MENTAL REPRESENTATIONS AND THE DYNAMIC THEORY OF MIND[1]

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ABSTRACT: In this paper I will investigate the possibility of defending the concept of 'mental representation' against certain contemporary critiques. Some authors, like Anthony Chemero, argue that it is possible to explain offline actions with dynamic concepts. Hence, the dynamic discourse preempts the representational one. I doubt that this is a recommendable strategy. A form of representation is necessary, though one which is different from the classical one. Instead of eliminating the concept of representation (as radical dynamicists do) or of splitting cognitive explanation in two separate discourses (as the adepts of the hybrid cognition version do), I consider that a dynamic concept of 'representation' is a better option. In my view, the higher level order resulted from the complex brain-body-environment coupling can be interpreted as being representational in nature. The dynamic paradigm involves a significant change concerning the intentional nature of representational states: the basic forms of representations are not maps of reality implemented as such in the brain, but limit conditions, attractors constraining the cognitive system's evolution in its space state to reach its goals. On a certain threshold of complexity, the system develops stable attractors and attractor landscapes which could be interpreted as standing for something outside the system. This conception offers the advantages of avoiding preemption argument, of unifying the cognitive explanation and, by its interscalar account, offers dynamic tools for building more complex artificial intelligent systems.

KEYWORDS: anti-representationalism, classic cognition, dynamic systems theory, interscalar account, mental representation.

The anti-representationalist challenge

The dynamic theory of mind (or the embodied mind theory – EMT), proposed already in the 90s of the last century by authors as Varela, Thompson, Rosch and many others,[2] is trying to break definitively with the assumptions of the classic

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[2] See Francisco Varela, Evan Thompson, and Eleanor Rosch, *The Embodied Mind. Cognitive Science and Human Experience* (Cambridge: MIT Press, 1991); Rodney Brooks, "Intelligence without Representation," in *Mind Design II. Philosophy, Psychology, Artificial Intelligence*.

cognition. Its slogan is to bring the mind back into the body and the body back into the world.[3] A central feature of the classic cognition is that thinking does not operate directly in and on the things in the world, but through their representations. Of course, the action takes place in the world, but the contact with the real world takes place first at the moment of perception and second when the behavioral output is produced.[4] These processes are external to the mind; they do not influence its core operations.

Anticipated by Dreyfus,[5] the change in cognitive sciences begins with Rodney Brooks' new bottom-up perspective on building robots. In his view, a system is intelligent when it autonomously copes in real time with the environmental challenges. The ambition of classic computationalism is to build intelligent systems, able to solve complex tasks (to play chess, to recognize linguistic sequences etc.). Brooks, instead, wants to set the coordinates within which the robot develops its own actions, starting with the simplest ones.[6] The robot is connected to the world in a much simpler way, by an ongoing sensing of it. It needs no internal world model. The world is its own model.[7] Perception is direct, not mediated by representations. Its result is not taken by another module in order to build a detailed map of the environment.[8] Perception and action are simultaneous, they form a causal loop.

Revised and enlarged edition, ed. John Haugeland (Cambridge: MIT Press, 1997), 395-420 (originally published in *Aritificial Intelligence* 47 (1991): 139-159); Robert Port and Tim van Gelder, eds., *Mind as Motion. Explorations in the Dynamics of Cognition* (Cambridge: MIT Press, 1995); Andy Clark, *Being There. Putting Brain, Body and World Together Again*. (Cambridge: MIT Press, 1997).

[3] Michael Wheeler, *Reconstructing the Cognitive World. The Next Step* (Cambridge: MIT Press, 2005), 11.

[4] During perception, after the physical input stimulates the sensorial interface of the cognitive system, the visual cortex computes this input in order to produce a three-dimensional representation from the two-dimensional projection of things on the retina; these representations are taken over then by other modules of the cognitive system in order to search for solutions and build action plans. Cf. David Marr, *Vision. A Computational Investigation into the Human Representation and Processing of Visual Information* (New York: Freeman, 1982), 23; Jerry Fodor, *The Modularity of Mind* (Cambridge: MIT Press, 1983), 102-103; Zenon Pylyshyn, *Seeing and Visualizing. It's Not What You Think* (Cambridge: MIT Press, 2003), ch. 2.

[5] Hubert Dreyfus, *What Computers Can't Do* (New York: Harper and Row, 1972); Hubert Dreyfus, *What Computers Still Can't Do* (Cambridge: MIT Press, 1992).

[6] Brooks, "Intelligence without Representation," 410.

[7] Brooks, "Intelligence without Representation," 406.

[8] Brooks, "Intelligence without Representation," 404.

Brooks not only 'weakens' the idea of cognitive processes as internal mental workings by emphasizing the constitutive role of the environment in shaping intelligent behavior, but also adopts an anti-representationalist stance. He shows that the new robots are able to exhibit intelligent and flexible behavior without mental representations. There are no mental symbols functioning as elements of the reasoning process. The robot acts directly on the stimuli, not on their representations. Other research in this field highlights dynamic aspects of infants' gait development,[9] of sensory-motor activity,[10] of phonological system,[11] of language,[12] of perception and action,[13] of limb movement according to a metronome.[14]

Adepts of representational theory assert that cognitive systems posses a set of stored concepts and that their main task consist in extracting information from the perceived stimuli, then comparing it with the stored concepts by deductive operations and, finally, sending an appropriate message to the motor areas in order to perform an action. There are many critiques against this linear process. For example, how does the cognitive system know under what concepts to subsume the features of the current situation?[15] The same problem arises for that representationalist who does not subscribe to inneism. An empiricist must explain how the system succeeds in generalizing the relevant cases, given that there are no absolutely identical situations.[16] Roughly speaking, the representationalists encounter either the problem of relevance or of generalization because the number of the relevant things or of the ways of classifying them is, theoretically,

[9] Esther Thelen and Linda Smith, *A Dynamic Systems Approach to the Development of Cognition and Action* (Cambridge: MIT Press, 1994).

[10] Elliot Saltzman, "Dynamics and Coordinate Systems in Sensorimotor Activity," in *Mind as Motion*, 149-174.

[11] Catherine Browman and Louis Goldstein, "Dynamics and Articulatory Phonology," in *Mind as Motion*, 175-194.

[12] Jeffrey Elman, "Language as a Dynamical System," in *Mind as Motion*, 195-226.

[13] M. T. Turvey and Claudia Carello, "Some Dynamical Themes in Perception and Action," in *Mind as Motion*, 373-402.

[14] Scot Kelso, *Dynamic Patterns: The Self-Organization of Brain and Behavior* (Cambridge: MIT Press, 1995).

[15] Hubert Dreyfus, "Merleau-Ponty and Recent Cognitive Science," in *The Cambridge Companion to Merleau-Ponty*, ed. Taylor Carman (Cambridge: Cambridge University Press, 2005), 129.

[16] Dreyfus, "Merleau-Ponty," 130.

infinite. That is why the robot, built according to the principles of Classic Cognition, does not solve the Frame Problem.[17]

In essence, EMT's critiques against the Representationalist Theory of Mind resort to: 1) the dense agent-environment coupling and 2) the absence of cognitive modules that communicate with each other by means of representations.[18] The brain, the body and the environment are equal partners in shaping the intelligent behavior. Consequently, how do we determine that only the neural factors are representational in nature? Secondly, in order to distinguish all the modules of the cognitive system, we have to a) identify the causal role of each cognitive module and b) explain the systemic properties in terms of system's parts features.[19] But the more intricate the relation between brain, body and environment is, the more difficult is to ascribe systemic properties to the system's parts.

Empirically, the neurobiologist Walter Freeman has proven that in case of perception, the aim of the cognitive system is not to create a faithful copy of stimuli. In his studies regarding the neurobiology of olfactory system of rabbits, he has remarked the phenomenon of variance of the neural patterns in the olfactory bulb (the so called AM – amplitude modulation patterns), given that the stimuli were the same. If the cognitivist thesis is true, the AM patterns should covary with the stimuli. The AM patterns variation depends on context, history and significance – whether the stimuli are associated either with reward or with punishment.[20] The AM patterns are not imposed from outside, they are created by the brain according to its own principles of self-organization.[21] When the rabbit perceives significant stimuli, Freeman has observed, strong bursts of energy cross

[17] Daniel Dennett, "Cognitive Wheels: The Frame Problem in Artificial Intelligence," in *The Robot's Dilemma: The Frame Problem in Artificial Intelligence*, ed. Zenon Pylyshyn (Norwood: Ablex, 1987), 41-65; Hubert Dreyfus, "Why Heideggerian AI Failed and How Fixing It Would Require Making It More Heideggerian," in *The Mechanical Mind in History*, eds. Philip Husbands, Owen Holland, and Michael Wheeler (Cambridge: MIT Press, 2008), 331-371.

[18] Michael Wheeler, "Two Threats to Representation," *Synthese* 129 (2001): 211-231.

[19] Wheeler, "Two Threats," 224.

[20] Walter Freeman, *How Brains make Up Their Minds* (New York: Columbia University Press, 2000), 77.

[21] "They cannot be representations of odorants because it is impossible to match them either with stimuli or with pulse patterns from receptors that convey stimuli to the cortex. It is also impossible to predict in detail the patterns that are constructed in the bulb from the patterns of receptor activation, because the constructions are by chaotic dynamics. They cannot be information because that is discarded in the spatial integration by divergent-convergent pathways. They are unique to the history of the individual, arising out of the past experience that shaped the synaptic connections in the bulbar neuropil." (Freeman, *How Brains*, 89-90.)

the nervous system. These states tend toward an energy minimum, which, in dynamic systems theory language, is called attractor. The system's entire activity can be seen as a transition from one attractor to another. The totality of the states tending toward the same attractor forms the attractor's basin. The brain develops basins of attraction for each significant class of inputs. Other experiences tend to integrate these basins of attraction, forming attractor landscapes. These landscapes govern the selection of the appropriate behavioral answer.[22]

The preemption argument

Some authors point out that Brooks and Co., by explaining gait development or limb movements, refer only to the online behavior which is generated by an ongoing interaction with the environment.[23] But there are offline actions, such as imagining counterfactual situations, planning vacations, arranging objects by their value etc., which, given the absence of direct environmental stimuli, require complex mental representations.[24] That is why Andy Clark argues[25] in favor of a hybrid version of EMT, which, on the one hand, will capture the dynamic aspects of agent-environment coupling using the concepts of dynamic theory, such as control parameters, collective variables, differential equations etc., and, on the other hand, will explain the offline actions by means of the classical cognitive sciences terms (representation, cognitive module, syntax etc.).

Fred Keijzer[26] argues that it is not necessary to postulate mental representations in order to explain 'representation-hungry' actions. He admits that there are internal states that determine the emergence of behavior, but the ontology of these states is essentially different from that of representations. There are two key concepts in Keijzer's dynamical explanation of behavior, namely, the control parameters picking out the conditions determining the evolution of the system in its space state and the order parameter describing the pattern of temporary order reached by the system. The control parameters, like, for example, the external stimuli, do not impose a certain order, but determine the system to construct a pattern as response according to its own principles of order.

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[22] Freeman, *How Brains*, ch. 4.

[23] Wheeler, "Two Threats," 214.

[24] Andy Clark and Josefa Toribio, "Doing Without Representing?" *Synthese* 101, 3 (1994): 419-420.

[25] Clark, *Being There*, 126.

[26] Fred Keijzer, *Representation and Behavior* (Cambridge: MIT Press., 2001); Fred Keijzer, "Representation in Dynamical and Embodied Cognition," *Cognitve Systems Research* 3 (2002): 275-288.

Keijzer identifies the control parameters of the anticipatory behavior[27] using the comparison with the morphogenesis. Morphogenesis explains how, starting from an egg cell, an organism develops itself to full maturity. How does the cell know that after some divisions it must transform itself in a bony cell, epidermis etc.? The image of the cell as blueprint – complete developmental model – is, according to Keijzer, wrong.[28] The cell does not contain in itself the entire plan of organism's maturation, the extra-cellular factors being as important as the cell in shaping the organism. The cell is a specific internal control parameter (ICP); it guides the organism's evolution in its space-state, being at the same time part of the organism's dynamics. It pushes the organism to follow a certain 'epigenetic path.' Considering that the ICPs of anticipatory behavior are located at the neural level, Keijzer argues that mental representations do not fit the new picture because the representations function as complete models for behavior, but the neural ICPs are just modulators in a dynamic process of producing order.[29]

In the classic cognition, as Fodor often emphasizes, the concept of mental representation plays the role of offering a rational, logic account of behavior.[30] The order of behavior is encapsulated in the syntax of mental representations. But this is an assumed order and, consequently, a homuncular one.[31] The neural ICPs do not already contain in themselves the order, but they are part of a mechanism of producing order that comprises also extra-neural elements. According to Keijzer, the development of the anticipatory behavior emerges from the codetermination

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[27] This is his term for representation-hungry actions.

[28] Keijzer, *Representation and Behavior*, 209-210.

[29] "In contrast to representations ICPs are intrinsically connected to a regulatory network of which they are a part. Also, ICPs do not consist of models of the external circumstances. Such an interpretation goes right against the grain of the idea of a regulatory trajectory. The macroscopic order is newly generated; it is not already encoded within the organism's ICPs." (Keijzer, *Representation and Behavior* , 241.)

[30] Jerry Fodor and Zenon Pylyshyn, "Connectionism and Cognitive Architecture: A Critical Analysis", in *Connectionism: Debates on Psychological Explanation.* vol. 2, eds. Cynthia Macdonald and Graham Macdonald (Oxford: Blackwell, 1995), 99, 112-113 (originally published in *Cognition* 28 (1988): 3-71).

[31] Distinguishing between intrinsic and derivative properties, Searle criticizes the claim that the brain is a digital computer. (Cf. John Searle, *The Rediscovery of the Mind* (Cambridge: MIT Press, 1992), 209-219). According to the computationalist theory of mind, the hardware level, or the brain, does operate with symbols in accordance with syntactic rules. If it were true that, for example, syntax is intrinsic to physical world, then everything instantiates a syntax, even the wall behind us would instantiate the program Word Star. (Searle, *The Rediscovery*, 208-209). Notions like 'symbol,' 'syntax,' 'program,' 'bits,' etc. always point to an interpreter.

of many scales of organization (sub-neural, neural and psychological scales).[32] Each scale is characterized by proper processes, situated in specific space-time dimension, conditioned by specific environmental stimuli (sub cellular, cellular and macroscopic stimuli),[33] being also in circular causation in which the neural factors modulate the body movements and these movements through a feed-back network influence the neural activity timing. To identify the neural activity with mental representations would mean to focus too much on one particular aspect of causation, neglecting the entire causal network in which they are embedded.[34] Being model for action, the classic mental representations are prior to the action. The agent acts as an intermediary between representation and environment. An ICP does not have significance outside the process of generating the behavior.

Adopting the same anti-representationalist stance, Anthony Chemero formulates the preemption argument.[35] He indicates an experiment[36] with subjects that receive sticks of different lengths (in increasing and then decreasing sequences); they should imagine that using those sticks they can move objects at a distance. Faced with the question whether they can move the object in front of them with those sticks, the subjects give answers that can be analyzed according to an order parameter and a control parameter. The situation is 'representation hungry' because the subjects must predict the result of actions which have not yet taken place.[37] Consequently, the dynamical explanation preempts the representational one: "If one has the complete dynamical story, what is left to be explained?"[38]

Representational states within dynamic systems

Chemero's thesis is that a fully dynamical, hence non-representational, story of our actions is empirically possible. Is this a recommendable strategy? I doubt that this is the case. He explains cases of strong decouplability by resorting to a special kind of oscillators that can keep track of absent stimuli.[39] But the elimination of mental representations is made only at the cost of transforming complex cognitive

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[32] Keijzer, *Representation and Behavior*, 223. See especially, the figure 5.2.

[33] The neural process takes place in a few milliseconds and the psychological one in seconds.

[34] Keijzer, *Representation and Behavior*, 241.

[35] Anthony Chemero, *Radical Embodied Cognitive Science* (Cambridge: MIT Press, 2009).

[36] Iris van Rooij, Raoul M. Bongers and W. (Pim) F. G. Haselager, "A Non-Representational Approach to Imagined Action," *Cognitive Science* 26 (2002): 345-375.

[37] Chemero, *Radical Embodied Cognitive Science*, 40-42.

[38] Chemero, *Radical Embodied Cognitive Science*, 73.

[39] Chemero, *Radical Embodied Cognitive Science*, 54, 57-58.

agent-environment interactions into simple coupled oscillations.[40] In the case of offline actions, there is something in the agent that stands for the absent stimuli. A form of representation is necessary, though one which is different from the classical one. Instead of eliminating the concept of 'representation' (as radical dynamicists do) or of splitting cognitive explanation in two separate discourses (as the adepts of the hybrid version do[41]), I think that a dynamical concept of 'representation' is a better option. A dynamical conception of 'representation' may offer the advantages of avoiding the preemption argument, of unifying the cognitive explanation and, by its interscalar account, dynamic systems tools for building more complex artificial intelligent systems.

My argument is that, although it excludes the classic notion of 'representation,' Keijzer's scalar explanation of anticipatory behavior still encourages a representationalist interpretation. According to folk psychology, the psychological level states (thoughts, desires, intentions etc.) have two fundamental features: intentionality (they are about something) and causal relevance regarding behavior. In what follows I will try to describe the dynamic concept of 'representation' following these two features – intentionality and causal relevance.

The dynamic theory posits a circular causation in which the level S(n-1) acts as control parameter modulating the emergence of order at the level S(n). In turn, S(n) functions as order parameter constraining the activity of the components of S(n-1).[42] Also, the elements of S(n) act as control parameters for the level S(n+1). See figure 1.

[40] Chemero himself realizes that there is something more to representations that could not be picked up with oscillations, momentum etc.: "Noneffective tracking, though, is not sufficient for registration. In fact, noneffective tracking could be accomplished just by causal connection and momentum. (…) In registration, there is a further distancing and abstraction. It requires detachment in that the subject must 'let go' of the object, stop tracking it (even noneffectively). The difference here is like that between knowing your niece will come out from under the other side of the table, and knowing that you won't see her again until next Thanksgiving." (Chemero, *Radical Embodied Cognitive Science*, 57). The latter situation is surely not a case to be explained by oscillators and tracking.

[41] The above sketched preemption argument concerns particularly the hybrid version because only this account splits the cognitive explanation in two different vocabularies (corresponding to the two kinds of behaviors), while one of them can, in fact, cover both domains.

[42] Modulation means here that upward causation in which the components of a system push the system to follow a certain developmental path, without being full-fledged blueprints that determine each step of that path. Constraining means here the downward causation in which the system as a whole imposes some general conditions upon the components.

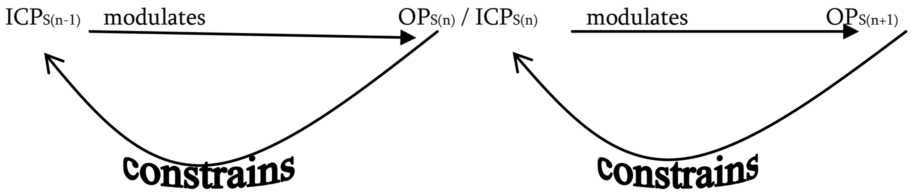

Fig. 1. Inter-scalar ratio between control parameters – ICPs – of the level S(n-1) and the order parameters – OPs – of the level S(n) and ICPs of the level S(n) and the OPs of the level S(n+1).

According to dynamic systems theory, the patterns can simultaneously play a double role: the role of downward causation (as order parameter) and upward causation (as control parameter).[43] For example, the cells make up the body, thereby setting its structure (there are different types of cells, for liver, heart, bones etc.), But the organism's existence as an autonomous entity guide their work.[44] The neuron (level S(n)) is, according to Kauffman,[45] the sequence of order emerging from the complex activity of hundreds of thousands of amino acids (level S(n-1)). At the same time, the neuron together with other many neurons act as ICPs modulating the emergence of anticipatory behavior at S(n+1). They do not dictate the order of behavior because it is not an already-given order; the order is generated during the brain-body-environment interaction.

In my view, the higher level order resulted from the complex brain-body-environment interaction is representational in nature. In dynamic system terms, the representational states are not the $ICP_{S(n)}$s but the $OP_{S(n+1)}$s.[46] The dynamic

[43] The dynamic system "is a set of quantitative variables changing continually, concurrently, and interdependently over quantitative time in accordance with dynamical laws described by some set of equations." (Robert Wilson and Frank Keil, eds., *The MIT Encyclopedia of the Cognitive Sciences* (Cambridge: MIT Press, 1999), 245.) The overall system activity emerges from the structural coupling of its parts, but the systemic properties are new in comparison to those of the parts; they represent more than their sum. Temporal rates of parts' activities are vital for the functioning of the whole and the system's overall state change, which occurs within the parameters set by the components, means the progress to a point in the space-state (that is, the space of all possible states of the system).

[44] Humberto Maturana and Francisco Varela, *The Tree of Knowledge. The Biological Roots of Human Understanding* (Boston: Shambhala, 1992), 87.

[45] Stuart Kauffman, *At Home in the Universe. The Search for Laws of Self-Organization and Complexity* (Oxford: Oxford University Press, 1995), 52.

[46] Mark Rowlands argues in his book *Body Language. Representation in Action* (Cambridge: MIT Press, 2006) that there is a sort of actions, called "deeds" that are intrinsically representational.

paradigm involves a significant change concerning the intentional nature of representational states: the basic forms of representations are not maps of reality implemented as such in the brain, but limit conditions or attractors constraining the cognitive system's evolution in its space state to reach its goals. On a certain threshold of complexity, the system develops stable attractors and attractor landscapes that could be interpreted as standing for something outside the system.

In the contemporary debate around representations, Haugeland's definition of this term is considered orthodoxy. Thus, for an organism to be credited as having representations:

1. It must coordinate its behaviors with environmental features that are not always 'reliably present to the system.'
2. It copes with such cases by having something else 'stand in' for those features and guide behavior.
3. The 'something else' is part of a more general representational scheme that allows the standing in to occur systematically and allows for a variety of related states.[47]

The dynamic concept of 'representation' meets the first requirement simply by the fact that many organisms react to stimuli that are absent. There are cases of dense agent-environment coupling, where we could not find enduring internal states guiding these couplings. For example, in the case of Watt governor,[48] the dynamic codependence between the speed of the engine and the steam pressure can be picked up in non-representational terms. The gill withdrawal reflex in the sea slug *Aplysia* can be studied as a chemical process in which the presynaptic motor neuron release less neurotransmitter due to a blockage of the calcium channels.[49] In such systems there are no enduring states.[50] However, there are more complex cognitive systems whose adaptive behavior is based on past experiences, that is, on enduring states.[51] The current states of the system are

[47] John Haugeland, "Representational genera," in *Philosophy and Connectionist Theory*, eds. William Ramsey, Stephen P. Stich, and David E. Rumelhart (Hillsdale: Erlbaum, 1991), cited in Clark *Being There*, 144.

[48] Thimothy van Gelder, "Dynamics and Cognition," in *Mind Design II. Philosophy, Psychology, Artificial Intelligence*, Revised and enlarged edition, ed. John Haugeland (Cambridge: MIT Press, 1997), 422-429.

[49] Arthur Markman and Eric Dietrich, "In Defense of Representation," *Cognitive Psychology* 40 (2000): 148.

[50] Markman and Dietrich, "In Defense of Representation," 148.

[51] "(…) systems that learn and make use of prior behavior have some enduring states that allow the system to react to new situations on the basis of past experience." (Markman and Dietrich, "In Defense of Representation," 148.)

directly coupled to the stimuli, but to something that is not reliable present (the past experiences).

The second requirement states something more than simply reacting to absent stimuli. It asserts the ontological condition that the representational cognitive systems should have specific internal states playing a representational role. My thesis is that the representational states are not explicit, full-fledged representations of absent stimuli, but an end-state, a goal state that guide the behavior of the more evolved systems. For example, the desire to drink a cup of milk triggers a certain action. This desire is a representational state, because it is an internal event that stands for an absent object. The desire to drink milk is an internal event, but "However, as soon as the action is initiated and I am on my way to the fridge for that glass of milk, my action is an ongoing affair that involves the ongoing scanning of my visual environment, using the results to adjust my movements and so on."[52] In this case, the desire is the permanent internal condition modulating the agent's interaction with the world toward a certain goal. In this case we can observe that there are internal states that do not emerge from the online coupling; they are prior to the coupling and more than that, they guide this coupling.

Hubert Dreyfus believes that such actions are purposive "without the agent entertaining a goal."[53] By means of the concept of 'optimal grip' (Merleau-Ponty) he explains purposive actions as a process of searching for equilibrium states. We are autonomous beings in need to cope with the environment. As such, "we are constantly 'motivated' to move so as to achieve the best possible grip on the world."[54] There is no need of explicitly representing goals because, when the deviation from optimal interaction occurs, the agent tends to look for a better grip on the environment, without knowing what she is looking for.

I think that Dreyfus' account neglects the fact that there could be two kinds of goals. His thesis is valid in situations in which, for example, I sit in an uncomfortable chair and keep moving almost unconsciously till I get the best position. In this case, there is no explicit goal inside the agent. But if I want a glass of milk, it could be either because I am hungry (and I happen to have only milk in

[52] Fred Keijzer and Maurice Schouten, "Embodied Cognition and Mental Causation: Setting Empirical Bounds on Metaphysics," *Synthese* 158 (2007): 119. For Keijzer and Schouten this desire is not a representational state, but simply a "psychological entity." (Keijzer and Schouten, "Embodied Cognition," 118).

[53] Dreyfus, "Merleau-Ponty," 138.

[54] Dreyfus, "Merleau-Ponty," 137.

the fridge) or because I prefer milk. In the latter case, I have an explicit goal, a mental state with specific semantic content: it stands for an object.

Regarding the third requirement, on my approach there is no gap between online and offline actions. For less evolved cognitive agents, the goal (or, in dynamical terms, attractor) means a release from tension. But as the system learns to use past experiences, in order to lower the tension, it develops more complex enduring states. According to Markman and Dietrich,[55] this is the second level of representation (the first one is that of simple mediating states). In the case of complex human cognition, the attractor shapes not just the tendency toward a stable, ordered energy state, but also specifies the semantic content of that end state. When it comes to semantic content, the state is systematically connected to other states, by means of this content. The evolved cognitive systems develop stable attractor landscapes that can be decomposed, rearranged, modeled etc.[56]

Developing further Keijzer's interscalar account of anticipatory behavior, we may find ways of improving the performances of the artificial intelligent systems. We observe that, on the interscalar account, the causal role of the representational states manifests itself in two ways: first, by influencing the neural activity (as order parameter) and secondly, by modulating the metarepresentational level (as control parameters). For example, Herbert, the robot built by Brooks in the 90s, could collect cans by running in parallel simpler actions, such as walking, avoiding obstacles, identifying cans. Its behavior is modulated by an electronic internal parameter. At first sight, the action is non-representational. However, if Herbert has to pick up only the valuable cans,[57] it should develop a new level of action which, in my view, is meta-representational. Herbert has to collect items which have something in common, but not at the level of physical properties. Therefore, Herbert operates not with a purely physical input, but with certain representations (of valuable cans). Only the meta-representational level enables us to grasp the presence of representational states. Herbert's new behavior is presented in figure 2 as follows:

[55] Markman and Dietrich, "In Defense of Representation," 148.

[56] See also, for example, Andy Clark, *Supersizing the Mind. Embodiment, Action, and Cognitive Extension* (Oxford: Oxford University Press, 2008), 27.

[57] This is, according to Clark and Toribio ("Doing Without Representing?"), a representation hungry action.

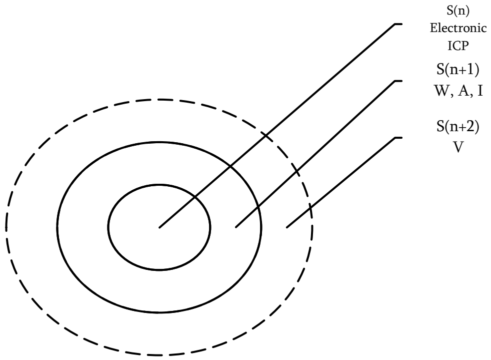

Fig. 2. The scalar structure of Herbert's offline behavior. W = walking, A = avoiding, I = identification, V = identification of valuable cans

The patterns W, A and I represent the order parameters resulting from robot-environment coupling. But they function as control parameters for the pattern V. At the same time, without the level S(n+2), it is not possible to grasp the relational (hence, intentional) nature of W, A and I. The lack of metarepresentations is perhaps the reason why Brooks has defended a nonrepresentational theory of behavior. The metarepresentational level is not condition of possibility for the simpler actions W, A and I as such, but it enables the agent to 'see' its relation to the world. The action V is not possible unless the robot operates with its own perspective on things.

We would not see our relation to the world, if we had not a meta-representational level. As Wittgenstein would say, a representation points to a state of affairs, but not to its own relation with that state. The relation shows itself; it is not part of the representation. Actually, we see the intentional relation by means of metarepresentations, that is, at the level where the subject sees itself as being in relation with the world. Here, we come across the essential meta-representation, the self.

By my argument I try to answer the question whether we can ascribe representational states to the dynamic explanations of mind. However, according to Ramsey,[58] this is a trivial achievement because, as Dennett has showed,[59] even a stone could be described through the intentional stance. In Ramsey's view, the non-trivial questions regarding representations refer to whether there is any explanatory benefit in describing the cognitive processes in representational terms

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[58] William Ramsey, *Representation Reconsidered* (Cambridge: Cambridge University Press, 2007), 33-4.

[59] Daniel Dennett, *Brainstorms* (Cambridge: MIT Press, 1978).

and whether there are internal states that function as representations in a robust and recognizable manner.[60] In reply: yes, we have meant to argue that a representational interpretation of the dynamic explanation of mind is possible; but this is not a trivial achievement, because it offers the advantage of unifying the field of the cognitive explanation. If the explanation were wholly dynamical, it would exclude the offline behaviors, and if it were a hybrid version, it could not explain how the two discourses (dynamic and classic computational) do stay together.

In the dynamic paradigm I propose here, the representational states suffer significant changes concerning their ontological status. In the classic cognitive paradigm mental states are symbols implemented as such in the brain. Hence, their intentionality, their aboutness, is external to them. In the new dynamic paradigm the intentionality of mental states derives from the self-organizing processes of an embodied and embedded agent. The mind spontaneously tends towards its attractors; these attractors are not copies of the stimuli, but express the internal energy equilibrium states to which the system is driven by its own principles of organization, given the impact of the environmental stimuli. Does it follow from this that the intentional objects are just constructions of the cognitive system? In the new paradigm the relation between the intentional state and its object could not be a linear one, namely, from stimulus to representation. The system generates dynamic trajectories in its space-state and stabilizes them in attractor landscapes as responses to the environmental perturbations; in turn, these responses modulate the perceptual activity of the system and so on. Obviously, the difference between classic and dynamic explanation reflects the difference between the textual paradigm and the processual one.[61] Mental states are not static symbols encoding semantic content, but topological entities, evolutions in space-time that constitute their object. From another perspective, the same difference could be understood as the difference between the heteronomic approach where the mental representations are faithful copies imposed as such by the stimuli and the approach based on self-organization, where the stimuli are just affordances that help the organism to enact its own sensory-motor domain of significance.[62]

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[60] Ramsey, *Representation Reconsidered*, 34.

[61] Clark has made this remark in his book *Associative Engines. Connectionism, Concepts and Representational Change* (Cambridge: MIT Press, 1993), 8, in the context where he discusses the virtues of the connectionist networks.

[62] Cf. James Gibson, *The Ecological Approach to Visual Perception* (Boston: Houghton- Mifflin, 1979); Varela, Thompson, and Rosch, *The Embodied Mind* ; Evan Thompson, *Mind in Life* (Cambridge: Harvard University Press, 2007); Dreyfus, "Why Heideggerian AI Failed."