

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/226504996>

Nonlinear Cobweb of Cognition

Article in *Foundations of Science* · August 2009

DOI: 10.1007/s10699-008-9143-x

CITATIONS

3

READS

31

1 author:



[Helena Knyazeva](#)

National Research University Higher School of Economics

35 PUBLICATIONS 86 CITATIONS

SEE PROFILE

Nonlinear Cobweb of Cognition

Helena Knyazeva

Published online: 15 August 2008
© Springer Science+Business Media B.V. 2008

Abstract The modern conception of enactive cognition is under discussion from the standpoint concerning the notions of nonlinear dynamics and synergetics. The contribution of Francisco Varela and his precursors is considered. It is shown that the perceptual and mental processes are bound up with the “architecture” of human body and nonlinear and circular connecting links between the subject of cognition and the world constructed by him can be metaphorically called a nonlinear cobweb of cognition. Cognition is an autopoietic activity because it is directed to the search of elements that are missed; it serves to completing integral structures.

Keywords Autopoiesis · Complex systems · Embodied cognition · Enaction · Non-linearity

The world that surrounds me and what I do to reveal myself in this world are inseparable. Cognition is an active participation, a deep co-determination of what seems to be external and what seems to be internal.

Francisco Varela

1 Situated Cognition: Links of Reciprocal Determination

The modern epistemology is essentially based on models from the evolutionary epistemology, the information theory as well as from nonlinear dynamics and synergetics. One of the most interesting and promising conceptions, which is nowadays under development in epistemology and cognitive science, is the conception of *enactive cognition*.¹ An important contribution in its development was made by Francisco Varela (1946–2001) who was one of the most brilliant and creative thinkers of the present. In its frames, a whole series of classical

¹ There are different names for this conception: embodied cognition, situated cognition. Following Francisco Varela, I prefer to use the term “enactive cognition”. Enaction is a complex term signifying an active embedding or an inculcation of a subject cognition in the surrounding world.

H. Knyazeva (✉)
Institute of Philosophy, Russian Academy of Sciences, Moscow, Russia
e-mail: helena_knyazeva@mail.ru

epistemological problems can be stated and solved differently. The following problems are among them:

- dynamics of emergent properties of personality in cognition (the coming-to-be of the self in acts of cognition, the appearance of new existential qualities of the self which cannot be derived from its former qualities),
- the openness of cognitive systems as a condition of their self-organization and their operational closeness as a condition of maintenance of their identity,
- local and global links nonlinearity in the aspect of individual cognitive acts,
- autopoiesis, i.e. self-production of cognitive systems and structures, etc.

The most important novelty is the notion of *cognition situatedness* and the loops of *non-linear feedback* which are being established between a subject and an object of cognition as well as between the individual mind and networks of the collective mind. These nonlinear and circular connecting links between the subject of cognition and the world constructed by him can be metaphorically called a *nonlinear cobweb of cognition*.

Some important peculiarities of cognitive activity in a subject's brain are reflected, in my opinion, in such a metaphorical image of a cobweb.

Firstly, the multitude of direct and reverse connecting links, branchings and bifurcations of the network in which a subject is an active knot.

Secondly, inseparability of the internal and the external in cognition (the views are represented in the epigraph to this article). The cognitive activity of a spider, according to Konrad Lorenz, is its life. It directs the world by creating a cobweb, i.e. extending itself into the external world. Similarly, a subject in his cognitive effort isn't pushed aside from the world, but he is built into it. As a matter of fact, he directs and studies himself projected on this world. The mystery of being can be clued up, as far as it's possible at all, only by a subject who stretches his cognitive palpus far away. On the one part, the natural aspiration for getting more objective results of cognition (for liberation from a seal of subjectivity) is an aspiration as it was uncommonly expressed by Konrad Lorenz, to pull oneself by hair out of a swamp, as Baron Munchausen did that. The history of science testifies that a seal of the human subjectivity lies on all products of human knowledge. On the other part, the infusion subject in the world is, according to the Buddhist worldview, a right way to the truth in cognition of the world. The Buddhists say that a subject that opposes himself to an object is being torn away from the world and from himself; when cognizing oneself, one cognizes everything as it is, as such.

Thirdly, there is an active and constructive source in any cognitive activity. A spider spins a web, and through such activity in the external world, it actively copes with the world, cognizes it. The cognizing subject not so much reflects the world as constructs it.

Fourthly, the act of cognition is the act of reciprocal determination of a subject and an object. A spider spins its web, and the web builds the spider as well. The cognitive subject is such as the world mastered by him and created by his activities. The cognitive action in the world and through the world constructs the subject.

When turning to the language of epistemology, I would like to underline that it is impossible to understand cognition if a researcher disengages himself from a living organism which is always inserted in a certain situation with a peculiar configuration, i.e. acts in certain environmental conditions. The cognitive act extends into a certain situation possessing definite topological characteristics. The relations of a cognizing subject to the surroundings are essential. The complexity and nonlinearity of loops of feedback which accompany any act of cognition signify that a subject and an object of cognition mutually determine one another, i.e. they are in relations of co-determination, they make use of reciprocally afforded

opportunities, waken each other, are simultaneously born, are being co-created, and undergo changes in cognitive action and due to it.

The cognitive psychology becomes an ecological psychology, and equally the cognitive science studying the human mind in all its manifestations becomes *synergetic* (since a synergism of an organism and environment exists there, their constructive mutual connection) and *ecological* (since cognition is determined by a situation) science. One can speak now both of ecology of the cognizing mind and of *ecological cognitive niches*. Only when rightly, resonantly integrated into the scientific medium, into the scientific community, a scientist can disclose his talents, realizes himself in science. Otherwise, he will feel, entirely according to Aristotle, the “pressure of place” upon himself, the pressure from the side of already occupied cognitive niches and will be forced to rebuild himself.

Such notions are blown by ideas of the Anglo-American psychologist Gregory Bateson (1904–1980). He developed a kind of cybernetic epistemology and introduced the notion of a loopback, loop structures, i.e., as a matter of fact, of the nonlinear circular causality, of ambiguity and retroactivity of relations which are established between the individual mind and the medium of his activity and communication, other individuals. As applied to the sense of messages, he spoke of “double bind” or “double command”, i.e. text and context of messages which could be entirely opposite to each other. The individual mind oversteps the limits of its bodily definiteness and dissolves in its ecological surrounding, in the nets of collective mind. “The individual mind is immanent not only to the body, but to contours and messages outside the body. There exists a great Mind as well, and the individual mind is only a subsystem of it” (Bateson 2000/1972, p. 246).

Bateson makes reference to the principle introduced by William Ross Ashby (1945) and shows that for stable existence of complex interactive systems of individual and collective mind, a certain part of chaos is necessary. Permanent changeability and variability of relations, diversity of constituent element guard such complex systems against big fluctuations which are able to destroy their system organization. A system must fluctuate constantly in order one of its fluctuations would not once become mortal for it. “A stable state and the enduring existence of complex interactive systems depend on the prevention of maximization of any variable, and an uninterrupted increase of any variable will inevitably lead to irreversible changes of such a system which will confine the increase. . . Under such conditions it is very important to allow some variables to change. . . Similarly, a rope-walker with a balancing pole can maintain his equilibrium only by varying forces which he imposes to the pole” (Bateson 2000/1972, p. 155).

To interactively build into a natural or social medium and to act adequately to the recent cognitive situation signifies, therefore, to understand the ambiguity and relative unpredictability of a response that can be received from the medium as well as the complexity and nonlinearity of loops of feedback that can be established here. At the same time, it is important to permit a certain part of chaos, of inner mobility and flexibility in an arisen system of nonlinear negative and positive feedbacks as well as to know how to use rules of resonant embedding in a medium for the formation of united and stably evolving a whole.

2 Conceptual Shifts in the Modern Epistemology

The notion of cognition situatedness is one of a whole series of interconnected and partially overlapping notions which are being nowadays intensively developed in epistemology, in particular, and in cognitive science as a whole. The new approach under development to understanding the functioning of the human brain and consciousness (mind) is often called

the embodied cognition approach in cognitive science. The essence of occurring conceptual shifts one might summarize in the following six basic theses.

(1) *Cognition is embodied*: cognition is both mental and corporal function of a human being; cognition is enveloped in bodily covers and is determined by a human body, i.e. is conditioned by meso-cosmically formed abilities² of a human body—to see, to hear and to sense. What is cognized and how it is cognized depend on the construction of body and its concrete functional peculiarities, on abilities for perception and for motion in space, on mesocosmic definiteness of a human as an earthly being. What is arranged differently cognizes the world differently.

Whereas earlier specialists in epistemology said that cognition is *theoretically* laden (that is to say, what we see is mostly determined by our available theoretical notions), nowadays, in the frames of the modern epistemological conceptions, one may assert in addition that cognition is *bodily* laden as well. There are bodily threads managing mind's activity. Psychosomatic ties are built according to the principle of nonlinear circular causality. The body and the mind, the brain and the consciousness are in relations of circular, mutual determination.

This thought was boldly expressed by Friedrich Nietzsche in his own way already in 1881: "We, philosophers, are not free to draw a distinction between the soul and the body, as people does it. . . . We are not at all thinking frogs that are non-objectivizing and recording apparatus with coldly established gibles,—we should incessantly give birth to our thoughts from our pain and motherly impart all what we have to them: blood, heart, fire, cheerfulness, passion, torment, conscience, destiny, fate. To live means for us to permanently transform all, we are constituted of, into light and flame as well as all, what we don't get in tough with,—we cannot do differently" (Nietzsche, 1990, p. 495).

(2) *Cognition is situated*. A cognitive system is *embedded*, implanted both internally (in a material neural substratum ensuring its activity) and externally (it is inserted in situational physical and socio-cultural surroundings).

(3) *Cognition is enacted*: cognition occurs in action and through the action. Through actions and through motor activity cognitive capabilities of a living organism are formed both in ontogenesis and phylogenesis. The cognitive activity in the world creates the very environment for a cognizing subject: in this regard a cognizing subject picks out of the world only what corresponds to his cognitive capabilities and attitudes.

Varela connects the notion of "enaction" with the concept of "das Geschehen" ("event") treated in detail by Heidegger (Depraz 1999, p. 590), and namely with the double conditionality of the act of birth as being-for-life and as historicity. Enaction is, indeed, an event (in Russian: "event" is "so-bytie", that is "co-being"), the joint and coordinated being of a subject and an object of cognition (the being as the becoming), their coherent iterative birth and concerted transformation.

(4) *Cognitive structures are emergent*. They appear in a spontaneous, unpredictable and relatively non-determined way during the course of self-organization processes. These processes embrace and link the brain of a human, his body and his surroundings together. They are connected with the establishment of circular causality loops (upward—from the neuronal and somatic substratum to the highest of manifestations of mentality and spirituality of a human; and downward—from an independent and conscious cognitive subject and spiritual finder to the striking his root in nature—to the neurophysiologic and corporal basic level).

² According to G. Vollmer, mesocosm is a "cognitive niche" of a human being (Vollmer 1988, S. 175). In other words, it is a cognitive window that is open for a human burdened with his own biological nature.

Varela who laid the foundation of the new conception of enactive cognition considered the notion of the “emergent” as an absolutely substantial for comprehension of cognitive processes. The global is simultaneously both a cause and a consequence of local actions. “Mind and the judgments of mind are something like a cherry on a pie. Mind is produced and generated in the latest stage of incessant emergent transformations of a consciousness” (Varela 1999, p. 13).

(5) *The process of cognition of an individual runs in the mutual connection, co-determination the I—the Other, their reciprocal and synchronous becoming.* The notion of *intersubjectivity* is key one in the new conception. Boundaries between the I and the Other, even in the processes of perception are not precisely fixed, are not drawn with full definiteness—to be Oneself, to manifest the own Self and to create the Other—these are events that accompany each other (Varela 1999, p. 15). The Self isn’t localized, it is in the process of becoming, co-determination, co-evolution with the Other/Others.

(6) *Cognition is dynamical and under construction in the processes of self-organization.* In other words, *cognitive systems are dynamical and self-organizing ones.* The functioning of cognitive systems is similar in principle to the functioning of natural systems which undergo our cognition, i.e. of objects of the surrounding world; the essence of these processes is analogous. Therefore, in the frames of the embodied cognition approach called also the dynamical approach in cognitive science, the latest developments in the fields of nonlinear dynamics, the theory of complex adaptive systems, the theory of self-organized criticality and synergetics are widely and fruitfully used.

3 Synergism of Cognizing Subject and of a Medium

The dynamical approach to cognition proposes a middle path in understanding mutual relations of a subject (a cognitive agent) and of an object (an external item or a medium). On the one hand, it is far from the subjective idealism which assumes that only a subject is active and the external world is merely its projection, emanation of its activity (as, for example, for Hegel—nature is another being of the world spirit). But, on the other hand, it is also far from a position which could be called objectivism where lines of determining influences go exclusively from a medium to the subject of cognition and where the subject deals with a rigid medium which is opposed to him as an immovable wall, and he has no choice but to adapt himself to it in a one-sided way.

In the frames of the dynamical approach, both a cognitive agent and a medium are active. At the same time, however, a medium in general as the whole external and objective world and a medium of the very given cognitive agent are far from being identical. The French thinker Maurice Merleau-Ponty wrote in 1945 that an organism actively chooses from the whole diversity of the surrounding world those stimuli to which it is to respond, and in this regard, it constructs its own medium for himself. A cognizing body and the world that surrounds it are in relations of mutual determination. The body lives in the world like a heart in the organism (Merleau-Ponty 1945, p. 235).³ Adherents of the dynamical approach nowadays completely share this opinion by esteeming Merleau-Ponty as one of their ideological predecessors.

Another French thinker Henri Bergson developed ideas that are congenial to the dynamical approach as well. Already in 1896, when his work “*Matière et mémoire*” was published,

³ M. Merleau-Ponty literally wrote in his “*Phénoménologie de la perception*”: “Le corps propre est dans le monde comme le cœur dans l’organisme: il maintient continuellement en vie le spectacle visible, il l’anime et le nourrit intérieurement, il forme avec lui un système” (Merleau-Ponty 1945, p. 235).

and then in his opus magnum “L'évolution créatrice”, Bergson connected the process of items extraction from the medium as well as of oneself, as one of such items, not only with specific characteristics of sensible receptors but also with the needs of cognitive agent and actions induced by them. “Unorganized bodies are cut out of the tissue of nature by perception, the scissors of which as if follows the dotted lines that determine possible seizure of actions” (Bergson 1998, p. 48). A human is built into environment in a certain, evolutionarily elaborated way, and he has his specific “optical window” of perception, his “acoustical window” of perception, etc.

The human eye is adapted to a certain “optical window” differing from “windows” of some insects being fed by nectar (bees, butterflies, ants) which are able to see the world in ultra-violet rays. The human ear is arranged in such a way that it hears in a certain “acoustical window”, it is not able to perceive ultrasonic signals which are of use for communication by some animals, such as dolphins and bats. And if the world of a pigeon is colored in five colors, a bee perceives the world in ultra-violet rays, and the world of humans is polychromatic, it is senseless to question what true color of the world is. Thus, as Varela said, the world can be characterized not by attributes but only by potencies that can be enactivated in the cognitive activity.

Every living organism cuts out the world in its own way. It selects, draws out a huge reservoir possibilities of the world, what is accessible for it and what corresponds to its cognitive abilities (abilities of thinking and/or perception). This is up to the spirit of the new conception of cognition: an organism as a cognitive agent actively masters the surrounding world, it cognizes by acting. Besides, this fully corresponds to the manner of synergetics: sets of paths into the future, i.e. of structure-attractors of evolution, determining by inner properties of open nonlinear media are a huge reservoir of possibilities of the world, a latent and unrevealed world, and each time only one a certain resonantly excited structure is realized and actualized (Knyazeva and Kurdyumov 2001, 2002, 2007).

According to M. Merleau-Ponty, the perceptual world of a living organism is a totality of ways along which its body moves. This is an invisible essence of the visible one, the belonging each time only to a certain fragment of the world. “The flesh of the world is a fount of possibilities” (Merleau-Ponty 1964, p. 304). And a cognizing body/mind wakes out of the vast latent and invisible world, leads to the surface out of an abyss of teeming possibilities in any given, concrete act of cognition. Only one of them, one something what is inherent in the world and simultaneously corresponds to its cognitive aspirations, its research intentions, its necessities of life.

In the process formation of own identity, a living organism as a cognitive creature cuts out of the surrounding reality a contour of its own medium. As Varela noted, “a cognitive self is the manner in which the organism, through its own self-produced activity, becomes a distinct entity in space, but always coupled to its corresponding environment from which it remains nevertheless distinct. A distinct coherent self, by the very same process of constituting itself, configures an external world of perception and action” (Varela 1997, p. 3).

During the historical process of evolution the life, the mutual adaptation of cognizing living organisms and a medium of their inhabitation (at least, its organic part) occurs. Therefore, evolution can *pleno juro* be called *coevolution*. For instance, as is well known, the eyesight of melliferous bees is shifted to the ultra-violet part of spectrum in order to see better the flowers with nectar which are a fragment of a medium for them. But the flowers have also gone their part of path in the course of evolution. Naturally, plants with flowers which are more perceptible for the bees have been selected, because the bees have enlarged the natural habitat of such plants by taking away pollen on their stalks.

4 The World and the Cognitive Mind: Mutual Affordance of Possibilities

The well-known psychologist Ulrich Neisser in his researches done in 1970s showed that the perceptible material enters the brain not in a pure and primitive form, “as it is there, on the outside”, but it lays down on a scheme defined in advance that he called a format. The available as yet format is set by the whole sum of previous acts of perception what testifies to self-organization of the cognitive process and to its flexible adaptability on the basis of the former experience. “Information filling in the format at any moment of the cyclical process becomes a part of the formal in the next moment, and will determine how the further information will be processed” (Neisser 1976, p. 75).

In the process of format creation, according to Neisser, a function of imagination is necessary—imagination prepares a scheme of future perceptions. On the one hand, a subject unaccountably creates for himself a “cognitive map of a medium” (Neisser 1976, p. 123) that directs perception and makes it selective, allows him to filter out incoming information. The cognitive map is determined by the stored information and by the accumulated experience of action and behavior, not by its verbal description. A child, for example, is able to find a way long before until he will be able to adequately describe by words where he was and how he found himself there.

On the other hand, objects themselves *afford* possibilities which can be perceived or not perceived by a subject. Perception is an active and constructive process of selection of the given possibilities. Neisser uses here a key concept from the theory of ecological perception developed by James J. Gibson—the concept of *affordance* (Gibson 1986). “The floor affords a possibility to walk on it, a pen affords a possibility to write, etc. . . . Possibilities afforded by an object—or, in other words, its meaning—depends on who perceives it. Every natural object can have a great number of ways of use and of potential meanings, and every luminous flux specifies an infinite multitude of possible properties. The perceptive subject makes a choice from these properties and affordances due to a specific preparedness to perception of some of them” (Neisser 1976).

The world is an ocean of potencies, the seething of different possibilities which can be open for a subject. Such a constructivist position was expressed in one of notes from André Jide’s diary: “Les choses ont besoin de nous pour être, ou pour se sentir être, et sans nous, restent dans l’attente” (“The things are in need of us in order to be or to feel their being, and without us they remain in expectation”) (Jide 1951, p. 93). The ray of perception of a cognitive subject highlights only *something* out of possibilities afforded by the world, only selectively, according to his attitudes and possibilities of perception. The perceptive subject is active, to a great extent he defines himself what he will see, hear, and feel. The affordance of possibilities (for manifestation of properties of the world) is the result of activities of the cognitive subject as well. To put it differently, the cognitive subject and the medium that surrounds him are connected by loops of mutual affordance of possibilities which are determined by current situation of cognition. This *mutual affordance of possibilities* is a true *enactive cognition*.

5 Autopoietic Cognition. Maintenance of the Proper Identity

The roots for the concept of autopoiesis are revealed here. The word “autopoiesis” signifies literally “self-production” (from Greek: *αυτός* for self and *ποιησις* for production, building, creation). Autopoiesis is a fundamental property of organization of any living creature. In early 1970s, Francisco Varela and Humberto Maturana elaborated the conception of

autopoiesis (or self-production) of life, living creatures. Only later on this conception was extended over society, first of all, by Niklas Luhmann and over complex self-organizing systems in general.

Main notions of this conception have something in common with ideas developed in the frames of evolutionary epistemology, above all by Konrad Lorenz, Ruppert Riedl, and Franz Wuketits:

- (1) the biological conditionality of the human cognition, of cognitive structures: “a human being cognizes, and his ability of cognition depends on his biological integrity”;
- (2) life is cognition: “living systems are cognitive ones, and life as a process is the process of cognition”;
- (3) living systems are autonomous and operationally closed ones; their organization is cyclical by its character; the deciding characteristic for them is a homeostatic function, self-maintenance, self-reference;
- (4) living systems are historical ones: “the relevance of the present behavior is always determined by the past experience”, i.e. life of the living beings contains such a narrative aspect the importance of which was emphasized later on in the philosophy of self-organization, in particular by Ilya Prigogine;
- (5) co-evolution of an autopoietic system and its surroundings takes place; they co-evolve in the general historical current (Maturana and Varela 1980, pp. 5, 13, 27).

The mechanical systems are allopoietic ones. These are machines which don't possess the property of self-production. A product that they produce by their functioning differs from such systems themselves. As opposed to it, living systems are autopoietic ones, i.e. they represent organizations which involve nets of production processes and transformations of their components. In the course of such processes

- (a) the same nets of processes production components which engendered them go on recursively,
- (b) a system as a physical unity determining its boundaries in the physical space arises (Maturana 1974, p. 424).

Maturana and Varela proceeded from an experimental computer model of artificial life elaborated by them. The model represented a certain variant of cellular automaton simulating the origin of closed-loop structures out of an unorganized substratum: an assembly of cells with addition of catalyzing elements to them. Arisen structures manifest an ability to self-maintenance and to the restoration of broken bounds between cells in case of destroying influences from the outside. The model showed that structures are able somehow “to get to know” about the breakdown of bounds in order to restore them, to recognize such disruption. This “recognition” was assumed as a basis for their definition of essence the phenomenon of life and hence, of the phenomenon of cognition.

To define the essence of life as a cognitive process, Varela picked out the most distinctive property of a living being. “I take here the view that reproduction is not intrinsic to the minimal logic of the living. Reproduction must be considered as an added complexification superimposed on a more basic identity, that of an autopoietic unity. . . . Identity has logical and ontological priority over reproduction, although not historical precedence” (Varela 1997, p. 76). Thus, the defining property of a living being is the *maintenance of its own identity* (of its own sameness) as well as the inner intention to preserve its own identity.

Varela summed up his thought as follows: “Every breakdown can be seen as the initiation of an action on what is missing on the part of the system so that identity might be

maintained. ...In brief, this permanent, relentless action on what is lacking becomes, from the observer side, the ongoing cognitive activity of the system. ... Cognition is action about what is missing, filling the fault from the perspective of a cognitive agent” (Varela 1997, pp. 80, 85). When developing these statements, one might add that cognition is an autopoietic process, since it is directed to the searches of what is missed and what one is still lacking for. Cognition in its relation to life is the “recognition” of a disturbance, and life gives an answer to this disturbance, by eliminating discovered defects.

The autopoietic nature of cognition lies in its ability for self-completing of integral images, perceptible and mental pictures. The image of self-completing of a whole cognitive structure is similar to the growth of “tree of knowledge” on a specially prepared and cultivated field of consciousness. It is a matter of a certain analogue of the biological process of morphogenesis (Knyazeva and Haken 1999).

6 Cognition through Actions. Constructivism as an Orientation in Epistemology

Thus, the world cannot be characterized by attributes but only by potencies which are realized by a cognitive action and due to it, the action being realized in a certain situation, configurations of which are essential. The cognitive activities are in need of action. Cognition is an epistemic action. As Henri Bergson expressed it, “originally, we think only in order to act. Our intellect has been cast in the mold of action” (Bergson 1998/1913, p. 44). As one of slogans in the orientation of constructivism in epistemology Jean Piaget’s thesis is often used: “L’Intelligence organise le monde en s’organisant elle-même” (“The intelligence organizes the world by organizing itself”) (See Watzlawick 1998, S. 23).

Probably, it’s worth mentioning here two imperatives formulated by Heinz von Foerster: the aesthetic imperative “Willst du erkennen, lerne zu handeln” (“If you want to cognize, learn to act”) and the ethical imperative “Handle stets so, dass weitere Möglichkeiten entstehen” (“Act always so that further possibilities appear”) (Foerster 1998, S. 60). Giambattista Vico formulated his thesis as follows: “Verum ipsum factum” (“The truth results from the done”).

The notion “cognition through action” has direct consequences for cognitive creatures, both for human beings and for animals: (“*learning by doing*”). The results of investigations of the behavior of animals show the importance of movement for the formation of a normal perception of a cognitive creature. In one of experiments described by Varela, two groups of kittens were singled out: kittens from the first group had possibility to actively move indoors, the others also moved together with them, but they were hooked to the first group in baskets on the wheels, that is they moved passively. In several weeks, a control test had been carried out. The test showed that the kittens from the first group saw well and orientated themselves in the investigated space very well, whereas kittens from the second group moved in the same space extremely hesitating, struck against corners and, on the whole, conduct themselves almost as blind ones, though they observed in their baskets all precisely the same as the kittens from the first group (Varela et al. 1991, p. 175).

According to the theory of cultural and historical development of psyche elaborated by Lev S. Vygotsky in the 1920s and 1930s, the handling with material objects in a spontaneous, trial and playing way made a decisive contribution to the development of intelligence with the higher mammals as an inventive and creative function of their brains. Young dogs and cats, like a human child and in contrast to insects, play. Their “play, being an instinctive activity itself, is at the same time an exercise for other instincts, it is a natural school for a young animal, its self-education and training” (Vygotsky 1993; Vygotsky and Luria 1993,

p. 25). When playing, animals learn to find alternative routes and to push aside all obstacles for realization of their intentions.

The world of a living organism emerges together with its action. This is an “enactive world”. Not only the cognitive mind cognizes the world, but also the process of cognition forms the mind and imparts configurations to its cognitive activities. And so Francisco Varela is right, by asserting that “a distinct coherent self. . . by the very same process of constituting itself. . . configures an external world of perception and action” (Varela 1997, p. 83), or elsewhere: “The world that surrounds me and what I do to reveal myself in this world are inseparable. Cognition is an active participation, a deep co-determination of what seems to be external and what seems to be internal”—this has been taken as an epigraph to the article.

The cognitive mind not so much reflects the world as creates it. It not only discovers the world, i.e. tears a cover (or the veil) of mystery off it and penetrates into its mysteries, but also partly invents it, carries something from itself, something personal in the world, constructs something like natural devices and forms or elemental motors (water or wind whirlwinds). A nonlinear mutual action of a subject of cognition and an object of its cognition takes place. A complex cohesion of direct and return bounds, loops of negative and positive feedback takes place by their interaction.

The complexity and nonlinearity of feedback loops that accompany every act of cognition signifies that a subject and an object of cognition, in point of fact, mutually determine each other, enter into relations of co-determination, awake each other. They are simultaneously and interdependently born, are co-created. They change in cognitive action and due to it.

A vivid image of such kind of cyclical and mutually determining connection reaches us in the known lithograph by Maurits C. Escher “The Drawing Hands” (1948). A right hand draws a cuff with a cuff link. Its work is still not finished but, on the right it, a left hand is already drawn in detail. The left hand draws a cuff with a cuff link from which the right drawing hand comes out. These two hands mutually draw each other, they mutually lay down conditions of their emergence. There are neither a beginning nor an end of this process. Their reciprocal determination stands out against a general background of the picture and constitutes a certain unity, some autonomous action that can be, probably, called a creative circle.

Similarly, a subject and an object of cognition (a cognitive agents and a medium of its activity) determine each other and mutually lay down conditions of their existence and development. “We cannot overstep the limits of such area that is defined by abilities of our bodies and our nervous systems, Varela notes. There is no other world except such a world which we know through these processes—through the processes which delivers data to us and from which we understand who we are. We are inside a certain cognitive area, and we are not able to jump out of it and to establish where it begins or how we manage to obtain it” (Varela 1998, S. 306). Such is a closed circle of our cognition. We whirl in it like a squirrel in a wheel. The relations between a subject and an object of cognition are being built according to the principle of recurrence, mutual attribution, and reference. These are relations of participation and complicity.

Enactivation, i.e. the building into the world through an action, means awakening of the world as a result of actions of a subject of cognition. And, by wakening the world, he wakes up himself. When changing the world, he changes himself. The road is not given *a priori* to a going and cognizing man, it is paved in the course of advancement along it. Not only a going man paves a road, but the road makes the going. By passing the road to the end, he turns into another man.

7 Nonlinearity of the Writing. The Work Transforms an Author: The Author Changes a Reader by Changing Himself

The same nonlinear connections of co-determination are established by the writing of a text of composition in the process of a verbal (especially literary) creative work. The creative work transforms an author. As Paul Valéry said, “a creator is a man who is created”, who surrenders himself to the work and by creating something significant, changes *per se* into another man. “A creative work is a modification of the author. In every movement which is undertaken by him, he undergoes alterations. And when the work is finished, it reacts once again upon his author. He turns to be (for example) a man who was able to create it. In a certain sense, it reconstructs the creator” (Valéry 1974, pp. 1006–1007).

Valéry compares the creation of a piece of work with the growth of a tree, as if the growth of the tree would be the fall of the possible in the being. Almost everything is in vain, almost everything is poor, scanty and useless, and only few things, from what is dropped out, keep on the sheet of paper and are being crystallized as a result of the nonlinear and synthetic growth of thought.

The very writing is nonlinear. The products of the verbal creative activities are composed in a nonlinear way. The strong nonlinearity is typical for brilliant patterns of literary creative work, in particular for poetry. “The poetry represents a highly nonlinear use of language where an inserted meaning is much more than the sum of parts” (Langton) (See Horgan 1997, p. 201).

The writing is getting nonlinear when it is saturated with mental and perceptible images, the so called thoughts-images, metaphors which perform a synthetic function. The metaphors allow combining what is not able to be combined or what is so far not combined, and thereby they often serve as a starting point for the increase of new knowledge and/or for the discovery of new senses.

It is known that, for instance in science, the new quite often appears originally in a form of metaphor or some mental image and only later on, in the case of successful elaboration of certain theoretical field, being building into a corresponding system of knowledge, finds a theoretical form in science. The introduction of neologisms in the text or the non-traditional use of generally accepted concepts that contains metaphorical nuances extend a semantic field and as if would invite a reader as a co-creator to eventual interpretations and re-interpretations of what is set forth by an author as well as to the joint reflections upon the essence of problems under consideration.

The nonlinearity of writing which is extremely typical only for the language of poetry, is connected, in my opinion, with the activation of holistic and integral properties of language, with the desire to concentrate attention on the polysemy and multilayer structures of texts created by an author and on their eventual interpretation by a reader, with the aspiration to reflect the change of direction and tempos of the course processes in the universe in a peculiar rhythmicity of texts. It is also connected with the accentuation of complexity and nonlinearity of the process of text composition and its subsequent reading, with the initialization of loops of nonlinear feedback between a writer and a reader, between the reading and the re-reading the text, between the search of a sense, the comprehension and re-comprehension of problems.

The reading is, as the Russian poetess Marina Tsvetaeva wrote, a participation in the creative activities, since, without such participation, there won't be comprehension of sense of creative work. The sense of the created work of art, as it was underlined by Paul Valéry, is potential. It is disclosed and created by a reader, differently by each of them, according to his emotional mood and mental preferences. “The “value” of the written piece of work is purely potential—this is what a reader could elicit from it, what conforms to his voice, his intelligence, his state, etc. This is a ground to be cultivated” (Valéry 1977, p. 1206).

Here again we face the principle of mutual affordance of possibilities, co-determination, of joint creative activities, co-birth and reciprocal awakening. An author-inventor affords possibilities for a reader to reflect upon problems, to reveal obvious and latent, hidden senses of the created text. And a reader affords possibilities for the author-inventor to express himself and is in the waiting, because the author-inventor is in want of a reader. Every work of art (in particular literary work) should be addressed to somebody, at least to one particular person and only in such a case it will be addressed to everybody.

Acknowledgements The research presented in this paper is supported in 2004–2009 by the Russian Foundation for Humanities (Project No. 07-03-00254a) and in June–July 2005 and in October 2007 by the Alexander von Humboldt Foundation, Germany (V-8121/RUS/1033436).

References

- Bateson, G. (2000/1972). *Steps to an ecology of mind*. Chicago: University of Chicago Press. Moscow: Smysl. (Russian edition).
- Bergson, H. (1998/1913). *Creative evolution*. New York: Henry Holt & Co. (Russian edition). Moscow: Kanon+.
- Depraz, N. (1999). When transcendental genesis encounters the naturalization project. In J. Petitot, F. J. Varela, B. Pachoud, & J.-M. Roy (Eds.), *Naturalizing phenomenology. Issues in contemporary phenomenology and cognitive science* (pp. 464–483). Stanford: Stanford University Press.
- Gibson, J. J. (1986). *The ecological approach to visual perception*. Hillsdale, N.J.: Erlbaum.
- Horgan, J. (1997). *The end of science. Facing the limits of knowledge in twilight of the scientific age*. New York: Broadway Book.
- Knyazeva, H., & Haken, H. (1999). Synergetics of human creativity. In *Dynamics, synergetics, autonomous agents*. Singapore: World Scientific.
- Knyazeva, H., & Kurdyumov, S. P. (2001). Nonlinear synthesis and co-evolution of complex systems. *World Futures*, 57, 239–261.
- Knyazeva, H., & Kurdyumov, S. P. (2002). *The foundations of synergetics: Blow-up regimes, self-organization, tempo-worlds*. St. Petersburg: Aletheia (in Russian).
- Knyazeva, H., & Kurdyumov, S. P. (2007). *Synergetics: Non-linearity of time and landscapes of coevolution*. Moscow: KomKniga (in Russian).
- Maturana, H. (1974). Stratégies cognitives. In *L'Unité de l'Homme. Invariants biologiques et universaux culturels* (pp. 418–442). Paris: Éditions du Seuil.
- Maturana, H. R., & Varela, F. J. (1980). *Autopoiesis and cognition. The realization of the living*. Dordrecht: D.Reidel.
- Merleau-Ponty, M. (1945). *Phénoménologie de la perception*. Paris: Gallimard.
- Merleau-Ponty, M. (1964). *Le Visible et l'Invisible. Suivi de notes de travail*. Paris: Gallimard.
- Neisser, U. (1976). *Cognition and reality. Principles and implications of cognitive psychology*. San Francisco: W.H.Freeman & Co.
- Nietzsche, F. (1990). *Die Frohe Wissenschaft* (Russian edition). Moscow: Mysl.
- Valéry, P. (1977). *Cahiers*, t.2. Paris: Gallimard.
- Varela, F. J. (1997). Patterns of life: Intertwining identity and cognition. *Brain and Cognition*, 34, 72–87.
- Varela, F. (1998). Der Kreative Zirkel. Skizzen zur Naturgeschichte der Rückbezüglichkeit. In *Die erfundene Wirklichkeit. Wie wissen wir, was wir zu wissen glauben?* (pp.294–309). München: Piper.
- Varela, F. (1999). Quatre phares pour l'avenir des sciences cognitives. *Théorie – Littérature – Enseignement*, 17, 7–21.
- Varela, F. J., Thompson, E., & Rosch, E. (1991). *The embodied mind*. Cambridge: The MIT Press.
- Vollmer, G. (1988). Evolutionäre Erkenntnistheorie. Zur Natur menschlicher Erkenntnis. In *Handbuch zur Deutschen Nation, Bd. 3, Moderne Wissenschaft und Zukunftsperspektiven*. Tübingen-Zürich-Paris: Hohenrain.
- von Foerster, H. (1998). Das Konstruieren einer Wirklichkeit. In *Die erfundene Wirklichkeit. Wie wissen wir, was wir zu wissen glauben?* pp. 39–60. München: Piper.
- Vygotsky, L. S. (1993). *The collected works*. New York: Plenum Press.
- Vygotsky, L. S., & Luria, A. R. (1993). *Sketches on the history of behavior: Monkey, primitive, child*. Moscow: Pedagogika-Press (in Russian).

Watzlawick, P. (Ed.) (1998). *Die erfundene Wirklichkeit. Wie wissen wir, was wir zu wissen glauben?* 10. Auflage. München: Piper.

Author Biography

Helena Knyazeva is Head of Sector of Evolutionary Epistemology at the Institute of Philosophy of the Russian Academy of Sciences in Moscow where she received Ph.D. in Philosophy in 1986 and Dr.habil. in Philosophy of Science in 1994. In 1996–98, 2004, 2005, she was an Alexander von Humboldt Research Fellow at Hermann Haken's Center of Synergetics with the Institute of Theoretical Physics, University of Stuttgart, Germany. Her fields of research interests are as follows: philosophy of science and epistemology, focusing on philosophical foundations of the theory of self-organization of complex systems and the nonlinear dynamics approach in epistemology. Dr. Knyazeva has a number of publications, including seven books in Russian and a number of research articles in international journals. Her books on synergetics present research results of the unique scientific school at the Keldysh Institute of Applied Mathematics in Moscow. She has participated and presented her papers at many international scientific conferences in the world.