Sign activity of mammals as means of ecological adaptation

Elina Vladimirova

Dept. of Zoology, Genetics and General Ecology, Samara State University
Ul. Akademika Pavlova, 1. 443011, Samara, Russia.
e-mail: elyna-well@nm.ru

Abstract. The present article discusses different basic semiotic-scientific postulates regarding mammals' sign activity. On the one hand, there are arguments denying animals sign activity, according to which mammals are not capable of semantic generalization on the basis of conventional linguistic values. According to another approach, mammals' sign activity can be considered as means of ecological adaptation, that is, the features of animal behaviour based on the information, received by them through their habitat characteristics without direct visual contacts with their kind. Movement elements, behavioural reactions of similar motivation and parameters of the sign field, which represents an animal's sign-information environment, may have some numerical expression and can be calculated depending on the research tasks. Formalization of the animal activity implies simultaneous consideration of the following parameters: magnitude, intensity, anisotropy and the value of a given sign object.

1. Introduction

Not all the contemporary scientific schools recognize animals as capable of sign activity. It is until recently that most Russian scientists regarded sign as an intersubjective mediator of communication, a "conventional translator of meanings from sender to recipient" (Nikitin 1997). This definition, which treats sign merely as means of communication, does not take into consideration the subject of Zoosemiotics — the scientific study about signs used by animals. During their individual and group accommodation activity, animals, including apes, are known to be unable to use any means of communication possessing all the entirety of functions characteristic of signs of the natural human language (Gardner R., Gardner B. 1969; Premack 1985; Sevastyanov 1989; Vladimirova 2001; Boutovskaya 2005).

If one tries to seek the "essence" of sign and define this concept proceeding from the study of the human sound activity, the statement about animals lacking "sheer tokenism" (Simkin 1976: 337) appears to be correct. "The very concept of the "sign function" arises only with the appearance of the natural human language and it is only this language that gives the model realization to this function" (Émile Benveniste 1974: 87; quoted from: Evgenij Panov 2005: 132). From this point of view, animals possess only simplified variations of tokens — "sheer signals" or "tag signals" (Simkin 1976).

The reasoning against animal sign activity provided by Gennadij N. Simkin (1976) is very similar to what can be found in numerous other works (for example, in the scientific studies by the famous Russian psychologist Lev S. Vygotski — Vygotski 1934, 1983). In brief, the reasoning that defines sign activity as a human prerogative is the following: humans and animals resort to different ways of sign usage, because the ability to generalize, which is based on the accordance with the relevant social rules, is a unique characteristic feature of the socialized *Homo sapiens.* Lev Vygotski established a direct connection between the emergence of speech as a function of communication and the develop-

ment of the ability to generalize. He emphasises that the means of transmitting a certain experience or mind contents to another human being, is referring the transmitted contents to a familiar group of phenomena — a process, which certainly requires generalization. Correspondingly, superior forms of activity characteristic of humans are only possible because humans reflect the reality generally by means of thinking (Vygotski 1934).

Thus, within the framework of the human sign activity, referring various single phenomena of reality back to one class, predetermined by the concept, follows social rules; whereas generalization goes not in counter to but in accordance with the natural laws of perception. That is why it may seem that attributing one generic name to various phenomena — their reference to one class — proceeds from the properties of the very phenomena. This is not correct. It is the social rule and not the "true nature of things" that establishes the peculiarities of perception that are to be considered essential or unessential. Thus, the social rule predetermines the ways that visual images are generalized. Nevertheless, generalization is a social rule; and having learnt this rule, one can refer new unfamiliar phenomena to the class predetermined by the generic name — the concept — with a high probability of correct prediction.

The motivation to follow social convention in sign activity is known to be uncharacteristic of animals and sometimes disappears even in human activity. That means, the realization of the sign function corresponding to the "essence of sign", when a single token from the personal experience of a user refers to a generalized class of similar signs, is not characteristic of animals. It follows, that animals are devoid of sign function.

We share an alternate point of view on animals possessing sign function. The supporters of this viewpoint do not care much about the ascent of their key definitions to the philosophical perception of the "true nature" of objects. The priority is given to the practical results of usage of the concept "sign", which is employed for the purpose of conceptualized modelling of reality (Stepanov 1967; Morris 1971; Vladimirova, Mozgovoy 2003). In this respect, sign is treated not merely

as means of communication, but as means of situational adaptation, communication being possibly one of its forms, if necessary.

In terms of the above-stated theory, sign is treated as a specific version of the associative process, the peculiarities of which depend on the current motivation and the memory of the user of the sign. In terms of biology, certain recognized characteristics of tokens may indicate the intensions and apperceptions of animals, which are covert from direct observation. As for the aforementioned quotation of the remarkable linguist Émile Benveniste, we share the viewpoint of numerous researchers and think that the concept of "sign function", like any other scientific concept, is a tool of human cognition. But the sign function itself appeared in the world of living creatures long ago and is not a unique feature of humans (Stepanov 1971; Melnikov 1978; Vladimirova, Mozgovoy 2004; Metchkovskaya 2004; Morris 1971; Uexküll 2001; Sebeok 2001).

In our opinion, one of the nuisances in the mutual misunderstanding of the mentioned scientific schools is that the word "sign" in one of its meanings accepted abroad (Bühler 1965) was traditionally translated as "signal" in Russian texts (Poletaev 1958; Naumov 1977). At the same time, "signal" denotes "signful". "A signal is a sign, physical process (or phenomenon), carrying the message (information) about a certain event, or condition of an object of observation, or transmitting instructions of control, imperative, notification, etc. (for example, the light signal of a traffic light)" (SED 1984: 1199). "A sign is a both materially and sensually perceived subject (phenomenon, action), which performs as the representative of another subject, attribute or attitude" (SED 1984: 464). Thus, the word "signal" in traditional Russian discourse is a partial synonym of the word "sign".

In semiotics, sign as the conductor of the associative process, is a means of adaptive activity of animals (and also humans, as superior living beings operating signs). Charles Morris, who was one of the founders of zoosemiotics, wrote in his book *Notes on the General Theory of Signs*:

> Men are the dominant sign-using animals. Animals other than men do, of course, respond to certain things as signs of something else, but such signs do not attain the complexity and elaboration which is found in human speech, writing, art, testing devices, medical diagnosis, and signalling instruments. (Morris 1971: 17)

Animals operate signs that are identical to linguistic and non-linguistic signs of humans, considering some separate characteristics essential for the practical usage of the concept "sign". This approach to the essence of sign suggests that the crucial role in defining whether the object (or event) is a sign or not, is given to the very process of usage of this object in sign function. The behaviour of the sign user (the interpreter), that has the properties of sign process (semiosis), marks the presence of the sign.

Thus, in ecology, the following definitions of "sign" are possible:

1) Sign is something which, in some respect or capacity stands for something else for a motivated individual possessing some experience of interacting with the environment;
2) Sign is a thing that for its user refers to some other thing;
3) Sign is a thing, which provokes a motor response in the addressee, when the signified item correlates with the addressee's prevailing motivation (Vladimirova, Mozgovoy 2003: 86).

In our view on the sign activity of animals, a sign, first of all, alludes to the previous experience of using a given object as a sign. Second, a sign, used by animals, can refer to a class of similar signs. In this case, the rule defining the set of similar signs is a uniformed biological need. Signs, signifying danger, availability of nutrition, necessity of territory protection, or possibility of den construction, may form a class of similar signs for mammals, because the motor responses to the signs of one class are identical. Thus, the generalizing function for animals is a biological need and not a social rule, which is based on social ideals, as, for example, in sign activity of humans.

Let us think of an example. Apes, in our opinion, are unlikely to have a complete cognition of the natural human language, because, first of all,

they do not need to form social ideals. Apes begin to use conventional tokens according to the model provided by a zoopsychologist only after receiving a reward — a sweet or a toy. The group identification of apes is underdeveloped; they do not find pleasure in speech imitating activity, which is, in its essence, the use of conventional language. Second (and what is, in our opinion, less important), the cerebral cortex of apes is not developed enough; as a result, they are unable to master the linguistic polysemy, which is usual for texts produced by humans.

The usage of signs by animals promotes not only their communication, but, more importantly, accommodation and self-organization of individuals and intrapopulational groups. Such an approach reveals not only advantageous possibilities in the field of scientific reflection for an ecologist; it is also suitable for analysing the results of field research on animal behaviour with, for instance, the snow tracking technique, using the theory of the sign field. A sign field represents the environment in which mammals, with the help of signs or directly, execute their vital activity. As a result, the environment acquires properties of structured-ness, that is, becomes functionally inhomogeneous for subsequent usage (Mozgovoy, Rosenberg 1992). Biological signal field as it has been defined by N. P. Naumov (1977), is a communicative component of a sign field. Term "token" used in this article stands for a thing or smell that are likely to provoke in theirs animal user some kind of action related to the user's major motivation.

2. The sign field of mammals investigation technique

Animals behave under the influence of both external impulses (tokens) and internal impulses. In the practice of field research, the external impulses may, in a number of cases, be reconstructed with a high extent of probability on the basis of animal tracks. In each case, the researcher makes an assumption about the significant object of the environment, that has provoked this or that movement of the animal. He makes his

decision, proceeding from the track pattern, the condition of the environment and the general context of the phenomenon observed, that is, from the biological sense of the accommodation activity of the animal.

The investigation of sign field by the method of detailed footprint analysis runs as follows. A field biologist carefully examines the track path of the animal on the snow. He detects the species, the sex and, if possible, the age of the animal that left the track. He also derives the direction of its motion and the dominant motivation. In winter animals most often act with nutrition or territorial motivation. Judging by what the accommodation activity is directed at, we distinguish between the following forms of motivation: locomotion, nutrition (searching for food or foraging) behaviour; the behaviour aimed at the search of the optimal temperature conditions; inspecting one's territory, protective behaviour (menace, escape); manipulative behaviour; exploratory behaviour, hygienic behaviour; play; reproductive behaviour (courting, brooding); social behaviour, etc.

Following the track path very carefully, without trampling it down, a zoologist detects the elementary motor responses produced by the animal. If it is clear from the track, the investigator matches the pattern of the track path with the external objects that have prompted a certain elementary response. In order to get the data characterizing the quantitative features of animal behaviour, judging by the track path on the snow, the continuous chain of tracks of an individual should be divided into elementary motor responses. An elementary motor response is a behavioural activity of small temporary expansion that can be detected judging by the tracks. It represents a uniformed movement possessing characteristic features, which make it possible to separate a given elementary response from the previous and the subsequent. The elementary reaction is a stereotype for a certain specimen; it is expressed by a specific "pattern" of the track path and represents the invariant part of the functional behavioural activity.

For instance, we have observed the following elementary responses of a red fox (*Vulpes vulpes* L.): straight linear vectors of movement

(locomotion); marking, position-finding response; shuttle pace (walking by "S-turn"); nutrition stereotype and capture of prey in particular; shift of gait type (trot, gallop, pace motion); started and interrupted attempt to move; position-finding, terror and comfort response; elevation from ground onto fallen trees or descent from eminence down to ground, etc. Elementary responses, provoked by movement (locomotion) and position-finding, as well as responses of nutrition search, constitute a large proportion of the general behavioural activity of an animal.

The behaviour of animals in their natural environment is determined by two groups of factors: 1) environmental features, including other animals' tracks, and 2) the state of the very individual in question; The latter includes: specimen fitting of the individual, inherent solution capacities of its receptors, individual peculiarities of behaviour (acquired reflexes and skills, phylum of a nervous system), sex and age, the motivation and context of the behaviour being performed at the moment. Besides, the behaviour of a single individual is influenced by the whole complex of biosocial relations, established within the population and the biocenosis.

The number of elementary motor responses displayed by an individual to one external object or event, as well as other peculiarities of the accommodation activity, may be analyzed. From the zoopsychological point of view, this index displays the extent of detailed elaboration of the properties of a given environmental object by the animal. From the ecological point of view, the number of elementary responses displayed to one object, points at the conformity of the biological motivation of an individual to the environmental conditions (in particular, the potential of a given object to satisfy any urgent needs of the animal).

The functional quality of the objects is detected alongside with their calculation. Thus, for example, an object may be nutritional, position-finding, promoting secretive or more comfortable motion, etc. Thereby, the functional character of the response behavioural reaction is specified. Having traced the tracks for a distance determined beforehand, 1000 m,

for instance, a zoologist counts up the total number of objects, the perception of which caused a movement response by the animals (*anisotropy* of the sign field), the quantity of elementary motor reactions displayed by an individual (field *intensity*, which is equal to the sum of meanings of separate objects), and the quantity of functional classes of the environmental objects, that provoked any motor response (the *magnitude* of the sign field) (Mozgovoy, Rosenberg 1992).

Thus, during field observation, one performs the analytical activity of correlating the token objects perceived by the individual and the "responding" motor reactions. The analysis starts with the separation of the elementary motor response from a continuous chain of tracks, because the "sketches" of the basic movement patterns of a given specimen are already available from the previous experience.

Let us resort to a practical sample of the described quantitative technique of animal ecology and behaviour investigation in the natural environment (Fig. 1). The zoologist made the following record in his field notepad: "The course of footprints of an adult individual of male fox: the track is left not earlier than several hours ago, the fox moves in the north-eastern direction. The type of activity — home range inspection alternating with foraging (searching for food)". Then, the objects and responses are described in quite a detail; the metric area of the track path matching a certain elementary response is marked. During the preliminary consideration of the field materials, one fills in the following table (Table 1).

Figure 1. These footprints belong to a red fox (*Vulpes vulpes* L.). The tracks go in the direction of the spectator, beginning from the upper left-hand corner of the picture. The fox is orientated by the following objects: reed mace, the tracks of corvine auks (not indicated in the picture because of their remoteness), a small cavity in the ice, a box, the channel bank, an anthill, a stook, the same anthill again, etc. (see Table 1.). The total of objects perceived by the individual — 34; the number of classes of objects — 27; the number of discrete motor responses — 98. The length of the track path — 670 m. Picture by T. V. Shuiskaya.

Table 1. The course of red fox (*Vulpes vulpes* L.) tracking in the woods of the Volga flood-lands across the river from the city of Samara, Russia in 2004.

№	Object provoking animal's response	Number of responses connected with the object	Types of behavioural reactions performed during the object perception	Distance (m)
1	None	1	Locomotion — 1 (the fox is moving by "S-turn" along the Volga channel with no apparent orientating object)	51
2	Reed mace bush	2	Locomotion — 1 (straight linear motion towards the reed mace bush), exploration — 1	41
3	Crow's tracks	3	Locomotion — 1, food-seeking responses — 2	13
4	Fishermen's ice-hole	3	Locomotion — 1, exploration — 2	27
5	Wooden box	4	Locomotion — 1, exploration — 1, communication (urinary point: approach and urination) — 2 responses	29
6	Channel bank	1	Locomotion — 1 (straight linear motion towards the bank)	43
7	None	1	Moving by "S-turn", with no apparent object orientating the motion	63
8	Anthill under the snow	1	Locomotion — 1 (straight linear motion towards the anthill)	22
9	Stook under the snow	1	Unfinished attempt of motion towards the stook	3
10	Anthill under the snow	3	Locomotion — 1, marking (urinary point) — 2 responses	12
11	Stook under the snow	1	Attempt of motion towards the stook	3
12	None	1	Moving by "S-turn", with no apparent object orientating the motion	31
13	Stump under the snow	4	Locomotion — 1, exploration — 3	6
14	Pine	4	Locomotion — 1, exploration — 3	27
15	Old stump with the remainder of snow	1	Attempt of motion towards the stump	4
16	Barkless stump	2	Locomotion — 1, exploration — 1	11

№	Object provoking animal's response	Number of responses connected with the object	Types of behavioural reactions performed during the object perception	Distance (m)
17	Old stump with the remainder of snow	3	Locomotion — 1, exploration — 2	25
18	Fox tracks left before (possibly, its own old tracks)	2	Locomotion — 1, imitation — 1	8
19	New pine	1	Locomotion	5
20	Crushed pine cones (squirrel's "eating" scattered around the trunk)	4	Food-seeking — 3, attempt to move to the right — 1	7
21	Tree trunk under the snow (fallen tree)	5	Locomotion — 2, position-finding and exploration — 2, motion towards the trunk apex — 1	33
22	Stump under the snow	4	Locomotion — 2, position-finding and exploration — 2	19
23	None	1	Straight linear motion; the fox is crossing the ski-track with no response	47
24	Stick protrude from under the snow	3	Locomotion — 1, exploration — 1, comfort — 1 (sitting)	4
25	Ski-track	6	Locomotion (attempt to move parallel to the ski-track) — 1, a turn of almost 180°, locomotion — 2 (motion towards the ski-tack — 1, following the ski-track — 1), attempts to move in the opposite directions — 3	21
26	Bushes	1	Locomotion	2
27	None	1	Locomotion	2
28	Anthill	1	Locomotion	17
29	Bunch of grass	2	Exploration	3

№	Object provoking animal's response	Number of responses connected with the object	Types of behavioural reactions performed during the object perception	Distance (m)
30	Anthill	3	Locomotion (elevation to the anthill peak) — 1, position-finding — 2	3
31	Snow-tractor track	2	Locomotion — 1, motion along the track — 1	27
32	Stump	2	Marking (urinary point) — 2	6
33	Juice package	3	Locomotion — 1, exploration — 2	12
34	Its own track	2	Imitative responses — 2	4
35	Small bush	2	Locomotion — 1, exploration — 1	9
36	New pine stump	6	Locomotion — 1, labeling (leaving an excrement on the stump) — 3, exploratory responses — 2	10
37	None	1	Locomotion	5
38	Craw's tracks and its "digging" in the snow	7	Locomotion (motion towards the crow's tracks, then — parallel to the tracks, a turn of 180° and straight following the crow's tracks) — 3, attempt to leave the crow's tracks, orientated by its own tracks — 1, food-seeking — 2, a turn of 180° and return following its own tracks — 1	6
39	Old track of a fox (possibly, its own track left before)	2	Locomotion — 1, imitative response — 1	9
	Total of number of objects (field anisotropy) — 34; number of classes of objects (field magnitude) — 27	Total of responses (field intensity) — 98		Distance — 670 m

The sketches made in field conditions, make the subsequent analysis of footprints much easier. As an example of topographic representation of the field stuff, we offer the schemes of track paths of the fox, the activity of which is described above (Fig. 2).

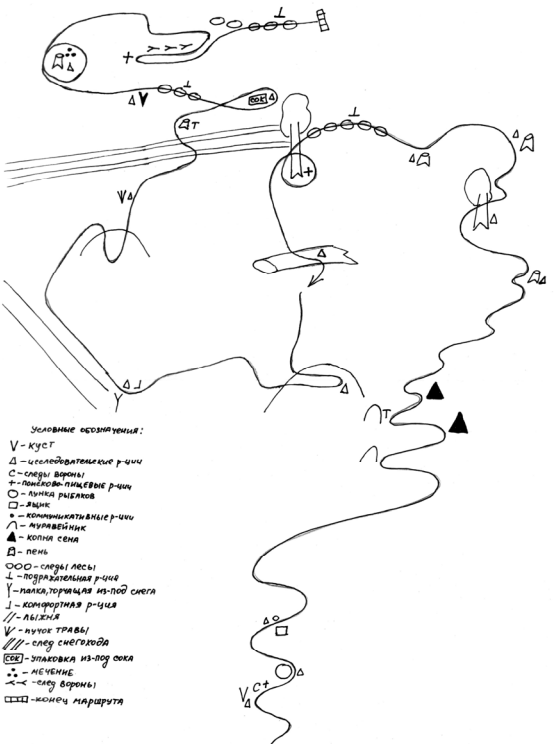

Figure 2. Scheme of a red fox's (*Vulpes vulpes* L.) footprints. A student's work. Conventional signs: 1 — a bush; 2 — exploratory responses; 3 — the tracks of corvine auks; 4 — food-seeking responses; 5 — angler's hole; 6 — a box; 7 — communicative responses; 8 — an anthill; 9 — a haycock; 10 — a stump; 11 — the tracks of a fox; 12 — an imitative response; 13 — a stick; 14 — a comfort response; 15 — a ski-track; 16 — a bunch of grass; 17 — the track of a snow-tractor; 18 — a juice package (rubbish); 19 — a marking response; 20 — a crow's track; 21 — the end.

Regarding simulation of the behaviour process, the theory of sign field is based on the nonbehaviouristic approach. That means, that among the causes determining the behaviour of an animal at the moment and in subsequent instants, within the frameworks of the sign field theory, the prominence is given to the perception of a certain token stimulus by the individual in question and the very performance of the motor response, produced in reply to this perception. One takes notice of the characteristics of the behaviour caused by any external influence; the connection between the token stimulus and the response reaction is considered a unit of behaviour analysis.

From the point of view of reflexology, which is pretty close to behaviourism concerning this problem, the motor response of an individual to an external signal corresponds, first of all, to the characteristics of the stimulus (for example, to the intensity of stimulus: either threshold or sub-threshold one). The peculiar feature of the "sign" approach, as compared with the reflexological view on animal behaviour, is that one takes into consideration, first of all, the motor responses of animals, performed during the perception of the urgent sign objects, and not the physicochemical properties of the environmental signs. The urgency is determined by the current motivation of an individual, which changes in the process of the performance of the functional form of behaviour, aimed at the realization of a certain biological need.

3. The basis for semiotic conceptualization of the obtained data

In order to define under which circumstances it is possible to call an object a sign and another object its denotatum (thing meant), let us resort to an example. The experience of field research proves that at the edge of an oak-grove, a fox orientates its fattening shuttle from one tree trunk to another. The niches under the tree roots and tree trunk

hollows near the roots create protective conditions for mice rodents, which willingly inhabit these natural shelters or dig holes at the branching basis of a tree trunk. "Numerous rodents are known to prefer settling their shelters under the protection of tree or stump roots. It is not accidentally that deep "digging" of badgers and foxes, hunting for rodents, is most frequently found there" (Novikov 1959: 96). In terms of semiotics, a tree trunk represents a sign of rodent for a mice-hunting fox, if after the appearance of the trunk in the reception field of the fox, the identification of the trunk provokes both the stimulation of a rodent image and seeking behaviour. This process is possible providing: 1) that the associative connection between the trunk image and the rodent image is stored in memory and is being constantly corroborated by successful nutrition activity; 2) there is motivation for food-seeking (the stimulation of famine centre functions in the central nervous system or the stimulation of the predator reflex).

Let us consider the sign process described above in more detail. If the fox had never seen trees before, it, nevertheless, orientates its food-seeking behaviour from one tree trunk to another under the influence of the seeing reflex (Slonym 1976). The image of a tree trunk for the specimen of red fox (*Vulpes vulpes* L.) possesses the properties of an inherent (instinctive) gestalt. An inherent gestalt is identified prior to any experience, because a typical tree trunk possesses steady attributes that Konrad Lorenz called "releasers", the presence of which is sufficient for the adequate perception of the tree trunk in the appropriate way. The association of the tree trunk image with the rodent image, recurrently corroborated in the ontogenesis, provokes the stimulation of the rodent image simultaneously with the tree trunk image stimulation, despite of the absence of a real rodent in the reception field of a mice-hunting fox. What is described above is actually a simplification relating visual images, because foxes usually hunt against the wind. Under these circumstances, the perceived odour or noise of the rodent corroborates the visual image of the tree trunk, thus

strengthening the associative connection between the token and its denotate. Thus, the tree trunk represents the token of a rodent for a mice-hunting fox, instinct and cognition performing in one and the same direction, increasing the probability of the positive preferential behaviour: the seeking, not the avoiding one. The positive food corroboration enhances the token properties of the tree trunk as a sign object.

Thus, it is motivation and memory, characteristic of the animal psyche, and not the process of communication that represent the indispensable condition of their sign usage. The sign activity of humans is socially normalized, whereas the interaction of animals with the environment through tokens is regulated by the urgent physiological needs and the peculiarities of the ontogenesis. In our opinion, such understanding of the nature of sign has a large heuristic potential and may be broadly applied in animal ecology.

The two-sided (material and ideal) nature of semiosis may seem an insuperable obstacle for science, though some researchers, like Charles Morris (1971) and Gennadi P. Melnikov (1978), for example, regard the sign process as possessing the properties of material phenomena only. Stale reproaches of innovative scientific work with an idealistic underlying motive are quite traditional for Russia. The acceptance of the ideal nature of sign process does not change a thing: the ideal psychic function of "imagination" is susceptible to scientific analysis (Leontyev 1994). The investigation of the attributes of sign behaviour that are materially fixed in the environment solves the problem of objectivity.

Yuri S. Stepanov (1999) asserts that "meaning in the organic nature is a biological connection between an organism and the environment, including the connection between the organism and other organisms, based on the conformity of the "structural plan of an organism" and its "external world". Animals possess an inherent ability to identify the objects crucial for the existence of their specimen or an individual. This recognition is performed with the help of a few differential tags,

by which the animal distinguishes one object or series of objects from the external world. This allows for the modelling of "stimulus-objects". Releaser becomes the "representative of the whole phenomenon, its signal or its sign" (Stepanov 1999).

For animals, the equivalent, which allows them to recognize various objects and events of the environment as signs with meaning, identical for the recipient, is not only the similar visual, acoustic, tactile or olfactory image, but also some definite behavioural motivation (biological function) which is usually performed during the perception of the given objects. On the other hand, one and the same signal for each specimen may have quite different meanings depending on the period of time (Panov 2005).

From the point of view of the sign field theory, the motor "answer" of an individual corresponds, first of all, to the semantic load of the situation, that is, depends on the context of the behaviour pattern being performed. Here, one should regard the context of behaviour as ecological (accommodative) meaning of motor activity. To put it differently, animals, possessing psyche (a peculiar ability of the living beings to create accommodation models of reality), exist rather in the world of meanings generated by a living organism during the perception of stimuli than in the world of stimuli, as perceived by reflexologists. Possessing psyche, mammals create and perform accommodation patterns of interaction with the ecosystem, which are realized in the form of behavioural activity, motivated by a biological need.

It is common knowledge that the abundance of sign stimuli coming from the environment and affecting any living organism exceeds the capacities of motor response of an organism. The integrative activity of the nervous system on selecting filtration of the information plays a significant role for the preservation of the vitality. Selective attention, that is, the specificity of the reactivity to the stimuli, which is controlled by the motivating condition of an individual, is characteristic of the accommodative-functioning psyche of living creatures. From all the diversity of signals coming at the animal receptors from

the environment, animals react, first of all, to those external stimuli which meet their predominant motivation (that is, prevailing intention). The sequence of signals forming sign fields is predetermined not only by the spatial characteristics of the environment. The effect provoking the individual's reaction can not be deduced to be the result of simple summation of signal influences. It represents the result of signal integration, complicated by the "internal" mood of the animal, its motivation, experience, skills, physiological condition and the context of behaviour. The very process of behavioural performance, its success and longitude, in its turn, influences the individual's perception of certain signals and corrects its further behaviour. The registration of behaviour in the field notepad alongside with the simultaneous calculation of the sign field indexes (anisotropy, magnitude and intensity), allows us to take into account the above-listed factors by their result.

4. Conclusions

What is the use of the semiotic encoding of the traditional concepts of reflexology? What are the benefits of apllying semiotic terminology in the field of animal ecology? First of all, the semiotic approach contributes to the realization of the axioms, limitations and assumptions of reflexology. Second, there appears a possibility to study a succession of reflexes in their syntagmatic dynamics. Third, the circulation of the term "meaning", which is one of the crucial concepts of semiotics, becomes possible. Fourth, there appears the opportunity to consider tokens in their complex effect, that is, sign field. Furthermore: the attention to the contextually-conditioned change of sign meaning allows one to observe the variations in the usage of resources and conditions of the realized ecological niche by animals. That means that the same denotates can possess different intensionals, depending on certain conditions, which, by the analogy with the formation of

meanings in human activity, may be defined as the "context of a sign situation".

Thus, a sign in the animal world alludes to a different object, and this reference does not necessarily have to be made by another participant of the communication process. For humans, and for animals as well, the reference can have various forms: 1) urgent accommodation activity, 2) reminiscence of its own previous activity, associated with the objects of similar kind, 3) fantasy, game, in which the sign user is still to encounter the object.

The application of the concept "sign" in animal ecology allows to differentiate between the two types of meanings which the objects and phenomena of the environment have in store for the accommodating animals: 1) the abstract meaning, which is delivered by the resources and conditions of the ecological niche of a specimen, and 2) specific, or situational one, determined by the actual place of a given token in the course of the accommodation activity of a certain individual.

References

Benveniste, Émile 1974. *General Linguistics*. Moscow: Progress. [Original: Benveniste, Émile 1966, 1974. *Problèmes de linguistique générale*, 1, 2. Paris: Gallimard.]

Boutovskaya, M. L. 2005. The person and apes: language abilities and opportunities of dialogue. *Journal of Zoology* 84(1): 149–157. [In Russian]

Bühler, Karl 1965. *Sprachtheorie. Die Darstellungsfunktion der Sprache*. Stuttgart: Gustav Fischer Verlag.

Gardner, R. A.; Gardner, B. T. 1969. Teaching sign language to a chimpanzee. *Science*, 165: 664–672.

Leontyev, A. N. 1994. *Philosophy of Psychology*. Moscow: Moscow State University Press. [In Russian]

Melnikov, Gennadi P. 1978. *Systemology and Cybernetics Language Aspects*. Moscow: The Soviet radio. [In Russian]

Mechkovskaya, Nina B. 2004. *Semiotics: Language, the Nature, Culture*. Moscow: Academiya. [In Russian]

Morris, Charles 1971. *Writings on the General Theory of Signs*. The Hague, Paris: Mouton and Co. Publishers.

Mozgovoy, John P.; Rosenberg, Gennadiy S. 1992. *Mammalian Biological Signal Field: Theory and Practice of Field Research*. Samara: Samara State University Press. [In Russian]

Naumov, N. P. 1977. Biological (signal) fields in the life of mammals. In: Shilov, Igor A. (ed.), *Latest Achievements in Theriology*. Moscow: Nauka, 93–108. [In Russian]

Nikitin, M. V. 1997. Limit of semiotics. In: *Questions of Linguistics* 1: 3–14. [In Russian].

Novikov, G. A. 1959. Mammal and Birds Ecology in the Forest-Steppe Oak Groves. Leningrad: Leningrad University Press. [In Russian]

Panov Evgenij N. 2005. *Signs, Symbols, Languages. The Communications in an Empire of Animals and in the World of People.* Moscow: KMK Scientific Press. [In Russian]

Poletaev, I. A. 1958. Signal (About Some Concepts of Cybernetics). Moscow: The Soviet radio. [In Russian]

Premack, D. 1985. "Gavagai!" or the future history of the animal language controvercy. *Cognition* 19: 207–296.

Sebeok, Thomas A. 2001. Biosemiotics: Its roots, proliferation, and prospects. *Semiotica*. 134(1/4): 61–78.

Sevastyanov, O.F. 1989. Mechanisms of reference that are specific to a species of animals. In: Panov, E. N. (ed), *Behaviour of Animals and the Person: Similarity and Distinctions*. Pushkino: Science Centre of Biological Research, 142–164. [In Russian]

Simkin, Gennadij N. 1976. The modern problems of Zoosemiotics. In: *Group Behaviour of Animals. Conference Participants' Reports.* Moscow: Nauka, C: 334–338. [In Russian].

Slonym, A. D. 1976. *Environment and Behaviour. Formation of Adaptive Behaviour*. Leningrad: Science. [In Russian]

SED = *Soviet Encyclopaedic Dictionary* 1984. Moscow: Soviet Encyclopedia Press, 1984. [Prokhorov, A. M. (ed.); in Russian]

Stepanov, Yuri S. 1967. Modern semiotics' structure and general notions. In: *Proceedings of the Conference "Language as a Kind of Sign System"*. Moscow: Nauka, 2–78. [In Russian]

Stepanov, Yuri S. 1971. *Semiotics.* Moscow: Nauka. [In Russian]

Uexküll, Jakob von 2001. An introduction to Umwelt. *Semiotica* 134(1/4): 107–110.

Vladimirova, Elena J. 2001. Description of the informative and communicative processes in ecological systems in semiotic terms. *Vestnik of Samara State University* 2(20): 163–177. [In Russian]

Vladimirova, Elena; Mozgovoy John 2003. Sign field theory and tracking techniques used in studies of small carnivorous mammals. *Evolution and Cognition* 9(1): 73–89.

— 2004. *Zoopsychology. The Manual for Students who Specialize in Biology*. Samara: Univers-group. [In Russian]

Vygotski, Lev S. 1934. *Thinking and Speech*. Moscow. [In Russian]

— 1983. *Problems of Development of Mentality. The Collected Works*. Vol. 3. Moscow. [In Russian]

Знаковая функция млекопитающих как средство экологической адаптации

В статье рассматриваются основные положения различных семиотических научных школ по поводу наличия у млекопитающих знаковой активности. Приведены аргументы научного направления, отрицающего знаковую активность животных, поскольку они не способны к семантическим обобщениям, основанным на конвенциальных значениях знака. Согласно противоположному подходу, которого придерживается автор статьи, знаковая активность млекопитающих может быть рассмотрена как средство экологической адаптации. Поведение животных базируется на полученных ими внешних сведениях о состоянии среды обитания, включая следы жизнедеятельности самих животных, без прямых контактов между особями. Элементы движения, целостные поведенческие реакции одинаковой мотивационной принадлежности, а также параметры знакового поля, которое представляет собой информационно-знаковую среду, могут быть рассчитаны в соответствии с конкретными исследовательскими задачами. Поведение животных формализуется с помощью параметров «величина, анизотропность и напряженность знакового поля», а также «ценность одного знакового объекта».

Imetajate märgikasutus kui ökoloogilise kohastumise vahend

Käesolevas artiklis käsitletakse erinevaid semiootilis-teaduslikke alusteooriaid imetajate märgikasutuse kohta. Ühelt poolt leidub neid, kes eitavad märkide kasutust loomadel, sest väidetavalt ei ole loomad võimelised semantilisteks üldistusteks konventsionaalsete keeleliste väärtuste alusel. Teine lähenemine leiab, et imetajate märgikasutust võib vaadelda kui ökoloogilise kohastumise vahendit, mis tähendab loomade käitumist informatsiooni põhjal, mida nad ammutavad oma elukeskkonna tunnusjoontest, ilma et nad mõnda oma liigikaaslast otseselt näeks. Liikumiselementidel, sarnase motivatsiooniga käitumuslikel reaktsioonidel ja looma märgilis-informatsioonilise keskkonna moodustava märgivälja parameetritel võib kõigil olla oma arvuline väljendusviis, mida saab vastavalt uurimisülesandele välja arvutada. Loomade käitumise formaliseerimine nõuab järgmiste parameetrite üheaegset arvesse võtmist: ulatus, intensiivsus, anisotroopia ja antud märgilise objekti väärtus.