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THE SIGNIFICANCE OF LIFE IN GROUNDING COGNITION

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ABSTRACT. The Significance of Life in Grounding Cognition. In this study I would like to investigate the relationship between life and mind. First, I take up the problem of defining life based on the theory of autopoiesis. Next, I consider the meaning of cognition and I interpret two lines of reasoning regarding the criteria for having a mind and about the beginnings of mind in the living world. I will argue that if we consider the narrow, more familiar meaning of the term "mind", then it turns out that only a subclass of living entities can be regarded as minded, but if we consider the broad sense of the term, that all living systems can be rightly thought of as cognitive. Secondly, the more advanced forms of cognitive processes found in animal life can be thought of as complexified extensions of the basic life-regulative capacities.

Keywords: *life, mind, enactive approach, autopoiesis, agency, autonomy*

Introduction – questions

In this study I want to demonstrate the current phase and results of an on-going research. This is the first part of a bigger project, and it is logically prior to the future research related to this. My central theme is the relationship between life and mind, and based on these results, I want to consider the implications of these conclusions regarding the artificial intelligence research. So, in this work, I want to focus on the first of these interrelated questions, which will be the basis of my further study. In this study I want to consider specifically the question of the meaning of natural cognition, or in other words, the question of what it means to ground the naturally occurring mind in biology. Phrasing it in a different way: what does it mean to say that the naturally occurring cognitive capacities are capacities of *living* systems? Although we know that different kinds of minds were realised in living systems in the course of evolution, this correlation still leaves open the next problem: can the mind be realised in non-living systems too? Is the relationship between life and mind contingent or necessary?

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The classic idea of artificial intelligence research contains the thesis of the multiple realizability of minds, according to which mind can be realized in non-living entities too. This assumption has the implication according to which the connection between life and mind is not necessary and we can speak, on the one hand, about the natural form of cognition, and on the other hand about the realisation of cognition in artificial systems, which doesn't require the biological organizations essential to life. So this assumption contains the thought that we have good reasons to hold the view according to which intrinsic, true intelligence can be realised in non-living systems (for example in robots). In the future I want to question this assumption (based on the enactive approach), but in order to do this I first need this introduction, in which I investigate the meaning of the phenomenon of life and mind, and also the question of what it means to ground the latter in the former.

First, we would like to have a definitional framework related to these two phenomena.

The problem of defining life

Let's start with the crucial question about the criteria used to separate those systems in the world which can be regarded living from those which are not. The reason why this definitional problem is really hard consists in the fact that, even after we come up with a list of characteristics, which can be generalised to hold across the living world, there remains the question about which of these characteristics should be regarded as essential, and which should not. Can we come up with a classical definition, which is based on necessary and sufficient conditions? Can we draw a precise line between the living and non-living systems?

When it comes to defining life, the science of biology in general holds that life has the following crucial, emergent characteristics: *self-organization, metabolism, homeostasis, sensibility, development, adaptivity, reproduction, evolutionary capacity etc.* But this or other, similar kinds of definitions, based on such lists, still leaves us with the following question: are all of these capacities in the list necessary for something to count as a living system? Can there be a living system without having one or more of these capacities?

One of the key discoveries of modern biology is the general idea that all biological systems are composed of the most elementary forms of living unities, namely cells. This discovery really made it possible to state a general proposition about life, but we can still ask, what it is about the cells, that makes them living, or can life exist, which is not based on cells.

One of the solutions to this puzzle comes from Francesco Varela and Humberto Maturana, who came to the conclusion that the essence of life consists of its unique autopoietic organization. The living cell is open to its environment, while constantly exchanging matter and energy. The cell membrane can be regarded as its boundary, which separates the cell from its surrounding[1]. Through its cell membrane molecules get inside the cell, are participating in cell functioning, while certain other molecules exit the cell as waste products. Through this metabolism the cell constantly regenerates itself, including those component parts, which are necessary for the on-going function of the metabolic network. This circular, self-building, self-organizing process is called autopoiesis.[2] Through this process, the cell constantly rebuilds and sustains its invariant organization as well as its own self-identity and its separation from its environment. The reason why this point is important for our purposes, consists of the fact that according to Varela and Maturana, the autopoietic organization is a necessary and sufficient requirement for life (it is debatable whether the original formulation implicitly contained the capacity for adaptivity, and we will return to this issue in the future). It can stand as a criterion, which holds the key for deciding whether certain borderline cases can count as living systems or not. Based on these considerations, the viruses don't fulfil the criteria necessary for life, because they don't have autonomous metabolism.[3]

According to the theory of autopoiesis, the perspective, which puts forward the functioning of the individual organism, is better than those other approaches, which stress the importance of reproduction, genetic information-processing or evolutionary changes. The approach which emphasizes the organismic perspective is based on the thought that although reproduction and evolution are crucial for understanding life, these processes are logically and empirically secondary, because they first require the living organism in place.[4]

For our purposes of discussion, let's grant the definition of life set forth this far. We know that about a few billion years ago the first autopoietic unicellular cells came into being on our planet Earth. In the perspective of big history this was the moment when the soil was ready to plant all other life forms on this planet. Based

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[1] Multiple Realizability. In *Stanford Encyclopedia of Philosophy.* First published Mon Nov 23, 1998; substantive revision Tue Jan 15, 2013. (http://plato.stanford.edu/entries/multiple-realizability/)

[2] VARELA, Francisco J. – MATURANA, H. R: *Autopoiesis: The Organization of the Living Systems, its Characterization and a Model.* North-Holland Publishing Company, Amsterdam, 1974. 188.

[3] THOMPSON, Evan: *Mind in Life. Biology, Phenomenology, and the Sciences of Mind.* The Belknap Press of Harvard University Press, Cambridge–Massachusetts, London–England, 2007. 104.

[4] VARELA, Francisco J. – MATURANA, H. R: *Autopoiesis: The organization of the Living Systems, its Characterization and a Model*. 189.

on our knowledge of life history and evolution we can now see that every living organism is part of the single Life-Tree, which represents the history of life, the unfolding of the many ways in which organism changed over time and adapted to their environments in countless ways. In this history we can highlight a few crucial steps, for example the emergence of eucaryotes, the rise of multicellular organisms etc. In this paper we cannot pursue this remarkable narrative in detail, but we have to ask a crucial question related to this history, namely when, why and how do some organisms acquire capacities which we recognise as cognitive, or minded? When does the mind begin? At this point I am not interested in the scientific question about exactly which organisms in the past became minded, but in the prior philosophical question regarding those criteria which we can use to make another distinction among the living entities, namely the distinction between minded creatures and systems which cannot properly be regarded as cognitive (in this paper I use the term mind and cognitive interchangeably). Related to this question I will consider two lines of thought in the next sections.

The demarcation problem about minded beings. First line of thought: the unique aspects of psychological capacities – intentionality/representation, consciousness

In this section I won't present the theoretical frame of a particular research program, instead I will be focusing on a quite popular way of thinking, which is very general and can be the background framework for more specific theorizing. According to this framework, we have some quite reasonable and intuitive criteria in hand by which we distinguish among the living systems those which are minded from those which aren't. Based on this reasoning, we find it quite obvious, that in the course of evolution the mind emerges quite late, so that there were many organisms living on Earth in such a way that they were not minded by any standards. This line of reasoning holds that it would be too absurd to say that all living entities are minded. The separation of the living beings into the minded and un-minded entities rests on a criterion according to which life is not sufficient for having a mind and in order for a system to count as minded it needs some additional capacities which point beyond mere biology (of course not in the sense of Cartesian dualism). Compatible with this thought is the idea that mind or psychology is a new, emergent level of reality, which transcends mere biology. While biology studies the living processes of living beings, psychology (in the broad sense) focuses on the minded capacities and the behaviour generated by these capacities of those living creatures, which make up a class in the living world – the subcategory of the living, but also minded beings.

If we follow this way of thinking, our most important job would be to investigate this supposedly obvious criterion. On what grounds do we think that not all living beings are minded? What would be the criteria for having a mind? We can provide different answers to this question, but maybe the two most important characteristics, which we usually think of as providing necessary and sufficient conditions for the presence of mind, are intentionality/representations and consciousness (one or both, depending on the way we think about their relationships).[5,6] These capacities are usually thought of as correlating with the emergence of the nervous system. With this change the mere biological bodies become extended with neuronal circuits, which make the control and regulation of the body possible through representational processes too. Because not all living systems are endowed with these capacities, it follows that not all living entities can be part of the class of minded creatures. According to this reasoning, psychological capacities begin in evolutionary time when we can speak about the emergence of representational capacities in unconscious or in conscious forms.

We can make a list about different mental capacities in general, and in doing so we can be more specific about the different modalities the representational/ intentional capacities can take.(By mental modality I simply mean the different types of minded capacities – for example sensation is different form cognition. There are more encompassing categories, which hold together more specific ones – for example, inside the category of sensation, we can speak about auditory or visual modalities). In harmony with this frame of thought, we can carve up the mental world into the following classes: 1.sensations (includes all processes of interoception and exteroception, like pain, touch, kinesthesia), 2. conative-motivational states (drives, wants), 3.emotional states and moods (fear, anger) and 4.cognitive states (attention, memory, planning, drawing inferences, concept formation, decision making etc.).

The most important specification about this list can be summed up in the following line of thought: a concrete individual minded being can have a unique configuration of a set of mental capacities. The cognitive entities may differ from each other depending on how rich or poor, how complex or simple is their mental repertoire (relatively speaking). The same capacity can have multiple forms and qualities, depending on concrete realisations of it. For example, common sense knows it well that the olfactory capacity of the dog is much more sophisticated than that of humans. We can't forget the fact that there are unique species-specific

[5] CRANE, Tim: *Elements of Mind. An Introduction to the Philosophy of Mind*. Oxford University Press, New York, 2001. 3.

[6] McGINN, Colin: *The Character of Mind*. *AnIntroduction to the Philosophy of Mind.* Oxford University Press, New York, 1996. 8.

capacities too – for example the bats navigating systems of echolocation. Between the many modalities there exist complicated relationships, because some of them can only exist as coupled with others, or based on others. Some of them are more basic or have a constitutive role in others' existence. It's obvious for example, that in order to have a conceptual apparatus, there has to be first a range of sensory information, because perception (identifying things) requires the more basic level of sensation. Furthermore, the different modalities sometimes fuse together, influence each other and often it is hard to separate them rigorously (emotions have cognitive components, for example the evaluations of situations).

Given the many varieties, the crucial generalisation could be the following: a living system by these considerations can be regarded as minded, only if it has some form of representational-intentional capacities, or can process information in this relevant sense.

Other fundamental concepts in grasping cognitive systems

In order to better understand those criteria which can be used in separating the cognitive systems from the entities not having minds, we need a whole range of other concepts.

Right now I will only point to these in a nutshell. One crucial aspect of cognition refers to the abilities to gain knowledge about the world, to acquire ideas, to be able to make sense of things and operate with concepts. We see in these capacities the mark of advanced forms of intelligence and the fundamental goal of the A. I research is to create systems which are capable of these kinds of mental operations. But if we want to build machines capable of these kinds of "higher level forms of intelligence", we cannot forget those more fundamental bases, which ground these levels in the first place. First of all – conception, understanding, having propositional attitudes, mastering a language – all require the so called symbol grounding[7] or in other words, the many varieties of pre-propositional experiences. The sensory experience is in turn inseparably bound up with the movements and interactions with the environment.[8] Clearly, this requires embodiment, embededness in the world and actions, while these, of course, require agency and teleology. However, insofar as teleology is not grounded in the system's own motivational bases, the system's teleology remains pseudo-purposive, which is imposed from

[7] HARNAD, S: *Minds, Machines and Searle*. Journal of Theoretical and Experimental Artificial Intelligence 1: 5-25. 1989.

[8] NOË, Alva: *Action in Perception*. The MIT Press, Cambridge, Massachusetts, London, 2004. 1.

outside.[9] That is the reason why it is necessary, when building an artificial intelligent system, to create something akin to the motivational and emotional life of biological organism, through the light of which the system can have some interest (in doing whatever). But this kind of real teleology and agency require autonomy at its core.

This compressed line of thought (which we will extract in details) calls our attention to the fact that, when thinking about the essence of cognitive systems, we have to take into account not just the question of intentionality and consciousness, but also other fundamental concepts, like individuality, agency, autonomy and teleology. Interestingly, this points back to the organization of life itself, which from its beginning shows these characteristics. So based on these considerations, we have to rethink the boundaries of mind in the living order.

The demarcation problem about minded beings – Second theoretical frame: the enactive approach, the continuity thesis

According to the enactive approach in cognitive science (which was introduced by Varela, Thompson, Rosh in their book, *The embodied mind*) the basic organizational principles of life need to be considered when trying to understand cognition in nature. Life from its inception is already mind-like, and conversely, mind is always life-like. The two processes unfold in a continuum.[10] How is that possible?

The first step would be the thought according to which biological and cognitive systems are autonomous entities. Autonomy in the first instance means self-regulation and self-creation. The specific way, in which processes in the system relate to each other determines the system's autonomous character. More specifically: the processes constituting an autonomous systems network **a.** recursively depend on each other for their generation and realization as a network **b**. give rise to a unity in whatever domain they exist **c.** specify a domain of possible interactions with the environment.[11] The paradigm case for the autonomous system is the cell's autopoietic organization. The meaning of the autonomous system doesn't imply independence from the environment, but it rather means that the autonomous system can give itself laws or settle its own norms. In contrast with the autonomous systems stand the heteronomous ones, those which are determined from the outside: for example systems which are designed, built and controlled by human

[9] ZIEMKE, T – FROESE T: *Enactive Artificial Intelligence: Investigating the Systemic Organization of Life and Mind*. In: Artificial Intelligence 173 (2009) 466–500. 14.

[10] THOMPSON: Mind in Life. *Biology, Phenomenology, and the Sciences of Mind.* 128.

[11] THOMPSON: Mind in Life. *Biology, Phenomenology, and the Sciences of Mind*. 44.

designers. In these cases the norms which govern the system's behaviour would not properly count as the system's own laws, because these derive from the outside designers. In the domain of biology then, the self-determined character of autonomous system implies not just the capacity for self-regulation, but also the capacity for self-building, self-creation. Autonomy requires an active, self-sustaining identity creation.

By identity in this point we have to think about the *organizational closure*, the interdependence of the system's internal components and processes. The system's network components and processes define the system's unity in the world in a self-referential, circular and recursive manner. The autonomous system's components affect each other in such a way as to create a closure and with it a unity, brought forth by these inter-relationships and mutual dependencies.[12] According to the enactive approach, the autopoietic organization of the cell, the minimal form of autonomy (together with adaptivity) is already a cognitive system. In other words – life, form its very inception is minded (in a specific and broad sense). From this it follows that looking at the functioning of the first unicellular lives we can already figure out those organizational principles, by which we can understand why all life can be thought of as minded (and not just those organisms, which are endowed with nervous systems with enough complexity). Let's look at the minimal form of cognition (in this case the organism is one single living cell):

The unicellular organism, through its metabolism constantly changes its own material components, while sustaining a formal, dynamic, invariant identity. The sustaining of life processes however, require that the dynamic activities inside the organism should work in the range of certain parameters – let's just think about the amount of certain materials, or the level of the temperature etc. Life-processes can only work within certain parameters, which are compatible with the on-going life-regulation. We can speak about the optimal circumstances, in which the management of life can be very efficient, and we can speak about the different levels of equilibrium break-up. Life has the essential capacity of *homeostasis*, the regulation and maintenance of equilibrium.[13]

Strongly related to homeostasis is the other essential characteristic of life, namely *adaptivity*. In order to better understand this capacity, we can start from the fact that the autopoietic system, embedded in its environment, is always facing uncertainties, disturbances, dangers, obstacles but also opportunities which could positively contribute to the good management of life regulation. The living system

[12] THOMPSON: Mind in Life. *Biology, Phenomenology, and the Sciences of Mind*. 45.

[13] DAMASIO, Antonio R: *Self Comes to Mind. Constructing the Conscious Brain*. New York, 2010.

already has certain powers and tolerance to survive some kind of disturbances. But the capacity of adaptation points beyond this, because it requires that the organism is able to have some sensibility of its own internal states (primitive "monitoring"), of the negative and positive (actual or possible) environmental effects on its own functioning and furthermore, to be able to have some form of evaluation and to show some tendency toward avoiding dangerous situations, to make the best out of the positive opportunities and to regulate its behaviour accordingly.[14] In order to provide am example we can now speak about the behaviour of the much discussed bacteria, E.coli, which shows this kind of behaviour pattern. The bacteria have the tendency to avoid dangerous environmental situations and to swim toward the nutrient rich environment. Adaptivity then requires a lot of other crucial capacities, which will be now taking into account.

Given the description of the autopoietic organization, we can see as outside observers which are those circumstances, effects, conditions, which can positively contribute to the maintenance and workings of autopoiesis, and which can affect it in the negative way. But meanwhile we can observe that the system itself is somehow able to be sensitive to these circumstances (on a certain level)and through its homeostasis and adaptivity is able to regulate itself in such a way, that in light of this we can state that it behaves precisely according to the *norm* of life sustaining. If we are considering a mere physical, but non-living entity, which was affected by a destructive force, it would be very strange to say that this effect was bad for the thing itself, but this idea becomes very natural in the moment when we are considering living systems, regardless of the fact that they have or lack consciousness. So the value of sustaining life cannot be just an outside projection, because we can see that living systems behave according to this norm, which they have "internalised". Of course, this normativity and evaluation is not a conscious process, but still, living systems are able to have some form of "discrimination" and "evaluation" even if these processes are not mental or conceptual in the usual senses of these terms. And all this is valid even in the case of bacteria (of course the evaluation of situations in the light of the norms of survival doesn't mean that the organism is sensitive to all effects and conditions, it just means the capability of some kind of evaluation).

From these thoughts it becomes clear what it means to say that according to the enactive approach living entities can accomplish something which is called *sense-making*, because we can see that organism have mechanisms, through which

[14] DI PAOLO, E. A. *Autopoiesis, Adaptivity, Teleology, Agency*. In: Phenomenology and the Cognitive Sciences. 4: 429–452. 2005.

they can enact meaning, values and significances (of course we have to keep in mind to use these terms in a very broad sense). And these activities don't require a nervous system of any kind. So, for the bacteria some level of temperature is not just a mere physical fact about the world, but it is evaluated as good or bad, depending on the relation it has to its own norm of life-regulation. Similarly, the sugar as nutrient cannot be observed through the lenses of physics, because it is a relational property, which reflects the needs of bacteria and the value associated with its own life-regulative behaviour. In this respect the living organism, through its interaction with its environment enacts an Umwelt. This environment cannot be captured only by physics, because for the living being it has surplus of significance – something can be food, shelter, poison etc. which are all relational properties. The organism constitutes a perspective through which it can evaluate things in its environment.[15]

From all of these considerations it follows that we can speak about the living organism as an *agent*, which, by the light of the thoughts so far, means: that autonomous, identity-creating and sustaining self-regulation, which makes it possible the adaptive behaviour to the environment in precarious conditions. So agency requires an individual entity, which, through the light of its norms, can actively regulate its own behaviour in its environment.[16] The normativity is very important, otherwise the activity could be totally random. The behaviour, through norms can become directional and purposive.

Cognition then, is basically the already explained meaning-creating adaptive conduct in an environment. It's important to note that this kind of cognitive behaviour reflects the sustaining of autopoiesis. This self-organization defines a domain of interaction with the environment, in which the system can behave in accordance with the relevance of its own identity-sustaining norm. Cognition refers to this kind of behaviour or self-regulative activity.[17]

Let's go back for a moment to the capacity of adaptivity and homeostasis. The action-tendencies related to the life-regulations were already in place in the first unicellular. This capacity presuppose the organismic sensibility to its own needs (some kind of primitive monitoring), and the tendencies to satisfy these needs. We can associate with this the thought, according to which in some way, life, already from its start, has some form of „instinct to carry on", „desire to survive", „concern for its own existence", „care for its own needs". From this pattern it becomes even more obvious to treat the living entities as autonomous agents, who enact their

[15] THOMPSON: Mind in Life. *Biology, Phenomenology, and the Sciences of Mind.* 153–154.

[16] BARANDIARAN, X., DI PAOLO, E. & ROHDE, M.: *Defining Agency.* Journal of Adaptive Behavior, 2009.

[17] THOMPSON: Mind in Life. *Biology, Phenomenology, and the Sciences of Mind.* 124.

own problem-space and with it their own problem-solving capacities. If it's reasonable to speak even about the first living beings as agents with cognition, evaluation, significance (as it happens in the enactive approach) we can also speak about the roots of the early forms of intelligence, namely, those problem-solving capacities, which are there for handling the difficult situations facing life-maintenance.

Moreover, the meaning of one kind of teleology becomes clear, because the reason why the language of teleology comes to us naturally when applied to living systems (as opposed to non-living entities) comes from their norm governed autonomy, which enable purposive behaviour.

From the enactive approach, the roots of intentionality (in the phenomenological sense) also points to the origin of life, because if we regard the intentional capacity as the constitution of a world from a perspective in such a manner that this disclosure of a world bears the stamp of the subjective conditions of possibility of experience, than the origin of this correlation is precisely the enactment of an Umwelt.[18]

The resolving of the contradiction between the two presented approaches

While according to the enactive approach all living things are cognitive-minded[19], the most widely held view is that life doesn't imply this equivalence. As we saw it before, in the latter perspective you need to have some additional criteria for separating the minded living beings from the non-minded ones, which cannot be cognitive systems, because they lack those requirements which are necessary for cognition. These requirements, of course, can vary, but among the usual ones we find the necessity of the nervous system activity, or some kind of intentional capacity with conditions of satisfactions or accuracy conditions. From these comparisons we can immediately see the contradiction of these two perspectives, but in my opinion this can be resolved in the following way: we can speak about the narrow or the broad extension of the concept mind. The point is to recognise that actually both perspectives can be right depending on which concept they operate with. Of course, by the usual sense of the word "mind", we understand psychological states, which are clearly lacking in unicellular organisms or plants. In this sense the right approach would be that one, which sees the emergence of mind in evolution as a new property beyond mere biology. But in the enactive approach,

[18] THOMPSON: Mind in Life. *Biology, Phenomenology, and the Sciences of Mind.* 159.

[19] VARELA, Francisco J. – MATURANA, H. R:*Autopoiesis and Cognition.* D. Reidel Publishing Company, Dordrecht, 1972. 13.

the unusual usage of the term cognition as applying to relatively simple living systems doesn't mean that we are taking the usual term (with the same meaning) and without any rational justification we force it to be applicable even to describe the behaviours of simple organisms.[20] In other words, the enactive approach does not state that relatively speaking simple organisms are conscious, or have representational or intentional capacities the same way as those living entities which are endowed with nervous systems or brains. For exactly this reason – at least if we are not concerned with other possible differences – we won't come up against contradictions, because the enactive approach admits that we can speak about the narrower or broader concept of cognition. So, in the broader sense then, all living system are cognitive, but in the narrower respect, only a part of the living world can be properly regarded as minded.

The origin of animal minds

Even after we have resolved the seeming contradiction before, we can still ask how and why the capabilities associated with the narrower concept of mind emerge in the living world(sensations, thinking, emotional life, which all require the usual sense of representational/intentional capacities or the different forms of phenomenal experiences).

With the rise of multicellular organisms (the second order autopoietic systems) the basic form of life and mind becomes much more complex. With animal life the original life-regulation and adaptation takes a richer form. We see the beginnings of those cognitive capacities which are more familiar to us, and about which we can use our term "mind" in a more natural way. But the origins of these capacities all points back to the activities of the early life-forms, because we can't forget about those grounds, which were put in place by the unicellular entities. In a certain sense what happens is that those basic organizational principles, which governed the unicellular systems, are now being brought back in a much more sophisticated way into the lives of the multicellular entities.

The primordial sensitivity to the inside/outside world and the related movements (let's think back to the activity of the bacteria, while approaching sugar or trying to avoid the dangerous environment) are now coming back in a complex sensory-motor form, based on the nervous system. The sensation directed to the outside world, or in other words – exteroception – will take the form of touch,

[20] THOMPSON: Mind in Life. *Biology, Phenomenology, and the Sciences of Mind.* 159.

vision, olfaction, gustation, audition. The sensation directed at the inside environment, namely interoception, proprioception, kinesthesis will provide the organism with a rich array of information. Because animals, unlike plants, have the need to search for food, the appropriate regulation of movements becomes crucial. Sensations would be impossible without movements, and inversely, movements would be impossible without sensations. In this sense, there is a circular interdependence and interplay between these two processes.

But the coordination of movement and sensation, the navigation through the environment needs some sort of directions and frames of relevance – otherwise the sensations and movements would become purposeless. There have to be some drives and motivations, in light of which this can be achieved. Of course, in the most fundamental sense, this role is played by the norm of life-maintenance and reproduction. The early form of homeostasis becomes more complex, because the biological needs will end up reaching to the level of psychology too, in the forms of those processes, which are witnessed by the animal as experiences of pains, exhaustion, hunger, thirst, sexual arousal etc. These organismic processes are signalling the states related to the equilibrium, the needs of the organisms and its satisfaction or dissatisfaction. As the equilibrium gets to an undesired state, it causes tension in the animal, motivating it to regulate its behaviour in such a way as to re-establish its well-being. If we look at these balancing states at the level of experience, the optimal level of homeostasis, and the states which are departing from it, we find those positive and negative bodily feelings and sensations, which constitute the first forms of experiences of well-being or suffering. The satisfactions or dissatisfactions of the needs can play a role as rewards and punishments in the regulation of life and it will have an important role to play in the process of learning (obviously, the pleasures are correlated with the satisfactions and become motivating forces to repeating and enforcing those patterns of behaviours, which were contributing positively to the good management of life).

Of course, the well-being and equilibrium of the internal bodily environment (getting the right amount of food and securing the right level of energy and temperature etc.) is not a process which only requires the regulation of the internal activities, because this achievement depends on the right interactions with the outside environment. This requires the animal being capable of sensing the environment in such a way as to be able to evaluate the significances of the stimuli for its own life. So the sensing of the environment has to incorporate detection mechanisms, which enables the animal to sense danger (for example predators) shelters, foods in contrast to poisons etc. There is the need for sensing and evaluating not just occurring stimuli, but sensing opportunities in an anticipatory way and so having some predictive power

either for the purpose of taking the right action when there is a favourable situation, or for avoiding a dangerous condition. The significances are brought forth by the light of the norms of life-sustaining and reproducing. So the fundamental biological and psychological well-being depends on taking the right actions, which in turn depend on this evaluative capacity, but of course we don't need to suppose that in animal life this process is accompanied by a conceptual understanding and conscious reflection.

From this perspective we can understand the significance of the basic emotional systems too. According to Joseph Ledoux, we can speak about different survival circuits in organisms, which are there for enabling survival and each system has its own role in defence, the balancing of energy, nutrition and fluids, temperature regulation and recreation.[21] Each system is dedicated to evaluate the occurring or expected challenges and to motivate reaction tendencies, which are appropriate to the computed significance of the stimuli. These systems are sensitive to specific environmental effects and after sensing the right stimuli they actuate a range of innate and learned responses to cope with those challenges, which are facing the organism. Many such activities can be called emotion. For example, fear is the action tendency in the defence mechanisms. The subjective experience of emotion emerges when the organism is able to witness these kinds of activities. The emotions are contributing to the basic motivational states, like, hunger, thirst, sexual arousal, because they have additional powers and drives in their core. Fear helps to flee, aggression helps in fighting or taking revenge, curiosity moves the organism to explore the environment, disgust helps avoiding poisonous material intake, pleasure signals the state of well-being and enforces those activities, which help maintaining this state etc.

The norm of life-maintenance, together with the sensing of the needs and motivational powers settles the directions and frames of relevance for the activities of living organism, in the light of which we can also see how cognition, which was traditionally referred to as "cold" can have its direction and meaning. Life-regulation establishes a core for the cognitive capacities of animals – discrimination, attention, memory, planning, prediction, learning, decision-making – in such a way as to establish an appropriate frame of relevance for the problems and for the problem-solving capacities, otherwise, cognition would stand without grounds, without directions, relevance and values. In other words – if we deprived cognition from the processes of motivations and affections – it would become groundless and purposeless. So the cognition in a more narrow sense can only find its place in harmony with the emotional and motivational basis and this basis comes from the characteristics of life-regulations.

[21] LeDOUX, Joseph: *Rethinking the Emotional Brain*. Neuron Journal, Volume 73, 2012. 655.

Conclusions

Let's think back to the third section, where I tried to give a classification of mental capacities (sensation, motivation, emotion, cognition). These capacities are actually the activities of organism brought about by their autonomous mode of being. If we look at these mental activities in the context of life, we immediately see that natural cognition refers to the activities of the *living bodies* in such a way that the more advanced forms of cognitive processes fond in animal life are complexified extensions of the basic life-regulative capacities, or arise from more basic life-mechanisms. Now, this thought only points to the strong relationship between psychology and biology in this bottom-up approach (just to be clear, my whole presentation was not meant to be reductionist, my point was to find the ground from which a system of thought can be built). From all of these discussions we can see on the one hand how life itself can be sufficient for mind, or if that sounds too radical, we can see the logic behind the way in which mind arises from life. The really interesting problem however, is to investigate the question whether life is also necessary for having a mind.

Although today, the attitude of the embodied cognitive science perspective doesn't treat the mind as purely disembodied abstract computational information-processing, the emphasis on the crucial role of the body (besides the enactive approach) does not mean the thought that maybe the body as *living* body is necessary for the realization of cognition. Even within the enactive approach the question whether life is necessary for mind is an open problem for the future. Interestingly, there is a distinction between autopoiesis and autonomy in the sense that autopoiesis meant to be just one kind of autonomy.[22] So from these considerations the gates are open for those who wish to argue that autonomy can be realised in non-living form in a way as to support genuine cognitive processes. However, we have to keep in mind life's unique mode of being, namely what Hans Jonas called needful freedom, the way in which life constantly and necessarily has to keep doing its self-sustaining processes in order to even exist.[23] This character of life is crucial in grounding the needs, drives, motivations of natural agents, or what we can call in one word: care. It is not obvious how this base for agency and teleology can be accomplished without life.

[22] VARELA, Francisco J. – MATURANA, H. R: *The Tree of Knowledge.* Shambhala Publication, Boston and London, 1998. 48.

[23] ZIEMKE, T – FROESE T: *Enactive Artificial Intelligence: Investigating the Systemic Organization of Life and Mind.*14.