alike, for cognition essentially depends upon the organisms' doings, and these, in turn, shape its environment. For those very reasons, this view is perhaps more clearly not an idealist

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[8] Of course, a skeptic about the external world could insist that we cannot know whether our actions are in fact real—maybe, their argument goes, we can only be sure about the content of some of our present-tense experiences. But that would imply a conception of mind as a disembodied entity, something that enactivists fundamentally reject.

one: although cognition emerges in autonomous systems, their autonomy is historically co-specified with their environments, and not something that happens entirely on the organism's side.

When it comes to the *metaphysical* dispute between realism and idealism—about whether an independent reality exists—, our view may be seen to lie closer to realism. For it accepts the existence of a mind-independent reality. But it is crucial to note that, if reality is historically codetermined with ourselves and with many other creatures, it does not exist apart from us. To say, for instance, that reality would persist if we (and all other living beings) were to disappear does not mitigate the fact that, up to now at least, reality is heavily shaped by our doings. This is why TEM's position about the metaphysical dispute can be cast in terms of a redefined realism: it eschews idealism because reality is not something inside the individual's mind. But it is not the case that there is a reality *out there* (as some realists would see it). Instead, we are part of a reality which is brought forth in relation to ourselves and to things other than ourselves.[9]

Crippen (2020) makes a similar point in arguing for the compatibility between enactivism and ecological psychology.[10] Crippen claims that enactivists inherited John Dewey's constructivism, which is not subjective or internal in any way. It refers instead to how one's actions necessarily alter how the environment is displayed. Accordingly, enactivism is committed to a kind of constructivism that does not obviate realism as it is advanced by the ecological approach. In discussing how *Physarum polycephalum* (a variety of slime mold) picks up chemical information in its environment by locomotion and secretion of non-living slime—which functions as a repeller for future behavior—, Crippen comes close to our description of how living beings bring forth their worlds. He writes: '[t]hese creatures, then, actively shape perceptually and cognitively available, value-laden environments. They do this

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[9] We acknowledge that our proposal may not satisfy anti-realists who hold that entities postulated by physical theories are *merely* culturally enabled abstractions, so they are not *objective* or *real* in a sufficiently robust sense. As we have argued in section 3.3, however, symbolic numerical counting, which is presumably a paradigmatic case of culturally enabled abstraction, is historically dependent upon material engagements. Therefore, it is not separable from our actions in the world. This, we believe, offers good initial grounds to resist the idea that theoretical entities are not real.

[10] Similarly to enactivism, ecological psychology, which was originally developed by Gibson (1979/2015) has its roots on pragmatism. Ecological psychologists emphasize the role of agency in perceptual cognition and reject that organisms have to enrich information about distal physical structures through computations over mental representations. Despite these initial similarities, the authors of TEM took Gibson's ideas to overemphasize the environmental side of the agent-environment relations, supposedly downplaying the organism's role in cognition (Cf. Varela et al., 2016, pp. 203-204). Recently, Harry Heft (2020) argued for a divergence between the two approaches by reading enactivism under an idealist light, in contrast with Gibson's professed realism. Despite their complicated past, recent developments indicate that ecological psychology and enactivism can be put to work together (Baggs & Chemero, 2021; Carvalho & Rolla, 2020; Heras-Escribano, 2019; Kiverstein & Rietveld, 2018; Rolla & Novaes, 2020).

by laying down openings and closures for movement – in other words, affordances – which scaffold their behavior and delineate their worlds'. And 'the constructed chemical geographies and indeed affordances retain independent existence in the same sense that furniture in an empty room does' (ibid., p. 5-6). The slime mold literally lays down a path in crawling, to paraphrase from TEM.

Importantly, Crippen takes realism to be the view that 'properties exist independently of agents, so that wood is smooth or sinewy regardless of whether human fingers caress it or cat claws dig into it' (2020, p. 3). Notice that his idea of an "agent-independent" existence is compatible with ours only if taken in a very punctual sense. To take Crippen's example, wooden objects—say, chairs in the next room—obviously exist independently from our continuous interaction with them. If you leave the room, the chairs will still be there. But wood, be it processed or in its natural form, depends on a myriad of physical, chemical, biological and sometimes cultural factors that are interwoven with the life of many other beings. So even though enactivism entails a realist-friendly constructivism in Crippen's view, our account is compatible with his because that conception of realism does not entail epistemological realism, the view that we access a pregiven world. For the idea that things exist independently from us—in the sense that our collective demise would not immediately affect their existence—still allows for their reality to be historically codetermined by the actions of the organisms that have engaged with these things and, perhaps more importantly, for their existence to codetermine a world of significance to those organisms.

We have shown that a literal interpretation of the enactivist idea that we bring forth a world succeeds in offering a genuine middle-way between realism and idealism. Enactivism is a viable alternative because it eschews the common denominator of both views, namely, the assumption that cognition necessarily goes through mental representations, either as a means of accessing a pregiven world (for realism) or as the very substrate of cognition (for idealism). At first glance, it may seem like we are advancing a variety of epistemic realism, for our view is compatible with the existence of a mind-independent reality (which is generally construed in terms of metaphysical realism). But it may also look like it leans towards idealism, since it acknowledges that the world is determined by the organism's cognitive processes. In fact, it is neither: it is not realist, in the epistemological sense, because the organism does not have cognitive access to a pregiven world, it brings forth its world instead. And it is not idealist because the organism's cognitive processes are not pregiven, that is, they are not secluded from the environment. They are codetermined by the environments inhabited by the organism—which, in our case, includes our social environment as well. These ideas naturally lead us to the question of how exactly organisms and environment become codetermined over time, which in turn requires us to pinpoint enactivism within a broader evolutionary framework. We address this issue in the next section.

4. Natural drift and literally bringing forth a world

To summarize our itinerary so far: we have emphasized how literally bringing forth a world is the key to situate enactivism as a viable alternative to both idealism and realism, as the authors of TEM originally intended. We hold that this very idea compels us to consider organism-environment codetermination at short and large timescales—because codetermination involves evolutionary changes. Enactivist literature has given sufficient emphasis on the developmental changes (see Di Paolo et al., 2017; Di Paolo et al., 2018), but not enough has been said about enaction over large timescales. This, in turn, is crucial for how organisms inherit and transform their bodily morphologies by bringing forth their worlds—as our discussion of niche construction shows. It is noteworthy that some current enactivist developments take for granted the received view on evolution and do not explore enactivist commitments to evolutionary theories. But this may be deeply problematic, after all, if organisms are autonomous in the sense that they author the ways through which their cognitive events unfold, and if they are autonomous in the stronger (autopoietic) sense that they produce their own components by giving rise to their organizational structure, it is at least strongly suggested (if not entailed) that organisms take an active part in their evolutionary pathways. This is of course at odds with traditional takes on evolutionary biology, which may indicate why enactivists typically avoid explicitly assessing the evolutionary implications of their views.

Gallagher (2017, chapter 9), for instance, discusses how the most coherent explanations about the selection of our upright posture (and the immense cognitive impact it had on our ancestors) look beyond anatomical changes. Current theories also consider the environments inhabited by our forebearers, and how their actions in these environments might have favored bipedalism. These developments seem to vindicate, partially at least, an enactivist story, for they make room for the theoretical relevance of agent-environment couplings. Notice, however, that Gallagher (2017, p. 54) only briefly mentions Sterelny's (2010) niche construction model of evolution, but he does not explore whether enactivism provides a good fit with orthodoxy on evolutionary theory, and goes only as far as to rely on evolutionary-developmental considerations.

Another example is Hutto and Myin's (2013, 2017) radical enactivism and their teleosemiotic account of basic directedness (or, as they call it, 'ur-intentionality'). Simply put, their idea is that an organism's most basic cognitive capacities are selected over large timescales, which dictates its capacity of accessing its surroundings. With this, they aim to explain how we are able to engage with our environments without smuggling representational content into their theory of intentionality. Taken at face value, the teleosemiotic explanation seems to imply that the organism's cognitive abilities are passively inherited, as Thompson (2018) points out—which is hard to settle within the broader enactivist picture and its emphasis on action.

With the notable exception of Thompson (2007, chapter 7), matters of evolutionary biology are surprisingly unexplored in the enactivist literature (see also Barrett, 2019). Interestingly, this pressing issue was anticipated in a much neglected chapter of *The Embodied Mind* (chapter 9). There, the authors argue that *adaptationism*, the received view on theory of evolution—which is a cornerstone for modern evolutionary synthesis (together with Mendelian genetics)—, is inimical to their enactive approach to mind and life. Given this incompatibility, TEM provides the outlines of an enactivist alternative to adaptationism, which they call *evolution as natural drift* and which is perhaps one of the least explored aspects of enactivism despite its centrality in understanding the proposed middle way between realism and idealism.[11] In this section, we try to do justice to TEM's aims in addressing the evolutionary question by unfolding the key features of natural drift. In so doing, we reclaim its relevance in the theoretical landscape by relating it with our main issue, which is the literal bringing forth of a world. Natural drift, as we explore it below, focuses on how the structural couplings between organism and environment trigger several viable pathways of maintenance and reproduction instead of selecting traits that are optimally adapted to a pregiven environment. Thus, it is important to keep in mind that TEM naturally does not deny evolution, nor that evolution involves selection, although it does involve reconceiving selection in terms of viable pathways of suboptimal performance. In fact, an enactivist account of evolution is crucial for attaining the middle way between realism and idealism that we explored above because it allows us to see how organisms and their environments determine each other over large timescales. TEM only denies that evolution occurs mainly by virtue of selective pressures and adaptation.

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[11] Natural drift should not be confused with *genetic drift*, which is the change in frequency of gene variants in the genetic compositions of populations due to the randomness of sampling, as opposed to genetic variation by adaptation.

4.1. Adaptationism and its critics

According to TEM, adaptationism is based on three claims: (i) evolution is a process of modification that occurs by means of small changes in organismic traits, which are specified by genes; (ii) the inherited traits constantly suffer mutation and recombination, which are responsible for the success or decay of reproduction rates, and this in turn leads to changes in the genetic configuration of a population; (iii) natural selection is the main mechanism that explains these processes of modification, for phenotypes/genetic traits that *best fit* the environment conditions (adaptation) survive across generations. Thus, '[s]elective pressures (the physical metaphor is fitting) act on the genetic variety of a population, producing changes over time according to an optimization of the fitness potential.' (Varela et al., 2016, p. 187). Crucial for our purposes is how adaptationism takes the fit between an organism's traits and an independent (pregiven) environment to be the key mechanism in evolution.

At first, TEM raises five points of dispute in the modern evolutionary synthesis debate in order to suggest that adaptationism is problematic for not considering non-selective constraints as relevant in evolution. We will not delve into them here.[12] TEM's more innovative argument against adaptationism is that the correspondence between organism and environment presupposed by the conception of evolution as mainly adaptive is analogous to the cognitivist assumption that the organism represents its surroundings according to specification conditions offered by the environment. That argument against adaptationism, therefore, relies on the parallel between adaptationism and cognitivism. This analogy is never fully drawn, but one can assume it runs as follows: cognitivism takes cognition to be essentially a matter of problem solving through computations over representations. This process, if successful, provides the optimal fit between agent and world. Accordingly, the cognitive agent and the world are taken to be separated entities—they are decoupled, and cognition only occurs when there is a fit between the agent's internal processes and a pregiven environmental setting. Analogously, for adaptationism, the central mechanism that explains how organisms are hereditarily modified is the selection of phenotypes that more efficiently cope with its current environment (Varela et al., 2016, p. 185). So, their argument goes, adaptationism and cognitivism are analogous

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[12] These points can be summarized as (i) specific genes rarely determine the manifestation of isolated traits (linkage and pleiotropy), (ii) development is determined by epigenetic factors, (iii) genetic frequency is random in maintained population size (genetic drift), (iv) some groups undergo very little changes over large timescales despite significant changes in the environment and high genetic diversity (stasis), and (v) there is a need for reconceiving the individual as a unit of selection.

because they are both committed to a pregiven environment and to the possibility of organisms achieving an optimal fit (cognition/adaptation) in relation to that environment. Moreover, just like adaptationism downplays the relevance of other evolutionary factors, cognitivism downplays the relevance of embodiment and action-related processes in cognition, which are relegated to merely causal factors (e.g., the reception of input), instead of being considered constitutive and transformative of cognitive events.[13]

TEM draws heavily on earlier criticisms by Gould and Lewontin's (1979) notorious paper, which is responsible for much of the controversy around adaptationism. An important point of contention raised by Gould and Lewontin is how adaptationism draws an arbitrary line between the organism's traits and its structure in order to assess the trait's fitness. Accordingly, from a methodological perspective, the unity of analysis in the adaptationist program is not the organism as a whole, but the trait taken in isolation from the rest of the body.[14] If a trait is locally optimal (best possible fit for a specific environment), it is considered to be a matter of adaptation. If, however, a trait is revealed to be suboptimal in some respect—according to empirical adaptationism at least—then it is typically speculated that some trade-off has happened in the organism's evolutionary history, so that the adaptation of some other existing trait (or traits) was favored over the suboptimal one(s). For our argument here, the important point is how adaptationism takes traits, *as abstracted from the organism as a whole*, to be the unit of natural selection. But, as Gould and Lewontin remind us, organisms 'are integrated entities, not collections of discrete objects' (1979, p. 585). An enactivist should add: living organisms are integrated entities that self-produce and self-maintain their own organization through a network of interrelated precarious processes. Downplaying the organizational dimension of life is as problematic as minimizing the embodied and enactive dimensions of cognition. In the latter case, it mistakenly leads one's analysis to focus on problem-solving and internal computations over representations, instead of acknowledging how embodied agents actually conduct their exchanges in their environmental settings. Similarly, focusing on traits and minimizing organismic structure may lead evolutionary scientists to ignore how constraints other than adaptation impact evolution.

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[13] Note that their criticism is directed towards what has been called *empirical adaptationism*, the view that natural selection is the main mechanism responsible for evolutionary changes. They do not affect (at least prima facie) explanatory and methodological varieties of adaptationism (see Godfrey-Smith, 2001; Orzack & Forber, 2017).

[14] The extreme version of this tendency of isolating individual levels of analysis for explaining evolution and natural selection is the selfish gene hypothesis (Dawkins, 1976). Opposing views, such as evolution as natural drift (see also the notion of group selection in Wynne-Edwards, 1982), suggest that the understanding of the evolutionary process will involve 'a clear articulation of various units of selection and their relations' (Varela et al., 2016, p. 193).

4.2. Evolution as natural drift

In advancing their programmatic alternative to adaptationism, the authors of TEM suggest a change of logic, more specifically, the switch from a *prescriptive logic*—according to which selection is a process that guides and instructs in the task of improving fitness—to a *proscriptive one*. So '[o]rganisms and the population offer variety; natural selection guarantees only that what ensues satisfies the two basic constraints of survival and reproduction' (Varela et al., 2016, p. 195). From the vantage point of enactivism, selection establishes the parameters within which life is viable but not necessarily selects the fittest. Accordingly, a proscriptive logic on selection makes room for developmental and structural constraints in evolution, which are downplayed by adaptationism. Thus, the explanation for evolution as natural drift is given by (i) structural couplings between organism and environment providing a diversity of genetic and evolutionary processes which, by constraints of survival and reproduction, is pruned by the unfolding of viable pathways; (ii) a process of *satisficing* by means of which a suboptimal performance of a self-organizing network (which is the unity of evolution) structurally coupled with the medium has sufficient integrity to persist; and (iii) organism and environment are involved in co-implicative relation, for they mutually specify each other.

In this view, the process of satisficing triggers the changes in viable pathways of structural couplings, but it does not specify them. Thus, the traditional picture of a pregiven world to which the organism is adapted is replaced by the idea that the environment cannot be separated from the organism and its actions (Varela et al., 2016, p. 198). So 'environmental regularities are the result of a conjoint history, a congruence that unfolds from a long history of codetermination.' (ibid., p. 199). This is important for our purposes because the very enactivist idea of *codetermination* in this context makes clear that natural drift is crucial for literally bringing forth a world, especially the level we described in terms of niche construction, for organisms codetermine their viability with the environment by actively modifying it. Moreover, this approximation allows for natural drift to include the construction of social niches as well, for we can now talk about how social norms and institutions specify their own viable pathways through the actions of socially endowed creatures and allow for a plurality of socialized behaviors.

Note, however, that natural drift makes no specific claims on how organisms actively take part in their evolutionary pathways. This is so because natural drift construes selection as a process of 'conservation of lineages of autopoietic forms, not as a mechanism to generate them' (Etxeberria, 2004, p. 356). Selection only *conserves* viable biological organizations, whereas evolutionary innovations are expected to be explained by other constraints (such as development, genetic drift, niche construction and other contingencies that enable variety in reproduction). This conservative aspect of natural drift is plausibly due to the autopoietic framework which is implicit in the background of TEM (Etxeberria, 2004). Autopoietic processes conserve identity and organizational closure—which is why organisms are said to *satisfy* conditions of viability without *optimizing* them. And this, in turn, leads TEM to turn the focus of evolutionary explanations from traits (and their local optimality) to patterns of organization via life history (Varela et al., 2016, p. 196).

Now, a concept of *adaptivity* was explicitly articulated in the enactivist literature by Di Paolo (2005), which in turn paves the way for a specific understanding of how developmental constraints affect evolutionary processes. Di Paolo argues that the notion of autopoiesis only explains how organisms achieve their unity and author their norms of operation, thereby creating the boundaries within which their survival is possible. Thus, autopoiesis only affords an explanation for how organisms discriminate fatal encounters from non-fatal ones. But it alone cannot explain how organisms are capable of anticipating and countering *potential* losses of viability by evaluating how some environmental encounters are more desirable than others. For this, enactivism needs *adaptivity*, which Di Paolo defines as:

> A system's capacity, in some circumstances, to regulate its states and its relation to the environment with the result that, if the states are sufficiently close to the boundary of viability, 1. Tendencies are distinguished and acted upon depending on whether the states will approach or recede from the boundary and, as a consequence, 2. Tendencies of the first kind are moved closer to or transformed into tendencies of the second and so future states are prevented from reaching the boundary with an outward velocity (Di Paolo, 2005, p. 438).

The crucial point in this definition is that adaptivity is needed to account for how living organisms dynamically maintain certain relations through self-monitoring and compensatory structural changes (ibid., p., 435). Thus, on this reading, adaptivity is the key for maintaining homeostasis, which is 'the process of ensuring the proper conditions of temperature, pH, and solute concentration and the organized delivery and distribution of nutrients, fuel, oxidant, and wastes throughout the body' (Turner, 2000, p. 78). Homeostasis is maintained as the organism acts in relation to many different encounters, so adaptivity also brings about how action takes place. Crucially, homeostasis has been persuasively linked to niche construction theory by Turner (2016). As cells achieve homeostasis by maintaining ionic disequilibrium across its membranes, not only their interior changes but their exterior changes as well. In a very enactivist fashion (which he does not explicitly refer to), Turner describes this coupling between the cell and its environment as a broadening of the cell's adaptive boundary (in this case, a membrane) as a case of 'extended physiology'. By 'adaptive boundary', Turner understands 'any interface between organism and environment that can be modified so that matter and energy flows enable the persistence of the modifier' (2016, p. 212). This process of broadening adaptive boundaries is iterated at different levels, as cells are associated into epithelia, epithelia into organs, organs into organisms, and organisms into tenants of niches built by the organisms themselves. In so doing, organisms drive their evolutionary processes by exploring viable pathways through their actions. This is the extended organism hypothesis (see also Turner, 2000), which brings into niche construction theory the missing point of agency. Agency is thus conceived as the active seeking of sources of matter and energy for sustaining the process of maintaining self-organization, from cell organization to niche construction (Turner, 2016; Di Paolo, 2005) and plausibly social construction as well.[15]

Now, how does this enactivist concept of adaptivity fit in with other usages of the term? In evolutionary biology, 'adaptation' usually refers to the outcome of genetic selection. Gould and Lewontin (1979) also distinguish between the way the term is used in physiology and what they call cultural adaptation. The latter refers to a heritable yet non-Darwinian mechanism that is especially salient in human life forms. This ties in with our third way of bringing forth a world: we adapt to our social environment by incorporating cultural norms into our practices and monitoring our own social engagements. As for the concept of *adaptation* and its use in physiology, Gould and Lewontin say it refers to the 'phenotypic plasticity that permits organisms to mould their form to prevailing circumstances during ontogeny' (1979, p. 592). So conceived, 'adaptations are not [genetically] heritable, but the capacity to develop them presumably is' (ibid.). This is precisely the point put forth by Di Paolo's extension of the

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[15] As one anonymous reviewer brought to our attention, this definition of agency has a flair of circularity. Regarding this alleged circularity, we may follow Di Paolo et al. (2017, p. 127) in their definition of an agent as an autonomous system capable of modulating its environmental couplings in an adaptive manner. Because the elements of this definition are themselves defined in dynamical terms, not presupposing agency, this definition mitigates the charge of circularity.

enactivist toolbox by adding the concept of *adaptivity* to it, namely, to explain in enactivist terms the phenotypic plasticity at play in ontogenesis.

More recently, Evan Thompson revisited the notion of natural drift and expanded on some of its earlier claims, thus providing a clearer articulation between autopoiesis and developmental systems theory, as well as renewed criticisms to the received view. He then presents natural drift under the label of *enactive evolution* (Thompson, 2007, p. 205, see also p. 460, fn. 19), and emphasizes that the unit of evolution is not the trait, but the organism-environment system in its life cycle, which includes 'not only endogenous elements (genes, cytoplasmic components, cytoskeletal and cortical cellular organization, and so on), but also structured exogeneous environments—environment structures into viable niches by the organisms themselves' (p. 204). This quote shows a remarkable approximation between natural drift, or enactive evolution, and niche construction theory, even if Thompson does not draw this conclusion explicitly. Importantly, one difference between TEM's take on evolution and Thompson's revisited position is that, in this latest version, he makes room for flexibility, which he describes as 'the capacity to change in relation to changing conditions, to accommodate change' (p. 195). Flexibility can be fleshed out in enactivist terms as *adaptivity*, as we discussed above, and was missing from the original formulation of natural drift.

In this section, we have shown that, even though the idea of evolution by natural drift was not picked up by most of subsequent enactivist literature, and even less so by evolutionary biology, it fits nicely into well-established criticisms of adaptationism and it provides suitable links to niche construction theory, which is one of the basis for the extended evolutionary synthesis. This suggests that enactivists do have a plausible story to tell about evolution, one that makes sense in the broader enactivist framework—especially if we have in mind the idea that organisms literally bring forth a world, which is the enactivist way to avoid both a naive commitment to a pregiven world and the idealist threat of projecting an internal world outwards.

Concluding remarks

Although it is indisputable that *The Embodied Mind* lays the groundwork for enactivism, some of its main themes remain under scrutinized to this day. One such case is the enactivist alternative to realism and idealism, as well as the idea of natural drift. In this paper, we argued for a literal interpretation of bringing forth a world, thus explaining how it happens at three different yet interrelated levels: enaction, niche construction and social niche construction. All of these levels depend on and are shaped by material engagements and interactions that turn a physical reality into a lived world over short and long timescales. Physical realities are therefore transformed into environments through the organisms' actions, thereby setting the stage for further developments and the continuous bringing forth of the organisms' world. Thus, taking seriously the idea of agent-environment historical codetermination enables enactivists to successfully avoid commitments with a pregiven world as the object of cognition, and at the same time to dismiss the familiar idealist worries that enaction is the bringing forth of an internal world. The very notion of bringing forth a world, as we interpret it, entails important considerations about evolutionary dynamics that are anticipated in *The Embodied Mind*, and which can be integrated into a broader framework of theories that reject that evolution occurs mainly in virtue of selection pressures and adaptation.

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