Chapter

‘Evolutionary Stories’: Narratives as Evolutionary Tools to Describe and Analyse Animal Behaviour and Animal Signals

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Abstract

Animal communication studies, and Ethology itself, deal with the analysis of behaviour in a way that can be understood as an analysis of signal sequences, mainly from a qualitative point of view. Thus, the main goal of behavioural analysis is to interpret the ‘semantic’ content of behavioural sequences and communicative signals. Considering these analyses as narratives to be interpreted, then hermeneutics, narrative schemas and structuralist techniques could be applied. Here, I propose that in fact when exploring and decoding animal behaviour sequences, we should use narrative analysis and biosemiotic techniques to interpret a type of information processing most effective in evolution, which could be called the analysis of ‘evolutionary stories’. Moreover, I think we do exactly that, but do not acknowledge it because is not considered ‘hard science’ (no maths involved). Nevertheless, this type of analysis seems to be the more flexible and appropriate way to interpret animal communication signals and systems, and also to interpret any general behavioural sequence, because it is mostly based on the cognitive capabilities of the involved species. This chapter will argue about the need for a re-evaluation of a cognitive and biosemiotic interpretation of behaviour and communication signals as central to biological behavioural analysis.

Keywords: behavioural analysis, narrative analysis, sign analysis, semantics, biosemiotics

1. Introduction

One of the more interesting issues of trying to describe and understand the behaviour and, even more important, the communicative messages of animals is the need for capturing the meaning of the messages in whole before analysing them in their constitutive parts. The process, from a scientific point of view as well as from a layman’s point of view, implies the capability of observation in detail and as a whole, and also the capability of a certain empathy for the animal we are observing. This empathy is, obviously, helped by the higher proximity we have with the organism we are trying to understand, and this proximity depends not only in our proximate relationship with them in the zoological scale or ‘tree’, but also in the similarity of the communication channels we use to exchange signals (or information):

the more channels we have in common, the more opportunities we have to grasp the sense of the communicative signals emitted by the observed organism.

When we do this kind of analysis with the goal of understanding the behaviour of an organism, or more specifically its communication signals, we tend to use an approach that could be identified with the hermeneutics of text analysis. We use an approach similar to that of the hermeneutic circle, in the sense that we try to understand the behaviour or signal as a whole in relation to its constituent parts, and the parts in relation to the whole. It seems to me that, in doing so, we use an interpretive (hermeneutic) approach, closely related with narrative analysis, more than a mathematical approach. This is probably due to the fact that we are trying to understand the meaning of a behavioural chain of acts or signals, and not the mechanics of the chain construction itself. Indeed, the mechanics of chain construction should (and probably will) be influenced by the meaning-making process involved in the process of chain construction, because of an issue of order: the need for building a clear succession of behavioural units or information elements constructing meaning that constrains the possibilities of sequential ordering, because in general no aleatory order is good for the task. If it is mathematically true that an equal probability in occurrence of signals can deliver the maximal quantity of information in a communication (at least, in a binary system), biological entities tend to favour construction rules and redundancy to ensure communicating the needed message and meaning against 'noise' [1].

Interpreting a sequence of behavioural acts is a process closely related, if not the same, to interpreting signals, even if the behavioural sequence is not communicative in itself, at least in the 'intentional' sense. The fact is that we humans (and more specifically, scientists), 'read' the sequence from an outsider position, trying to interpret it and to understand the 'story' the animal is telling with its behaviour. In doing so, scientists could be (and in many ways are) assisted by mathematical tools and technical devices helping our analysis capabilities, but the ultimate resource is our brain and our interpretive methods. This view is supported by Cognitive Linguistics, as the discipline assumes that our interactions with the world are mediated through the use of informational structures in the mind [2].

Even if it has been proposed that there are two different modes of thought—a narrative one directed to think about human action, and a paradigmatic mode to think about natural science and mechanisms—we know that scientists are not restricted to think about problems using only mathematics, experiments and diagrams, but that they also use narratives [3]. Understanding a story implies to examine the possible planning processes running under the story backwards, trying to find explanations about the agent's goals and plans for actions and events that we can identify in the story [3]. Indeed, as animals are far from being optimal, mathematical models of optimality are not always very useful for the task of extracting meaning from a chain of behaviour (and its context of production) and, at the same time, for evaluating the cognitive capabilities of the organisms using those signals.

I think that, in essence, when we humans interpret or read a behavioural sequence or signal from an animal of other species, in fact we try to extract meaning of those sequences in the same way as when we read a story or watch someone performing a narration. We mostly evaluate the meaning of the behavioural acts disregarding any considerations about the physical ways of the narration or their physiological characteristics; we try to understand, and also to extrapolate into the future the information gathered as a way to predict future behaviours of the subject(s). Probably many animals do the same in their heads. Those behavioural chains we read as signal sequences are what I call behavioural narratives or stories, and once they are interpreted, compared and systematized, we can say we have read evolutionary stories.

DOI: http://dx.doi.org/10.5772/intechopen.89209

Thus, the goal of this chapter is to think about our ways to tackle the analysis of behavioural chains, and to show how, when doing this kind of analysis, we are nearer to a narrative analysis than to a 'hard science' mathematical approach. As I said before, we are in fact discovering or telling 'evolutionary stories', and working with its semantics, pragmatics and syntax.

2. Narrative analysis as a parallel way to interpret behaviour

Barthes [4] proposed a method of analysis of narratives considering the sequential analysis of narrated actions and/or facts, and thought to be used into film or literary analysis fields. Briefly, the proposed analytic method was presented as the structural study of a narration—series of sentences—in order to describe it as a system of meanings, and revealing the narration from two points of view: the story, through an examination of the logic of actions and their sequential order or syntax, and the modes and times of the narration (the discourse). To understand a narration implies the (witnessed) unfolding of a story, in our case a behavioural or evolutionary story, but also the recognition of a narrative sequence, and to travel between the levels of story and discourse.

In her book about narrative analysis, Kohler Riessman [5] proposes four possible modes or approaches to the analysis: thematic analysis, structural analysis, interactional analysis and performative analysis.

Thematic analysis puts its emphasis on the content of a text (message), on what is told, and mostly uses a typology of narratives organized by theme [5].

Structural analysis of narratives puts emphasis in the ways a story is told. Even if thematic content is not disregarded, focus is put equally on the form or in which narrative devices a 'storyteller' uses and how the narrative is achieved. In this type of analysis, the importance of language (or signalling) and its referential content is high [5].

Interactional analysis emphasizes the analysis of the dialogic process between teller and listener (emitter and receiver) [5]. This kind of narrative analysis is specially suited for situations in which the 'storyteller' and the 'questioner' participate in a conversational type of exchange while constructing a narrative. While there is no dismissal of thematic content or narrative structure in this approach, the emphasis is put on storytelling as a process of co-construction [5], creating meaning in collaboration between teller and listener (that could, obviously, exchange places). In animal communication, this approach could be paralleled to the study of duetting, both in song or sound emissions as well as in visual display exchanges in sequence or chains [6], or even in communication through choruses. All these processes can enhance information transfer and meaning-making in animal signals.

Performative analysis [5] goes beyond interactional analysis, and the exchange is seen as a performance, as a narrative praxis that could be interpreted as a form of social action. This view is suggested by Kohler Riessman [5] as appropriate for studying communication practices and for detailed studies of identity construction. In humans, this can be applied to theatre and their ways of narrative, but trying to devise a parallel use of the concept in animal communication, it can be thought that this kind of 'identity construction' could be utilized by emitters while cheating, in the sense that they are 'performing' to try to convince receivers of some lines of action or situation evaluations that are not 'real', allowing the emitter to take advantage over the receiver.

As Kohler Riessman [5] says in her paper, structural analysis approaches need the examination of syntactic and prosodic features, thus this is not a type of analysis suitable for large numbers of data but very useful for detailed case studies

and comparisons. This type of analysis can help build theories relating language (communication, behaviour) with meaning. Indeed, this author highlights that 'The "truths" of narrative accounts are not in their faithful representations of a past world, but in the shifting connections they forge among past, present, and future' [5].

The analytical system proposed by Barthes [4], the one we use as a base here, is mostly of a structural kind, but contains—as far as I can say—at least some elements of the interactional type of analysis referred to above. In his paper, Barthes [4] defines a narrative as 'an organization based on relays, whose basic units can be no other than a small group of functions, which will be referred to as a sequence (in conformity with Bremond's terminology)'. In the same paper, a sequence is considered as 'a logical string of nuclei, linked together by a solidarity relation: the sequence opens when one of its terms is lacking an antecedent of the same kin, and it closes when another of its terms no longer entails any consequent function' [4], this being very similar to the behavioural analysis of sequences. If we add to these descriptions the idea that for working with sequences they need to be named (i.e., 'struggle', 'seduction', etc.), it shows that sequence analyses in narrative and in behaviour are much alike. Indeed, Barthes [4] considers that the receiver of the narrative (reader, listener, observer), while apprehending the sequence surely nominates it at least internally, and in its own way of 'thinking', depending on the species involved in the communication process.

Barthes [4] also proposed the use of three levels of description as a way to understand a narrative: the level of *functions*, the level of *actions* and the level of *narration*. *Functions* are the basic narrative unit, and should have a specific functionality in the corpus of the narration. *Functions* usually integrate into sequences, and those sequences make up the capital part of a narration. *Actions* are used to describe the characters that act in the narration, characters that are defined by what they do, by their role in the narration: receiver, sender, opponent, helper, etc. *Narrations*, looking at the literary process, always have a narrator and a reader, and define the code providing meaning to both narrator and reader (or, in biological terms, sender and receiver). These levels are to be viewed as a top level (*narration*), a middle level (*actions*) and a bottom level (*functions*). This bottom level is composed of two 'sub-levels': *distributional functions* (or simply functions), composed of cardinal functions or nuclei and catalysers, and *integrative functions*, composed of indices (that relate to character, feeling, etc.) and informants (that identify and locate in space and time).

A narrative is, then, made of *functions* (functional units) and, as Barthes [4] says, everything in the narrative is significant and every unit in the narrative fulfils a function and occupies a place in the chain for a reason. *Functions* are then the basic pieces of a narrative, and can then be paralleled to the behavioural units used in ethological sequence analysis. Thus, in ethological analysis, behavioural units have also a function and they are, usually, functionally related both to the one before and the one after it. In that sense, the act of interpreting behavioural sequences appears more as a semantic and interpretive kind of problem than one of the 'numerical' kind, even if in Ethology we can use algorithms (i.e., Markovian processes) to search for a certain order and repetition degree on a behavioural sequence's constitutive units.

In essence, behaviour is depicted through the use of ethograms based on the definition of behavioural units that compose them, those tools being the most used to describe the behavioural 'narrative', being also an 'evolutionary story', as said above, we can consider this type of behavioural description/analysis as similar to the narrative analysis proposed by Barthes [4]. If that is the case, the use of basic units of behaviour in behavioural description could be paralleled to Barthes'

structural analysis [6, 7] if we accept that in ethology the narrative—the continual 'production' of behaviour by a living being—should be divided into units in order to analyse it and to approach an interpretation. These behavioural units are arbitrarily defined by the user, and their definition is based on the user's interpretation of their function and significance, acquired through observation of the whole behavioural sequence and its relation to its parts, their meaning and their order in the behavioural sequence under study (sort of a semantic processing of information), like in an hermeneutic circle [8].

As Barthes [4] discusses, narratives—because of their structure—tend to provoke a confusion between consecutive order and consequences, between time sequence and logic. This is because narrative logic accounts for narrative time, then the need for memory (cognitive memory and/or genetic memory, in biology) to put to use the narrative for communication purposes, because the belief in time as a guiding line is based on the mechanisms of memory and combinatorial discourse.

The process of behavioural analysis of sequences is then almost identical to Barthes' narrative analysis [4], considering the analysis of a narrative as the determination of different levels or 'strata' in the sequence, these levels being divided into units, and units being determined by meaning as the main criterion of analysis. The units, especially those translated into certain types of behaviour in a repeated way, can be interpreted as sub-narratives or sub-chains, acting as subordinate narratives or 'cycles' in the sequence arrangement. Repeated functions could be used to identify a 'character', characters representing types of actions making up the narrative.

The level of actions is the middle level of description that refers to characters and their participation in the narration. Characters are classified in narratives not by way of their psychology, but mostly by way of their participation in actions (i.e., communication, desire, struggle, etc.), and in biology by their role in a population or deme. Usually, actions have two sides that link actants together, like in Emitter and Receiver.

Repeated arrangements or units describing certain behavioural acts can identify 'behavioural syndromes' [9] in ethological analysis, characterizing the behaviour of certain individuals in the population, in a similar way as narratives do with some types of characters in the level of actions. Barthes [4] proposes to use these repeated actions (indices) to evaluate how certain functions contribute to character building in narrative analysis, while in behavioural analysis those syndromes contribute to the characterization of some types of behaviour—possibly also extrapolating to other areas of behaviour—in the same subject.

Processing information gathered from a chain of behavioural acts performed by other (living) subjects—in the same way other living beings do for themselves—leads to partition the chain of actions for the sake of better understanding. This is mainly an unconscious act (exception made, probably, of a scientific description), an innate act of interpretation, using our own decoding capabilities. When doing this, we are decoding a narrative.

We are then processing a chain of behavioural units or signs, analysing them and trying to interpret its significance. In fact, the observer is interpreting the chain of behavioural units (movements, etc.) as a 'narrative schema' that allows the perception or the interpretation of intentional movements or signals (probably the core of what Barthes [4] called actions) that guide to a goal [10]; thus, in doing the already mentioned hermeneutic circle interpretation of behaviour, the observer is processing a narrative in the same way we do with a verbal chain of signs when trying to interpret what another person is trying to say.

Understanding a sequence of behavioural units implies understanding the logic of the behavioural chain and at the same time the interpretation of the signs those

behavioural units represent for the receiver or interpreter, thus understanding the narration. Bremond's ideas [11] about narrative analysis established that the logic behind the narratives' study relies on following the 'choices' made by the subject. It seems that, essentially, we can see this as a similar interpretation or hermeneutic process as the one used in behavioural biology when analysing decision-making or (even) meaning-making processes in animal subjects. Through this analysis, interpreters probably make a widespread use of the abductive syllogism referred to by Peirce [12]. Abductive guesses '..are not always correct, but they are correct far more frequently that would occur by chance' [3]. As abductive inferences are composed of two elements, an observation and a base of relevant knowledge [3], it enables the use of information 'included' in actions described as a narrative schema [10] allowing the interpretation of those actions.

The structure of the narrative sequences enhances the interpretive possibilities of receivers/interpreters because, as signalled by Barthes [4], the different levels of narrative construction and analysis are bonded together towards a progressive integration. Thus, a function has a meaning only if it takes place during the general line of action of an actant and the action performed displays its meaning when it is included into a narrative or discourse utilizing its own code.

Sequences have certain points of choice, called 'dispatchers' by Barthes [4], and these points are those in which, biosemiotically speaking, freedom of meaning could be introduced. So, from this perspective, a sequence is a 'potentially incomplete logical unit' [4], rooted in the actual context, and in need of interpretation. This interpretation, through an hermeneutic analysis that takes account of the context situation, external information and other concurrent pieces of information, could transform the 'incomplete logical unit' into a complete logical unit meaning something to a receiver/interpreter of an ongoing behavioural reality [13]. The use of external information to decode/interpret the narrative (signal or behaviour sequence) was acknowledged by linguistics when considering *situations*; these situations can be understood as the facts known by the receiver at the moment of the semic act, and being independent of this act [4]. In animal communication studies, these *situations* could be interpreted as the use of *previous probabilities* in a certain communicative situation, contributing to the context of the communication and the possibilities of decision-making by the subjects.

In behavioural analysis, sequences can also be analysed as units, and play a role as a simple term in another sequence. This characteristic allows the use of different (highly arbitrary, subjectively defined) units, that can be represented by 'minor' behavioural sequences acting as units on a higher level sequence, when parsing a behavioural continuum in an ethological study. This process is basic in behavioural analysis, and is highly dependent on 'sign' interpretation (decoding) by the receiver/observer, while also independent of mathematical/statistical analysis [4, 14, 15], exception made of some grouping and sequence detecting algorithms.

The described levels [4] are bonded together using a progressive integration modality in which each function has meaning only if is integrated in the line of action of an actant, and this action takes its definitive meaning because it is being told/emitted as a part of a discourse/narrative.

3. 'Reading' behavioural/evolutionary stories

Writing about Darwin and Biosemiotics, Markoš et al. [16] said 'Thinking in terms of stories seems to be a type of 'information processing', which became most effective in evolution.', alluding in this way to information managing by means of interpretive—hermeneutic—thinking, as a cognitive process. This process

does not (necessarily) involve the use of formal mathematical or physics thinking or modelling. Recent papers propose that at least some animal brains evolved mathematical and geometrical capabilities without the need for theoretical developments [17, 18] but do it mostly in an holistic and intuitive way. Other studies suggest that mathematical capabilities and processing are somehow separated (in the human brain at least) from the semantic processing [19]. These authors suggest that 'the behavioural dissociation between mathematical and linguistic skills is accompanied by a major neural dissociation between math-responsive brain regions and other areas involved in language processing and semantics. Such a clear-cut separation may explain why acquired or developmental mathematical impairments often leave other aspects of language processing and comprehension untouched, or vice versa', implying that the processing systems for these two kinds of information or 'languages', even if loosely connected, are different in essence [19]. Indeed, science uses modelling and computerized simulation studies for analysing some hypothetical interpretations of reality (like animal behaviour, that is the reality we are concerned with here), while narratives are not necessarily descriptions of actions but simulations of actions running on the mind of the interpreter or 'storyteller' [3]. All the previously mentioned papers and other related evidence lead us to think about what are the real processes animal brains perform to analyse behaviour and communicative messages.

We cannot describe here a complete view of brain functioning, but in a general way we can say that nervous systems are basically organized in three systems: receiving systems (the perceptual components), response systems (the motor systems acting through muscles and skeleton, and the glands mediating hormonal response) and integrative areas (integrating, combining and comparing different streams of information, linking organs and reactions and acting as modulating systems for behaviour production) [20]. Neurons in different centres are charged with the analysis of information patterns and the decision-making for complex responses, in a way similar to that proposed by von Uexküll [21] in his functional circle model, with representational systems acting in a way that enables categorization and analysis of information (at least in birds and mammals) [22, and references therein]. In fact, as animal behaviour seems to be detected and analysed as patterns in the same way signal chains are analysed by animals, the idea of a process resembling a narrative analysis [4, 22, 23] pops-up as a theoretical issue relevant for the practice of interpreting animal behaviour, a practice that seems to have been present in the methods used by classical ethologists [6]. These patterns or chains of signals are communicating meaning to the receiver/observer (the receiver being another animal of the same or other species, and the observer being a scientist) in the same way a narration, text, film, etc. are delivering meaningful contents to their receivers.

If we examine the statement by Markoš et al. [16], we can see that hermeneutic procedures (analysis of meaning and interpretation) are probably more powerful and evolutionarily developed than a supposed (and always collateral) mathematical-physics analysis of the signalling concatenation. This is the way we, as a species, look at the world and take in information for analysis, and that is the scenario in which our lives and our evolution as a species have developed, and the one we have to act on and make decisions about. Cognitive Linguistics seems to support this view because one of their general concepts establish that linguistic (semiotic?) knowledge involves knowledge of the language but also knowledge of the world as mediated by language [2], thus the fundamental idea that communication (and labelling and naming) constitute the meaning-making process for our interpretation of the external world, a construct depending on our senses and information processing which allows our capability of (inter)acting towards the outside of our bodies.

Probably, this is also true for other animals, even for all animals if we take in and examine the theories and interpretations of animal behaviour and sensing put forward by von Uexküll [21] with his Umwelt concept and his representation of the 'functional circles' intertwining animal perception and action.

I recently [13] tried to show that spontaneity in behaviour, using the definition by Tinbergen [6], could derive from the unpredictability introduced by triads and chains of triads in the process of meaning-making and interpretation argued by Peirce [24]. The previous mentioned concepts can be related because ethologists used the concept of spontaneity when describing the source of behavioural acts controlled by the Innate Releasing Mechanism, conditioning the behavioural output of an organism. Spontaneity would be introduced by the triadic relation between Sign Stimuli, Innate Releasing Mechanism and Modal Action Pattern, when coupled with other triads. This concatenation of triadic relationships could reveal some spontaneous interpretations of signs that can be facilitated or monitored by the process of triadic concatenation itself [13]. The mentioned new 'interpretations' could intervene in the process of meaning-making by producing (spontaneous) new signs for a situation, then, the relationships become 'stable' for the users, especially if new signs are responded to by receivers with an appropriate behaviour [13]. These chains of triadic relationships also originate a spontaneous and continuous behavioural output that could be considered as a narrative to be sensed and interpreted (described) by the receiver/observer (interpretant). The behavioural output becomes a narrative, sort of a 'novelization' descriptive of the active life of a subject, because animals behave from their birth (or before) until their deaths, proffering a continuous chain of actions [13].

As Barthes [4] explains, the structure of a narrative functions as the structure of a musical *fugue* in the sense that, before a sequence is completed the initial term of a new sequence could be introduced, so the narrative pulls in new material while holding to previous material, and for our biological narrative model this implies the capability of the system to derive new actions and to create evolutionary novelties [13].

It is clear to me that this is related to the notion of 'narrative schema' [10] in the sense that actions of an actant are informative about its meaning because of the interpretation a receiver makes when sensing the sequence of events or units (functions). As Bundgaard [10] puts it, narrative schemas are '…a major principle for the combination of partial significations…' in many domains. The receiver/interpreter (especially if human) could attribute intentionality to movements and, as established by Bundgaard [10], attributing intentionality to a being is considering that being moving according to a micro-narrative program, with acts that are purpose-oriented. These interpretations occur through the use of an empathic process that allows interpreters (receivers) to attribute meaning to displays and movements in an integrated chain of behaviour, mostly based on the general knowledge of the actant's behaviour and on the context in which that behaviour is expressed (including its Umwelt). This is crucial for the capability of using behavioural/evolutionary narratives to interpret animal behaviour and communication.

In this matter, it is important to consider Lakoff's ideas [25] about why hypotheses built with complex metaphors (empathic thinking and narrative schemas' embedded information interpretation) cannot be directly falsified. They could only be rejected based on interpretations of empirical observations guided by other complex metaphors, because falsifiability itself cannot be established by any method that would not rely ultimately on a shared human bias: the set of conceptual metaphors governing how people interpret observations (like narrative schemas, empathy, gestaltic processes in sensory input interpretation, and so on). These arguments could be seen as an extension of the 'embodied cognition' argument sustained by many philosophers and scholars, Lakoff included, arguing that minds

(human mind at least) are embodied, and cognition processes are rooted mostly on 'low-level' body functions like the sensorimotor system and emotions. In addition, for cognitive linguistics, human reason is determined by our organic embodiment and by our individual and collective experiences [2] relating, at least from my point of view, these ideas to von Uexküll's functional circle and Umwelt [21] concepts, as ways to interact with the external world generating 'experiences' and allowing categorization in functional communication.

The above-mentioned interpretive processes are to be assumed as cognitive processes built in evolution, thus not necessarily included in all animal species' toolbox, because as Bundgaard [10] puts it '...recognizing movements as intentional is tantamount to recognizing basic narrative programs,...'. Then, narrative schemas could be not only considered as high-order syntax processes but also as '...highly significant meaning gestalt...' [10]. As this author [10] stresses, if narrative schemas are essential cognitive gestalt with meaning value, we should expect them to organize meaning in many domains, especially in relation to structures with 'intrinsic signification': morphological features interpreters/receivers specially pay attention to. Let me cite Bundgaard [10] again to clarify this point: 'The idea we expose in our article is that if in a XY-compound, the Y-term evokes some idea of purposeful action or functionality, then the X-term will specify one of the constitutive elements of a purpose-oriented process, i.e., it will take on one of the actantial roles available in the narrative schema [e.g. positive purpose (what should be obtained or furthered), negative purpose (what should be prevented), subject in charge of realizing the purpose, instrument, raw material, result (insofar as it differs from the intended result)]'. All these roles can be represented by signals or behaviours in animal behaviour sequences or communication signal sequences, thus allowing us to think that, at least in many species, we can consider narrative schemas to be applicable in interpretation from the point of view of interpreters, receivers and/or observers, and meaning-making processes probably to be involved in message or behavioural sequence construction from the point of view of (not necessarily intentional) emitters/actants.

It is also clear that many of the behaviours used by animals—including humans, obviously—are spontaneous responses to a combination of external stimulation and internal motivation, both contributing information to a decision-making system. The decision-making system that weighs the inputs to offer an output is often an unconscious mechanism, responding to evolutionary rules that tend to preserve certain 'values'.

In that sense, Kaplan et al. [26] have shown (for humans) that narratives can support what they call 'protected values' that are non-negotiable for users, can transcend logic or rational choice models, and also transcend cost-benefit considerations. This information derived from human subjects studies can eventually be extrapolated to animal communication systems if we accept that there could be 'protected values' embedded in animal signs. These protected values should refer to survival issues and/or highly valuable behaviours, and can put 'out of order' many models of behaviour based in 'economical' cost-benefit paradigms.

This same study [26] shows that reading about protected values leads to increased use of brain parts related to semantic rule retrieval, because those protected values reveal fixed principles (originally fixed—or modal—action patterns? [6]) rather than (unconscious) calculations of costs and benefits. This could mean that, all processes being similar in non-human animals, there are some behaviours that could have 'fixed' or 'innate' elements of interpretation, especially if behaviour is seen as a narrative.

Kaplan et al. [26] also mention that there is evidence from human studies that points to the intervention of some brain zones related to: social cognition, internally

directed processing, self-directed processing, and 'mental time travel'. These zones are activated when individuals deal with narratives involving the above-mentioned 'protected values'.

Then, some brain regions activate when social emotions and moral dilemmas are present, and those regions are the suspects of playing a critical role in representing complex emotions dependent on the knowledge of social conventions. These studies were performed in humans [26], but nevertheless we can wonder if similar processes could operate in other animals' sign evaluations. Indeed, these brain regions activated when social emotions and moral dilemmas are present could be also activated—in a 'mirror neurons' sort of way—when processing information or judging attitudes and behaviours of their species, helping and/or biasing our interpretations. The above-mentioned facts and interpretations could be taken as evidence, or at least as a probability, that our brains and the brains of other species are prepared (probably pre-wired) by evolution to process information acquired through their senses and interpret it with the aid of an emotional (empathic) and natural (external) framework, as when interpreting a narrative or a story, mainly pointing to meaning interpretation through a sort of (if not a real) hermeneutic process. Possibly this kind of processing is not optimal (as some of our theories—wrongly, from my point of view—seem to model) but are more real and more naturally 'unpredictable', better describing biological reality; they are 'evolutionary stories'.

Bundgaard [10] supports that narratives we compose from our observation of other subjects' behaviour are not arbitrary, because not any pattern of movements can trigger an 'acceptable' interpretation (for the meaning-making system of the interpreter) except if they are temporally correlated in a specific way. If the right temporal correlations are presented in the sequence of units proffered by an emitter, a narrative 'scene' is built, and the information contained in it could be perceptually extracted constituting (or at least appearing as) goal-oriented actions. These facts imply, at the same time, that some (intentional or probably intentional) actions seem to be built through characteristic modes or styles of 'presentation' allowing a sort of direct perception of intentionality or causality that will end, depending on its range of action, in a meaning-making process for the analysis of behavioural sequences or 'evolutionary narratives'.

4. Conclusions

Taking all the previous arguments into account, we can examine many of the parallelisms existing among classical behavioural analysis [6] and narrative (structural) analysis [4] that lead to assume that when describing and interpreting animal behaviour and/or communication, we are, in fact, telling (reconstructing) 'evolutionary stories'. Importantly, the fact of telling stories does not mean that our interpretations of animal behaviour obtained by these methods/means are not scientific, because the capability of understanding behaviour and signals of animals in a scientific way does not depend on the higher or lower level of mathematical formality of the description or interpretation, but on the ability to understand/decode the information present in the 'stories' animals tell through their behaviour, and in the contextualization of those stories through hermeneutic analysis.

The idea of Umwelt introduced by von Uexküll is fundamental in our possibilities of interpreting animal behaviour and animal signals [27]. This is because, the capabilities of meaning-making in a signalling system each species has depend on their sensory capabilities, and the relationship between perception and action—highlighted by the Umwelt concept—is related to their sensory abilities (also part of the Umwelt). In a similar way to what Cognitive Linguistics does essentially for

humans only [2], biologists (supported by the 'narrative' view here expressed and by the concepts taken from von Uexküll's work) should study the communication systems and behaviour of animals as if they were 'grammatical' phenomena whose characteristics are determined by a combination of internal (structural and motivational) and external (biological and non-biological) contextual factors.

Then, we need to have a similar Umwelt to that of the species being studied (or at least some means to access the sensory capabilities needed if different from our own) to be capable of decoding the information exchanged through animal behaviour signals or narratives.

The preceding argument derives from the idea that the older language of all is the language of life [28] expressed through genetic codes and biological signals, thus through semiosis, a process that is thought to be ancestral to all life, and probably a process that defines life. As Sebeok's ideas of semiosis in nature linked to von Uexküll's concepts relating the internal and external world of animals and their abilities to produce signals, their ideas have developed into a new science initially known as Zoosemiotics, and later theoretically rounded as Biosemiotics.

The argument of this chapter is mainly about the way we should look to animal behaviour and communication if we want to understand what animals do and why, and how they can cooperate and compete, by the understanding of the messages they use and their real meaning. Here I argue that in fact that is what we do, as scientists, because we tend to interpret animal behaviour and signals as if we were reading (or listening to) a story. Thus, the type of analysis we can apply through formal narrative analysis and/or cognitive linguistics analysis to animal behaviour is similar to the way we in general examine the world and our own communication system, and depends on our abilities of interpretation and decoding. Indeed, maybe many other animal species use similar 'cognitive devices' (through an embodied type of cognition) to code/decode their communication signals' meaning and construct an image of the external world.

Finally, we can say that the possibility of interpreting behaviour and/or animal signals will depend on our capability to empathize with other species and on our decoding abilities towards the behavioural sequences constituting informational units we can understand as 'evolutionary stories'.

Acknowledgements

The author wants to acknowledge partial funding for the publication of this manuscript by PEDECIBA (Uruguay).

Conflict of interest

The author declares that he has no conflict of interest.

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