

John Maynard Smith's Typology of Animal Signals: a View from Semiotics^[*]

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Abstract

Approaches to animal communication have for the most part been quite different in semiotics and evolutionary biology. In this context the writings of a leading evolutionary biologist who has been also attracted to semiotics — John Maynard Smith — are an interesting exception and object of study. In my presentation I will focus on the use and adaptation of semiotic terminology in Maynard Smith's works with reference to general theoretical premises both in semiotics and evolutionary biology. In developing a typology of animal signals, Maynard Smith employs the concepts of icon, index and symbol to denote distinct signal classes. He uses «indices» or «indexes» to express a signal type where the relation between signal properties and meaning is restricted because of physical characteristics. Such approach also points out the issue of motivatedness of signs that has had a long history in semiotics. In the final part of the paper the usage and content of the concepts of signal form and meaning in Maynard Smith's writings will be analysed. It appears that in evolutionary biology the meaning of signal is a vague concept that may denote a variety of things from an animal's specific physiological status to artificial theoretical constructs. It also becomes evident that in actual usage the concept of signal often includes references to the receiver's activity and interpretation that belong rather to the characteristics of sign process. The positive influence of Maynard Smith's works on semiotics could lie in paying attention to the role of physical necessities in animal communication. Physical constraints and relations seem to have a significant role also in semiotic processes although this is not always sufficiently studied or understood in semiotics.

[*] This research was supported by the European Union through the European Regional Development Fund (Centre of Excellence CECT) and by Estonian Science Foundation Grant No. 7790. An enlarged version of this presentation is accepted for publication in the international semiotic journal *Sign Systems Studies* (special issue on zoosemiotics).

An appreciation of semiotics by an evolutionary biologist is a rare event that certainly deserves attention. Especially if the biologist under consideration is John Maynard Smith (1920-2004), a promoter of neo-Darwinian evolutionary biology and an author of well-known textbooks in animal communication (Maynard Smith, Szathmáry 2000; Maynard Smith, Harper 2003). In this short survey, I am focusing on the explicit references to semiotics and their context in John Maynard Smith's writings and leave the rest of his vast legacy untouched. This means I do not include his position in debates on memetics, which is generally supportive (Maynard Smith 1995; Maynard Smith, Szathmáry 2000: 139-140), and his thoughts on the evolution of human language, which appear to be allied to biological determinism (Maynard Smith, Harper 2003: 133-136; Maynard Smith, Szathmáry 2000: 149-170). Concerning the proximity to semiotics, there are several relevant texts of interest by Maynard Smith (Maynard Smith, Harper 1995; Maynard Smith, Harper 2003; Maynard Smith 1982, Maynard Smith 1999; Maynard Smith 2000). Although many of these are co-authored, contemplations that include references to semiotics have also been presented by Maynard Smith solely, which justifies regarding these as a part of his original heritage. On the other hand, many ideas and inclinations that I critically discuss in this article belong to the general legacy of evolutionary biology and their appearance in Maynard Smith's writings should be treated as an individual occurrence of much wider development. Maynard Smith's texts relate to semiotics both in regard to terminology used (icon, index, symbol, arbitrariness, form, meaning, content, etc.) and references made (Charles S. Peirce, Umberto Eco). Maynard Smith's interest in semiotics has also been widely noted (e.g. Szathmáry 2006, Williams 2007). There exists at least one study close to the topic of the present article, namely the analysis of the semantic content of the concept of «animal signal» in Maynard Smith's writings with the reference to Ruth Millikan's teleosemantic theory (Stegmann 2005). I also touch upon the issue of meaning and use of concepts of animal communication in Maynard Smith's writings in the second part of this article, but my approach and frame of analysis remain strictly semiotic (meaning zoo- and biosemiotics here and hereafter).

1. CONTEXT OF JOHN MAYNARD SMITH'S WRITINGS IN ANIMAL COMMUNICATION

Despite his use of semiotic terminology and references, the context of Maynard Smith's interest is very different from that of semiotics. Namely, his aim in the considered publications is to establish and elaborate a typology of animal communication for evolutionary biology. Maynard Smith's approach is close to the gene-centric views of Richard Dawkins and understandings of communication by Mark D. Hauser, John R. Krebs, Oren Hasson and other eminent Neo-Darwinian evolutionary biologists. An essential problem concerning communication in this paradigm is the question of the reliability of the communication system. In evolutionary biology organisms are considered to be essentially egoistic (as maximising their fitness in evolution) and because of that they are believed to have generally conflicting interests in communication. This understanding was expressed by Richard Dawkins and John R. Krebs as conflict between senders as manipulators and receivers as mind-readers (Krebs, Dawkins 1984: 380-402) and

it is also immanent in their (as well as in many other evolutionary biologists') definition of communication: «The process in which actors use specially designed signals or displays to modify the behaviour of reactors» (Krebs, Davies 1993: 349).

Built on this premise, a central question for evolutionary biology is: how does a communication system not become corrupt in evolution under the conflicting influences of its participants? One hypothesis, promoted by Israeli biologists Amotz and Avishag Zahavi under the name of the «handicap principle», argues that signals in honest communication must be costly to produce and maintain by the sender (have excess energetic cost) in the way that the same signals cannot be afforded by *low quality individuals* (Zahavi, Zahavi 1997: xv, Maynard Smith, Harper 1995: 306). This means that the handicap signals are superfluous and hindering, tail of the peacock being a textbook example. In *Animal Signals: Models and Terminology* John Maynard Smith and David Harper (1995) present their views on this question in the form of a three-dimensional typology of animal communication. The first distinction is made between types of information that signals convey (self-reporting signals, other-reporting signals and cues); the second classification describes the mechanism that is used to ensure the reliability of the signal (minimal signals, cost-added signals and indexes); and the third dimension describes the relationships between the signal form and the object of the signal (the semiotic terminology employed for this is discussed in the next chapter). The most remarkable aspect in this typology is perhaps the introduction of «indices» or «indexes» (the terms are used interchangeably), as a type of signals that by definition cannot be faked (Maynard Smith, Harper 2003: 45-67). Maynard Smith describes «indices» or «indexes» as reliable because of their motivatedness, i.e. there exists a restrictive relation between the signal properties and the quality of the sender because of physical necessity (Maynard Smith, Harper 1995: 306). In addition to that, there are also other possible ways for a communication system to remain functional such as inclusion of coordination games, where the sender and receiver prefer different outcomes, but share some overriding common interest; repeated interactions, where honest signalling contributes to the sender's reputation in the group; and behavioural punishment by species-mates for the sender of a false signal (Maynard Smith, Harper 2003: 30).

Although the question of the existence of a communication system under interest conflict can be a fascinating topic for semiotics, the validity of the presumption by Richard Dawkins, John R. Krebs and others about the manipulatory and deterministic nature of communication needs to be disputed. The well-established criticism against such position is presented by theoretical ethologist W. John Smith. He disproves the neo-Darwinian understanding of communication on the following grounds: 1) the emphasis is placed mostly on formalised signalling, while other sources of information for the receiver are not addressed; 2) formalised displays are not taken as probabilistic but rather believed to have one-to-one correspondence with the sender's subsequent behaviour; 3) the conditional nature of animal signals is not considered (e.g. the receiver's ability to synthesise different types of information, send feedback to the sender, make predictions about future scenarios and act accordingly); and 4) the social environment where communication takes place is generally neglected (i.e. long-term consequences of deceptive communication are not taken into account) (Smith 1986). The general difference between the views of Smith and Maynard Smith (and many other Neo-Darwinians) appears to lie in their understanding of the role of the sender and the receiver in communication. For

Maynard Smith the sender is the one who controls the communicative situation whereas the receiver is a passive recipient. For Smith, on the contrary, it is the receiver who has autonomy and subjectivity of acting and who can relate different types of information (this position is also supported by many semioticians, c.f. Kull 2004: 103). For Smith the outcome of communication is undetermined and probable; for Maynard Smith it is rather determined and rigidly structured. The position taken by Maynard Smith appears to be inevitable for Neo-Darwinian biology for demonstrating that the evolutionary success of different genes is the relevant factor for the outcome of animal communication. Giving an ability of choice for the receiver (as it is more often in animal psychology and especially prevalent in cognitive ethology) would make the situation too unpredictable for a reductionist paradigm.

2. EMPLOYING ICON, INDEX AND SYMBOL WITH REFERENCE TO MOTIVATEDNESS

Another peculiar metamorphosis takes place when the semiotic notions of icon, index and symbol are employed in Maynard Smith's typology of animal signals. These concepts turn into distinct types of signals, whereas the distinction is based on the relation between *form and content* or between *form and meaning*. It appears that the semiotic terminology is basically employed for arguing the motivatedness of the signals. Thus, icon is said to be «a signal whose form is similar to its meaning» (Maynard Smith, Harper 2003: 15) and in icons «the form of the signal is similar to its content» (Maynard Smith, Harper 1995: 309). Indexes or indices are defined as signals whose form «is determined by the content» (Ibid.) and «whose intensity is causally related to the quality being signalled» (Maynard Smith, Harper 2003: 15). Symbol is understood as «a signal whose form is unrelated to its meaning» (Ibid.). Although the use of concept of «meaning» in this context is a rather remarkable influence of semiotics on evolutionary biology, such interpretation raises some critical questions. For instance, arguing for the similarity between form and content or meaning presupposes their belonging to the same logical category and being comparable, which is far from being self-evident. Discussing arbitrariness in regard to the relations of form and content indicates, however, the influence of Saussurean tradition and the whole trichotomy is probably adapted through the writings of Eco (e.g. 1976: 178). Substituting the relationship of sign and its object with that of form and content (or meaning) as done by Maynard Smith can be perhaps explained with the specifics of biological signalling, where the appearance of an animal's body often signals various inner characteristics of the animal.

The most important alteration in this is, however, that in Peircean semiotics icon, index and symbol are types of signs — not signals — and are therefore inseparable from the interpretative activity of the receiver. According to Peirce, «*nothing* is a sign unless it is interpreted as a sign» (CP 2: 308, my Italics) and sign (or representamen) is «*anything* which determines something else (its interpretant) to refer to an object» (CP 2: 303, my Italics). This also means that being an icon, index or symbol is rather a quality of sign and can be related with one and the same physical structure depending on the participating individual and the specific course of the sign process. For instance, the begging display of the female passerine with flapping wings, head and neck bended down and beak opened can be both indexical and iconic. In the

short-term perspective, it can be an indexical sign, i.e. indicating a physical relation with a meaning something like, «put this caterpillar here, in my mouth.» In the long-term perspective, it can be a sign with iconic dominance, signifying the relationship between this specific female and the subsequent feeding behaviour of the chicks.

At the same time it needs to be admitted that the situation is actually also more complex in semiotics and Maynard Smith's unintended criticism points to some essential questions of semiotics as that of the relationship between the sign and the sign vehicle. It is evidently basic intuition in semiotics that signs are relational units that cannot be separated from the activity of the interpreter. At the same time they are not independent from the properties of the physical structures of the world (sign vehicles). This determining relationship is present in some of Charles S. Peirce's many definitions of sign: «I define a Sign as anything which is so determined by something else, called its Object, and so determines an effect [...], which effect I call its Interpretant» (SS 80-81), and it is especially expressed in the concept of «Dynamical Object, which is the Reality which by some means contrives to determine the Sign to its Representation» (CP 4.536). Additionally, Peirce's distinction between icon, index and symbol can be understood as an array of signs from the dependence on the object to the dependence on the interpreter's activity. Icon is a sign that «stands for something merely because it resembles it» (EP 1.226), index is a sign «determined by its dynamic object by virtue of being in a real relation to it» (SS 33) whereas symbol is a sign «which fulfills its function regardless of any similarity or analogy with its object and equally regardless of any factual connection therewith, but solely and simply because it will be interpreted to be a representamen» (CP 5.73).

Maynard Smith's perception of icon and index as being more motivated than the symbol thus corresponds in general to Peirce's views. This intuition could also perhaps be a relevant dimension for the contemporary debate over symbolic signs in animals (Deacon 1997: 69-101; Queiroz, Ribeiro 2002). For instance many signals used in courtship such as the tails of the peacock or lyrebird are considered to be symbolic by Maynard Smith exactly on the basis that «form is unrelated to actual fighting ability» (Maynard Smith, Harper 2003: 59). In a similar vein, many developmental processes can also be considered symbolic as for instance regulatory codes that have an arbitrary nature (Maynard Smith 1999: 74). Inducer molecules that could switch any gene on or off are considered symbolic by Maynard Smith, as «there is no necessary connection between their form (chemical composition) and meaning (genes switched on or off)» (Maynard Smith 2000: 185; for discussion, see Godfrey-Smith 2000). For semiotics, the whole topic can be reformulated as a question of relations between a sign vehicle and a sign, or between a message conveyed in communication and its interpretation by a receiver.

3. MEANINGS OF SIGNALS IN EVOLUTIONARY BIOLOGY

As Maynard Smith employs semiotic terminology to describe the relationship between the meaning and form of the signal, it would be clarifying to find out what is considered by those two concepts. Meaning and form are not explicitly defined, as is also noted in the analysis by Ulrich E. Stegmann (2005: 1016-1017), so assumptions need to be made by observing the context of use. Under the concept of form Maynard Smith appears to describe the general

appearance of animal signals, as for instance the ornamentation of male birds (Maynard Smith, Harper 2003: 54), fighting displays in many groups (Ibid., 80), nuptial gifts in crickets (Ibid., 85) and others. Thus form stands for how animal signals are usually distinguished and described in ethology. Concerning the concept of meaning, indirect confirmation can be found when addressing the question based on the discussion above — with what signal form is believed to be in an iconic, indexical or symbolic relation. It appears that meaning in animal communication can be: «fitness» or «some component of» it (Ibid., 14), «quality of interest to the receiver» (Ibid., 33), «heritable foraging ability or health» (Ibid., 48), «body size and likely fighting ability» (Ibid., 50), «relative RHP» (resource holding potential, Ibid., 50), «running ability» (Ibid., 52), «heritable parasite resistance» (Ibid., 54), «ownership» (Ibid., 57), «foraging ability» (Ibid., 60), «aggression» (Ibid., 69), «hunger» (Ibid., 110), «good genes» (Maynard Smith, Harper 1995: 309) and «intentions» (Maynard Smith 1982: 4). From this incomplete list it becomes apparent that animal signals in evolutionary biology may mean a variety of things. These meanings also appear to form different categories: some indicating the specific physiological or psychological status of animals (that can probably also be perceived by animals); others indicating some general ability or future potential of an animal; and still others, which are rather theoretical constructs.

When looking for the pairs of signal form and meaning in Maynard Smith's writings, it appears that they are also often accompanied by the specific reference to the receiver (mostly female, but also contestant or predator). Some examples of such constructions are: the «female may choose an index of some component of fitness» (Maynard Smith, Harper 2003: 14); «we describe how female *Drosophila subobscura* select males according to their ability to 'dance' ... — a measure of neuromuscular coordination» (Ibid., 14); «the female has a rule for estimating the quality of a male from his advertisement, $p=P(a)$ » (Ibid., 20); «exposure of the abdomen is a signal of a male's condition, which may be of interest to a female as an indicator of heritable foraging ability or health» (Ibid., 48). These excerpts indicate that although meaning/form dyads are explicitly described as signals, as it was uncovered before, in actual use the characteristics of the sign process are also included (where according to the definition of Peirce, something «stands to somebody for something in some respect or capacity,» CP 2:228).

In works of evolutionary biology such game-theoretic constructions are sometimes accompanied with the remark that these should be taken metaphorically (e.g. Krebs, Dawkins 1984: 386, the issue is addressed by Krebs and Davies 1997: 11). This makes things even more obscure for a semiotician, as semiosis is a specific triadic relation and there is not much room for metaphors in it. Signals either participate in semiosis or not. If they do, then it should be shown how the signals (representamen) and their possible consequences (interpretant) are present for the animal. In regard to given quotations this would mean demonstrating the relevance of the concepts of «fitness,» «neuromuscular coordination,» «rule $p=P(a)$ for estimating the quality,» and «heritable foraging ability or health» for the animal. That would probably require including some form of intentionality or prescience on the cognitive or organismic level of the animal, and on the other hand acknowledging the artificial and combinatory nature of some concepts such as fitness (as discussed in length in e.g. Mills, Beatty 1979; Ariew, Lewontin 2004).

A principal difference between semiotics and evolutionary biology is in putting an animate subject into the foreground and considering biological processes from its perspective

(cf. Kull et al 2008: 45-47). Concerning the present topic, this would mean detailed analyses of an animal's subjective world or Umwelt and distinguishing phenomena and processes that can be present for the semiotic self of an animal (in the wide Sebeokian sense, including the immunological, cognitive and linguistic self, Sebeok 1991). Evolutionary processes should also be considered from that premise, by distinguishing the processes that an animal can perceive and influence from those that it cannot. Everything in the environment that is present for the animal and passes its organs of perception and subsequent action is subject to its internal representation and interpretational activity. Such a process can be legitimately titled «semiotic selection» (Maran 2005: 171) and sexual selection in most of its expressions is one type thereof. A principal argument for building an understanding of evolution that starts from the individual is the autonomy of the semiotic self as it builds and calibrates itself in self-organising and not a predetermined way in the specific environmental context and developmental history. Thus a semiotic understanding of evolution finds its kinship in biology more in evolutionary developmental biology than in Neo-Darwinian synthesis.

4. SEARCHING FOR COMMON GROUND BETWEEN SEMIOTICS AND EVOLUTIONARY BIOLOGY

As the conclusion of this presentation, I would raise a question about the possible dialogue between semiotics and evolutionary biology. Searching for common ground could turn out to be a rather difficult task because of major foundational differences between the two paradigms. Maynard Smith's approach appears to include at least a possibility to relate semiotics and evolutionary biology in a way that is not antagonistic or subordinating. The positive lesson of his works for semiotics could lie in paying attention to the physical structures and constraints and their influence on the animal communication processes. Introducing indexes or indices as signals that use pre-existing physical restrictions or relations to convey meaning is a major innovation that Maynard Smith made later for evolutionary biology. Additionally, in semiotics the role of physical relations or Peircean secondness as a «brute action» for semiotic processes has not received enough attention. From the writings of Thomas A. Sebeok we know that semiosis is the most characteristic trait of life that is common to all life forms (Sebeok 2001:10-12). Jesper Hoffmeyer has added to this the principle of growth of semiotic freedom (understood as the depth of meaning that an individual or species is capable of communicating, Hoffmeyer 2008: 186). The physical space that the biosemiosphere inhabits, relates to and gradually overcomes, has remained, however, a quite unexplored area in semiotics.

In following, I am sketching a few possibilities for how physical processes can relate to and be involved in semiosis. First, semiosis may incorporate Peirce's secondness in order to foresee and avoid this *brute force*. For instance, a bighorn sheep that uses its senses for searching for safe passage over a mountain cliff employs semiosis to avoid the effect of a physical impact. Cause-effect relations and physical necessities, as for instance the need for food, form a major class of objects of semiosis in the animate world. Additionally, regularities of the living world constantly become bases for the formation of new signs and semiotic structures. According to the maxim by Jesper Hoffmeyer: «Whenever a new habit appears, it

tends to become a sign for somebody» (Emmeche, Kull, Stjernfelt 2002: 20). The specifics of this process, and the patterns and limitations in it, are, however, not very well scrutinised in semiotics. Karel Kleisner's concept of *semiotic cooption*, defined as a situation when the character that was shaped serving a particular role or having a specific meaning within the Umwelt of an organism is coopted by another organism gaining thus a new meaning within its Umwelt, hints at a possible direction (Kleisner 2010). In such a process of sign formation, similarity and categorisation can turn out to be vital mechanisms.

Second, signs may often be motivated and non-arbitrary because of the existent physical properties or regularities of the world. Here we can think of biological universalities —described on the linguistic level as ontological metaphors by George Lakoff and Mark Johnson (1980: 25-32) — for instance up, growth, full, whole, fresh, symmetry having generally more positive connotations than down, decay, partial, rotten, asymmetry. These relations are built on the general tendencies of organisms participating in natural processes and the behaviour of organic matter. As such they are quite general but not absolute in nature, as for the meat fly, rotten flesh is just fine. Another example of this kind would derive from the studies of Heini Hediger on spatial relations. Mutually liberating and lasting physical proximity in humans or animals stands for non-aggressiveness and psychological closeness. Grooming behaviour in primates as a sign of attachment has been built on the physical premise that for aggression, close distance is needed.

Third, in some cases there is a specific interrelatedness of semiotic and non-semiotic processes, where things that do not participate in the semiosis become objects in the subsequent semioses. An example of such type can be found in camouflage and mimesis. Differently from most communicative relations of animals, in camouflage and mimesis the specific appearances that do not participate in semiosis prevail for the subsequent generations, whereas those which do participate in semiosis fail. Despite that, the appearances that emerge in such a process of exclusion have a semiotic nature by developing an iconic sign-relation with the object of their imitation (cf. Maran 2007).

A possibility for the dialogue between semiotics and evolutionary biology could especially be found in the relationship between the physical necessities and effects of semiotic selection, between the motivatedness of signals and unpredictability of semiosis and the influence of all this on the evolution and development of animal communication and sign systems. From semiotics this would require acknowledging the role of physical processes and limitations in semiosis, and from evolutionary biology the introduction of a subjective interpretative perspective is needed. The latter is actually nothing new — in 1993 Tim Guilford and Marian Stamp Dawkins argued that evolutionary biology would benefit from psychological perspective (Guilford, Dawkins 1993). There is unfortunately little such emphasis in the writings of Maynard Smith and his approach to semiotics also remains on the level of naïve interpretation which focuses mainly on adapting terminology. It is also an unfortunate turn of events of the development of science that Maynard Smith approached semiotics through the works of Umberto Eco, who is one of most anthropocentric and culturocentric figures among the classical authors of semiotics. Given the significant differences between the foundations of both paradigms as well as contemporary developments, it is not very likely that the door slightly opened by John Maynard Smith would be used by many researchers in coming years.

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