Basics of Animal Communication

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Interaction, Signalling and Sensemaking in the Animal Kingdom

By

Dario Martinelli

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TABLE OF CONTENTS

PREFACE

This monograph was written with two main purposes in mind, both mirrored by my choice to employ the term "basics" for its title. On the one hand, after almost twenty years of professional interest for animal communication via various paradigms (zoosemiotics primarily, but also cognitive ethology, sociobiology and others) – an interest that verged into dozens of publications, presentations and lecture courses – I realized that I had never tackled the task of a plain, systematic introduction to the topic in such a way that both my personal research and the most significant works of my illustrious colleagues in the field would be reflected. The closest I had got to this idea was what I tend to regard as my most accomplished monograph so far, *A Critical Companion to Zoosemiotics* (Springer, 2010). Then again, that companion was "critical", meaning that the implied mission was not only a description of existing theories (including my own), but also an attempt to develop alternative, *lateral* paths, not sparing a share of criticism to what I considered obsolete, biased or inaccurate approaches. Of course, and regardless of how successful I may have been in my arguments, that program produced a less consistent structure of the book, one where certain topics were more (sometimes *much* more) relevant than others, because their demand for problematization was higher.

Through this monograph, on the contrary, I intend to pursue a more systematic, *equalitarian* approach, where description is not just a vehicle for prescription, but it is actually the main point. The *basics* of animal communication are in this sense intended as the bulk of essential, systematized information that I consider necessary in the study of this fascinating area of inquiry.

The second goal of this monograph is also the most important one, at least in the economy of this enterprise's genesis. The book was indeed started in accordance with Dr. Kristian Donner, professor of zoology at Helsinki University, a great scholar, a friend, and really one of the kindest people one could ever meet. Having given a few courses in animal communication for his department, I discussed with him the possibility of assembling some pedagogical material that would allow us to employ one single, general resource for my (or someone else's) lectures, instead of gathering single articles and book chapters here and there, and to uniform

the level of complexity to our target: BA and MA students. The project received the crucial support of the Ella and Georg Ehrnrooth Foundation, which sponsored all of my research and writing work for this book, and also, for a few months, the assistance of my talented former student Cecilia Calais.

In the course of the project's implementation, it must be said, I experienced quite a U-turn about the quantity and the quality of features that this particular "textbook" was supposed to offer to its readership. I had started with a full collection of services to the student (and to the teacher willing to employ the book in his/her courses): every chapter (or lesson) was planned to include an introductory summary ("in this chapter you will learn that..."), a schematic list of topics tackled, a series of slides (in case the teacher wanted to turn the lesson into a presentation), a final summary ("in this chapter you have learned that..."), a ten-question test that students could use to verify their understanding of each lesson, a glossary of the difficult terms and two kinds of bibliography: one with the references mentioned in the text, and one of the "For more on this topic, read this" type. Quite a package, huh?

This was until I realized three important things (and I have to thank many of my students and colleagues, with whom I had the chance to discuss the structure of this book, for opening my eyes): one, students are not idiots; two, teachers are not my servants; three, academic courses are becoming a mess. Students are not idiots: in the last few years, many universities have started the practice of packing courses with all sorts of extra material that is supposed to take a student by the hand and guide him/her through the mist of... through the mist of what? Through the mist of a written text! We "map" the information because we assume that the students would find its "narrative" too difficult. We spare on the natural *time*-flowing of data, and instead we fill the *space* with notes, post-its, snapshots and "bites".

In other words, indeed, we assume they are idiots. The problem is: I would not mind betting that, on the contrary, we are *making* them so, by using this strategy. The demonization of narratives, in modern academic courses, has certainly produced some advantages (sparing time being one, indeed), but it is also endangering the fundamental development of information-processing and critical skills in the students. It is a strategy that roughly equals the decision to take artificial vitamin integrators instead of bothering to eat a balanced amount of fruit and vegetables. We save time but we kill the "narrative" of food intake, the one that suggests what to eat with what, how much, when, and so forth.

Also, have we ever thought that, once in a while, students really do not mind sitting on a sofa with a cup of tea, to actually *read a book*, instead of a collection of schemes? Have we ever thought that, perhaps, if a book is well written, it is actually a more *pleasant* (therefore more effective) way of studying? Please, do not get me wrong here: I am not criticizing "mapping" in general (on the contrary: it is an extremely effective way of processing information). I am just suggesting that a *textbook*, as such, should adopt the "narrative" strategy, because (along with a teacher's lectures, of course) that is the very *source* of information to process. If the latter is already processed, then we are simply providing bad quality information (the same way – keeping up with food metaphors – ready-made frozen dishes will never be as good as those carefully prepared with fresh ingredients). Any phenomenon of "learning", in reality, needs to go through this two-step procedure: we intake the information in a "narrative" way (which means, we see the whole picture, the natural flow of time, the many variables...), and *then* we process it in a schematic way, distinguishing the more from the less relevant, generalizing the single elements into groups or patterns, and so forth.

Therefore, the main challenge here, is making this kind of book *clear* and *engaging* reading, clarity being the very reason why maps came to replace narratives, and engagement being the very reason why students are less and less eager to invest their time in studying. This monograph wants to be game for this particular challenge, and would like to leave the important mapping stage to its readership, in the conviction that this will stimulate even more their understanding of the concepts.

Secondly, teachers are not my servants: I do not really have a right to tell them what are and what are not the relevant parts in my text, nor how they should phrase them. A monograph, if employed as a textbook, must be a *tool* for the lecturer, not a bible. The lecturer should be able to do whatever s/he likes with the book, including the total omission of parts that I would instead consider crucial, and vice versa. The lecturer too has to *work* on the book, and not rely on ready-made information. The above-mentioned mapping stage is, or should be, a teacher-student cooperation

Finally, academic courses are becoming rather messy. There was a time (not such a long time ago, since I was living in those days myself) when a course consisted in a) a teacher coming in a classroom and doing most of the talking; b) a bunch of books (not few, in fact) to read and study with great attention; and c) an exam. End of story. None of the people of my generation seem to suffer from serious traumas as a consequence of this system. What we have nowadays, instead, is a glorious parade of handouts, Moodle accounts, mid-term exams, mock-

exams, workshops, discussion groups, self-assessment processes, and so on and so forth. Anything. Except, well, a clear and engaging textbook. My intention here is not a conservative one, in fact it is experimental: I am not particularly against the new system (although, I must admit, it adds a lot of extra-time to my work, and I am deeply convinced that I could use that time in ways that would be much more useful for society). I just would like to perform an experiment of re-establishment of a direct dialogue between course material and students. I suspect that a) the general decrease of interest and preparation we are witnessing in modern students has nothing to do with a "traditional" textbook, when the latter is clear and engaging; and b) a storytelling approach to teaching is not more difficult or time-wasting than the schematic approach. Rather, it is simpler.

In conclusion, it is not my intention to make a case out of this choice. The reader will be informed about my opinion on the matter only in these preface pages, and nowhere else. The book is called *Basics of Animal Communication*, and the title says all I intend to convey here. No subtitle of the likes of "towards a comeback of good old textbooks" was ever intended for this project.

Plus, truth be told, it is not as if I will erase each and every sign of "organization" of the information, here:

- Each chapter is carefully pondered to be in the vicinity of 4500 words of length (sometimes a little more, sometimes a little less). That is the length that usually corresponds to one hour and a half of attentive reading. One hour and a half is the standard duration of an academic lecture.

- A glossary of difficult terms is available. In the text, they are marked with asterisks at both sides (e.g. *adaptation*, *behaviourism*), and at the end one can find short definitions for each of them.

- Of course the bibliography tries to be as rich and informative as possible.

But, really, the main strength of this book is, or should be, its clarity. Animal communication is a very complex topic: I put all my efforts into making some key issues as understandable as possible.

I would like to express my gratitude to Kristian Donner for believing in this project from the start; to Cecilia Calais for assisting me in the first months; to Gavin Stewart for language-editing and Aušra Berkmanienė for proof-reading; to all my students in the various Animal Communication and Zoosemiotics; and most of all to the Ella and Georg Ehrnrooth Foundation for their generous support.

I dedicate this book to my family.

CHAPTER ONE

INTRODUCTION TO ANIMAL COMMUNICATION STUDIES: DEFINITION AND PROBLEMS

To study animal communication has very little (or at least, *not only*) to do with admiring dogs whenever they are able to execute our requests. To study animal communication rather means to understand as much as we can of the way those dogs' brains work within their own "canine" experience and how they are able to project their cognition while relating to the environment – including us, other animal species or other dogs.

The point in animal communication is not only our disposition, as humans, to consider other animals as actively involved in communicative processes, but to see if such a 'thing' like a communicative process exists, and is operative, within their minds.

There are many ways, and not necessarily coherent, to define communication. If we take a rather standard approach to the concept, we can say that communication is a phenomenon that involves the transmission of information from one living organism (sender) to another (receiver). We may of course say "animal" instead of "living organism", but scientists are more and more convinced that communication occurs among plants as well, so it is safer to affirm that "communication" is a chief characteristic of being "alive". Information is processed within the mind of the organism and encoded into a signal. When received by the other organism, this information undergoes a decoding phase, while still retaining a more or less recognizable relationship to the encoded information. During this process of encoding and decoding – which may consist of many steps – the information undergoes many transformations (including the fact that it may be "misunderstood", while encoded): the receiver puts many other elements into the process, not only the information received (expectations, previous experience, relationship with the sender, circumstantial events, etc.). From the combination of all these factors, the receiver produces a response of some sort (which may also not consist in another act of communication, although usually it does).

This approach to animal communication is called "cognitive", and is the one we are adopting in this book. To possess *cognition* means to actually have a "mental activity" and the capacity to "process" information.

Needless to say, scholars have not always defined animal communication this way. There was a long period, particularly before the late 1970's, when the scientific community was not exactly persuaded that non-human animals had "minds" that could process the information in any complex way (in the next chapter, we are going to deepen the question of "mind").

Two traditional approaches to animal communication

Somewhat generalizing, we could say that there used to be two important approaches to animal communication, in the past (and, partly nowadays, although there are fewer and fewer scholars who follow these outdated paradigms).

In one approach, communication is considered the result of *instinct*, which is a very tricky notion. Instinct is generally defined as a genetically acquired force that drives animals to react to a stimulus in certain fixed ways. In other words, when it comes to communication, the animal would not be really "processing" the information that s/he receives from the environment or from another animal: rather, there is supposedly a pre-determined mechanism that makes the animal respond in a certain way. In a sense, instinct is like an application in a smartphone: when we install an app, we know that it has certain functions and that the smartphone is not really "reasoning" but simply enacting those functions. We tap on the screen and we see something appearing (a "response"), but we know very well that this is not because the smartphone has "understood" us in the way a friend of ours would understand our request. By assuming that communication is regulated by instinct, scholars were paralleling communication among animals to a mechanical, automatic process.

Criticism of the concept by other scholars started from various angles. First of all, from a methodological point of view, it was noted that instinct was a kind of a "black box", where we can put most (or all) of the observations that we are not able to explain in a more elaborated way. We see an animal doing something particularly complex, and we think "oh, it must be instinct!", because – in principle – we are not ready to admit that animals can indeed do complex things. Another remark was that the notion of instinct makes no allowance for environmental influences upon behavioral patterns. If everything comes is pre-determined by instinct, what about the external stimuli? Does it not make any difference whether an animal is communicating with an animal that is bigger, smaller,

friendly, aggressive, predator, prey…? Does it make any difference whether the animal him/herself is healthy, sick, young, old, relaxed, angered…? Finally, as research on animal behavior progressed, increasingly accurate descriptions of several behavioral patterns, originally thought of as "instinctive", started appearing. It turned out that such patterns were not "smartphone apps", but rather the result of different categories of motivation and cognition.

In the second main pre-cognitive approach to animal communication we have an accent to the environment and external stimuli (exactly one of the critiques advanced to the promoters of instinct: what about the context?). This approach was heavily bound to a methodological school that developed in various fields of science (mainly in psychology): behaviorism. Behaviorism is founded on the idea that all actions performed by an organism do not have to be interpreted as the result of internal physiological or mental processes, but are rather the result of a direct contextual conditioning. When we talk about behaviorism, most of us think about "Pavlov's dog" (from the famous behaviorist Ivan Pavlov) – a dog hears a bell sound and salivates in hunger, because, in a previous phase of the experiment, s/he was repeatedly given food right after the bell sound, so now the sound alone was enough to stimulate the salivation. The dog, in other words, was exposed to an external stimulus, and that (not some inner predetermined mechanism) was the reason why s/he reacted in a certain manner. Instinct would have made the dog salivate only after the food had appeared, but Pavlov's insistence to announce food with a bell sound made the dog hungry at the sole announcement, even if no food would appear.

Before being challenged (and partly overcome), in the second half of the 20th century by cognitive approaches, behaviorism was widely popular in the study of animal behavior. The objections to behaviorism were opposite-but-equal to those raised about instinct. In both cases, the process stimulus-reaction is automatic: either the reaction comes from the inside of the organism (instinct) or it is the stimulus that provokes and determines the reaction: in either case, no "mind" is conceived in the middle of the two steps.

Also, if instinct risked becoming a "black box", similar fears could be applied to behaviorism: we again see an animal doing something complex, and we go "oh! It must be the environment conditioning the animal!" Once again, albeit for different reasons, we deny the animal the possibility of "reasoning". Finally, if instinct totally neglected the possibility that the animal could be influenced by the context, behaviorism neglected the

possibility that there could be anything pre-determined at all in what the animal could do.

For several decades, in the 20th century, scholars were divided into these two schools: communication by instinct, and communication by external stimuli.

The cognitive approach

Then, as we said, the cognitive approach appeared in the second half of the 1970's, provoking something of a revolution in the interpretation of animal behavior (communication included). It is frequently maintained that the turning point was the publication of a book called *The Question of Animal Awareness*, by Donald Griffin (1976), where issues of complex cognition in animals were finally raised in a very articulated way (there had been several scholars reflecting on this point in the past, including Darwin, but nothing had gone beyond the level of hypotheses and speculations).

However, even if this approach soon became the most reliable of the three (and is an approach that is in constant progress: almost everyday we read in the news or in popular science magazines about discoveries on the complexity of animal behavior), criticisms were not spared in this case, either.

First and foremost: how do we *really* know that animals have minds? And, once we (hopefully) establish that, how do we know how those minds operate? How do we go *inside* an animal's brain to see what this animal is thinking? In fact, such questions are not easy even when studying humans (particularly certain communities or certain groups). How will this be possible with other animals? Everything we say is based on human criteria, which we are just arbitrarily applying to other animals, since nobody could ever say if animals really think in the ways we think they do. So, what do we do?

Inside and outside perspectives

This problem was actually already emphasized in the field of linguistics (particularly after Pike 1954), as an opposition between the so-called "etic perspective" and the so-called "emic perspective". Etic stems from "phonetics" – the study of linguistic sounds without regard to their significance in a language; while Emic comes from "phonemics" – the study of speech sounds that are meaningful in a language. In brief, by the emic perspective we mean that we are interested in what the insiders of a

certain community think, believe, etc. By the etic perspective, on the other hand, we are rather interested in the outsiders' perspective: what *we* think when we see a certain community. Clearly, the same principle is applicable to other animals: can we afford to be "emic" and understand how *they* think, or shall we be "etic" and project our own interpretation on what they do?

Simplifying a bit, we can say that the two traditional approaches to animal communication were quite happy to be just "etic", while the cognitive approach has a pretention to be "emic" too, at least to an extent.

Evidently, however, the latter task is not an easy one. Even in the study of human behavior, cultures, etc., there is still an ongoing, quite animated discussion on the etic-emic issue. One of the main points is that a totally emic perspective is impossible to take, especially when there is no way to establish linguistic interaction with the culture observed, so that its members could describe their own views. How can we understand the insiders' perspective, if we cannot even speak the same language with them? The problem becomes even more serious with non-human animals, where not only there is no *language* in common, but there is a whole gap based on physiological, behavioral and psychological differences. This problem was very well posed by a scholar called Thomas Nagel, who possibly wrote the most famous essay on this topic, "How does it feel to be a bat?" (Nagel 1974). Indeed: how does it feel? To Nagel, we will never know, because, simply, it is impossible to be a bat for someone who is not a bat.

The scholars who were more eager to accept the cognitive approach to animal communication (and behavior in general), generally had three types of reaction:

1. From a common-sense perspective, that thesis sounds a bit simplistic, because it represents a comfortable way of facing a problem that is in fact more complex. Yes, it is true that there is no way to fully understand another subject, but such a problem exists in principle in every field of science, so we can only cope with it. For instance, pharmacology is possibly far more inexact than is animal communication studies. When a doctor prescribes a drug for a patient affected by a given disease, s/he knows perfectly well that that particular drug, made for that particular disease, does not necessarily work on that particular patient. In other words, an objective interpretation of a given disease does not allow one to grasp all of its possible individual implications. But, of course, this is not a good reason to dispense with pharmacology and not give any medicine at all: we still need to take some responsibility, the doctor cannot just dismiss the patient because s/he is not totally sure whether the drug will work or

not. The doctor knows that there are "more chances" that the drug X will work on the patient A, because X worked much better than Y on the patients B, C and D, so there is a good reason to believe that it may work on A as well.

2. Secondly, everything, or almost everything, that can be grasped about phenomena occurring within any organism, is basically the result of observations made from the outside. When we see a teenager with long hair, black leather trousers, various metal accessories, and a T-shirt with an Iron Maiden album printed on, well, we cannot be 100% sure, and we do not want to have prejudices, but it *really* looks like this teenager is a heavy metal fan, does it not? Nobody could blame us if we made that assumption. If, on the contrary, we said that we have no clue what this guy is, then perhaps someone would look at us and think that we are not exactly bright-minded people.

Now, in many cases, a given non-human animal pattern recalls a human one. Modes of production and correlated behaviours of that pattern are also impressively similar, and the same applies to emotional experiences. In addition, we know that this animal has a brain, we know that s/he interacts socially, and so on. So, if there are all these similarities, it is not that crazy to assume that maybe also what goes on *inside* the animal's mind is very similar to what goes on inside our mind. Again: we are not 100% sure, but…

3. We actually do have clues as to how we might "emically" study non-human species. To start with, we can scientifically study the sensorial organs of animals – and we know that the way an organism interacts with the environment is largely due to the way s/he perceives it. By now, we have reached enough knowledge in research that is possible to wire a computer to an animal's brain and create videos of what the animal is actually seeing. By recording the electrical activity of nerve cells in the thalamus (that region of the brain which receives signals from the eyes), the researchers can create images of what the animal sees. In other words, technology is little by little helping to be more "emic".

So, is the suggestion here that emic is good and etic is bad? Of course not. The best solution is a balanced combination of etic and emic. What we need to understand is that an etic approach is not necessarily "external" to the subject observed. When we observe another animal species, we are external at the very moment we take a "human" eye to look at it, but we should not forget that we are also animals, so our etic view is not only external. If we observe a community of chimpanzees, we are external as specimens of the *Homo sapiens* species, but we are insiders in many other categories. Taxonomically speaking, indeed, there are only three taxonomic

rings that make us different from the *Pan troglodytes*: the species indeed (we are *Homo sapiens* and they are *Pan troglodytes*), the genus (we are *Homo*, they are *Pan*) and the subtribe (we are *Hominina*, they are *Panina*). This is it. In all other taxonomic groups, there is no "we" and "they" anymore: there is only "we". *We* are the same tribe (*Hominini*), the same family (*Hominidae*), the same suborder (*Haplorhini*), the same order (*Primates*), the same class (*Mammalia*), the same clade (*Synapsida*), the same phylum (*Chordata*), and finally the same kingdom (*Animalia*). So, we are united by eight groups and separated by three only. If we were able to take, for instance, a "mammal" eye, when looking at chimpanzees, we would be taking their same eye. Is this possible? Of course it is: it just takes the right knowledge that will allow us to distinguish between what we do as "humans", from what we do as – say – "primates", "mammals", "animals", etc. We learned to do this very well *within* the human culture, so, let us say, an English person who comes from London, lives in the Whitechapel district, and comes from a certain family, knows very well what characteristics make him/her a member of *that* family (as opposed to other families), of *that* district (as opposed to other districts), and so forth. The way we are, obviously, does not come from a single source: we are shaped by dozens of factors, and we have to learn that these factors do not come only from our being "human", but also from our being *Hominini*, *Hominidae*, *Haplorhini*, *Primates*, *Mammalia*, *Synapsida*, *Chordata*, and *Animalia*. Our style of parenthood, for instance (which is known as "K-selection" strategy: we make few offspring, but we take great care of them, as opposed to the "r-selection": many offspring, but less care, like fish, amphibians, insects, etc.), is something that makes us much more "mammals" than "humans": so, if we look at the way chimpanzees take care of their offspring (and communicate with them), we can relate to them much more than we think. Our position of "etic" observers, in other words, is not an unfair one, because it is not entirely external: we can *recognize* chimpanzees' parenthood as belonging to the same style of parenthood that we have.

This is a very important lesson that we need to learn, when we approach other animals. They are not just "others": they are also something that *we are*. The more we accept that, the more we will fight the many prejudices we still have about these topics.

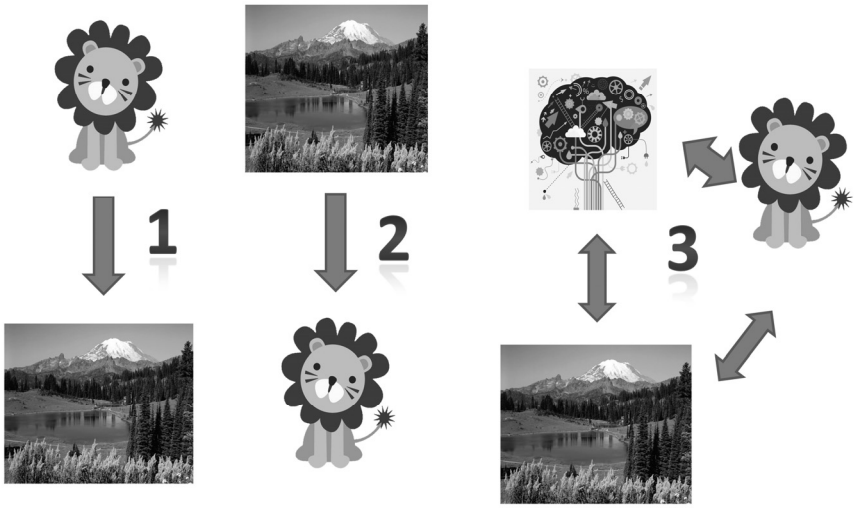

Fig. 1 – A summary of the three approaches to animal communicaiton. In (1) instinct determines the animal's response to the environment, in (2) the environment affects the animal's response, in (3) there is an intemediary stage corresponding to the cognitive processing of the information

The main areas of inquiry concerned with animal communication

Animal communication has been studied under a wide range of disciplines and fields of inquiry. Occasionally, it has been named in different ways, too, so it is not rare that scholars discuss the same thing by using different terminology. To make just one example, since Tembrock 1971, a popular term among scholars is "biocommunication", used to describe various types of communication between different specimens of the same species, or even across different species (since the prefix "bio-", from ancient Greek, stands for "life", biocommunication is a term adopted not only to describe animal communication, but any other living forms like plants or fungi).

Ethology

At any rate, a short overview of (some of) the many disciplines that deal with animal communication cannot but start from **ethology**, the most important field of the category. A branch of zoology, ethology is the

scientific study of animal behavior, and that, of course, involves a lot of research on communication patterns and processes. The term stems from the Ancient Greek "ethos" ("custom", "behavior"), and was first coined in 1762, by the Academie Française des Sciences. John Stuart Mill employed the word in his System of Logic (1843), but in a different sense, proposing the establishment of a field of inquiry, "ethology" indeed, would account for individual and national differences in character. It was the American Myrmecologist William Morton Wheeler, in 1902, to popularize the term in the modern sense. Leaving aside the word, however, traces of, so to speak, proto-ethology can be already found in studies on instinct and innate behavior, such as Pernau 1716, Reimarus 1773 and Spalding 1873.

Before ethology, the main field devoted to the study of animal behavior was **comparative psychology**: however, besides being very different fields in themselves, comparative psychology prefers to perform empirical observation in artificial experimental contexts, while ethology concentrates on behavior in natural situations. Because of this, the two approaches may be considered either complementary or competitive, and so they acted all through the 20th century (collaborating in some cases, and disputing over their respective findings in others). Another difference is of geographical type, as comparative psychology developed most strongly in North America, while ethology was more followed in Europe.

One of the main focuses in ethology is the study of the evolution of behavior and the interpretation of behavior in terms of natural selection, and that of course reveals the instrumentality of Charles Darwin to the foundation of modern ethology (particularly, the book *The expression of the emotions in animals and men*, 1872). Early ethologists, like Oskar Heinroth and Julian Huxley, focused primarily on the notion of instinct, as an explanation for animal behavior. An important step was the construction of the concept (and research related) of *ethogram*, which allowed significant collection of data about behavior.

The turning point was the generation of Konrad Lorenz (whose name is still the first one we associate to the term "ethology"), Karl von Frisch and Nikolas Tinbergen, who 1) established unmistakeably ethology as an autonomous discipline; 2) set a number of methodological standards that are still used nowadays, and 3) engaged in sophisticated investigations of animal behavior that led to important, and sometimes revolutionary, discoveries (like von Frisch with the bee dance – which we shall talk about later in this book).

Through the work of this generation, ethology became strong particularly in Europe before World War II, and also in the UK right after, when Tinbergen moved to Oxford University, and figures like William

Thorpe, Robert Hinde and Patrick Bateson came onto the scene. In continental Europe, meanwhile, another generation of ethologists, pupils of the old masters, was growing fast, providing new names of historical importance, such as Irenäus Eibl-Eibesfeldt and Martin Lindauer.

During the 1970's, ethology underwent that cognitive "restyling" we mentioned, witnessing the birth of cognitive ethology, but also of another branch we shall soon talk about, sociobiology. **Cognitive ethology** was pioneered by Charles Darwin in his last works of zoological nature (1871 and 1872), and established by Donald Griffin's *The Question of Animal Awareness* (1976). It is a rapidly growing field with a strong inclination for interdisciplinary work. Currently, the list of eminent cognitive ethologists includes Colin Allen, Marc Bekoff, Frans De Waal, Dorothy Cheney, Robert Seyfarth, Dale Jamieson, Remy Chauvin, and the great majority of scholars in interspecific communication experiments (which we shall discuss later on in this book).

Sociobiology, on the other hand, specifically studies the social behavior in animals, therefore with communication on the frontline. Its main goal is to prove that social behavior is also the result of natural selection, even in cases where it seems clear that context and stimuli play a prominent role (like aggressive behavior, for instance).

Wilson (1975) is generally regarded as the landmark in the development of the field, although it must be pointed out that proto-sociobiological approaches to animal behavior had existed since the end of the 19th century already (e.g., in Kropotkin 1902), while the term itself "sociobiology" had allegedly been circulating since the 1940's in biological and psychological environments.

At present, it is safe to say that ethology consists of at least the following branches:

1) Field ethology: the classical investigation of animal behavior in natural conditions;
2) Applied ethology: the practical exploitation of ethological knowledge in activities like breeding, veterinary medicine, companion animals, etc.;
3) Cognitive ethology: the study of the mental processes of acquisition, representation and use of information in animals;
4) Human ethology: the application of ethological theories to the study of human behavior;
5) Sociobiology: the systematic study of the biological bases of social behavior.

An excellent introduction to classical ethology, before the cognitive breakthrough, is Eibl-Eibesfeldt (1970).

Other fields

Ethology is of course not the only field of inquiry that is interested in animal communication. There are also more specific fields that focus on particular aspects of animal communication. One of these is **bioacoustics**, an interdisciplinary field that mainly combines biology and physical acoustics, devoted to the investigation of the neurophysiological and anatomical mechanisms of sound production, spreading and reception in all animals. Its foundation is generally attributed to Slovenian biologist Ivan Regen, who started studying sound communication in insects around the 1920's. In bioacoustics, the study of acoustic signals is also aimed at practical and applied use, such as agriculture and biological pest control.

Methodologies and equipment are varied. Perhaps more than any other field mentioned in this chapter, bioacoustics employs a lot of hi-tech tools, including software for sound recording and analysis, special microphones, infrasound and ultrasound detectors, laser vibrometers, recording machines and others. Methodologically, the research work can be performed both in natural and artificial contexts. An excellent overview of the field is Hopp et al. 1998.

It is not only natural sciences that investigate animal communication. Important contributions also come from humanities, and **zoosemiotics** certainly deserves a special mention. The study of animal communication is precisely the main concern of this discipline, which uses methodologies such as semiotics, linguistics, information and communication theory. The term and the first definition were established in 1963 by Thomas Sebeok and Rulon Wells, and were proposed for a discipline that would cross the paths of semiotics and ethology, focusing on the study of signalling behavior in and across animal species. Like ethology, zoosemiotics too went through a transformation in the late 1970's, adopting the cognitive paradigm for a more complete understanding of animal communication. An overview of different approaches and theories in zoosemiotics appears in Martinelli 2010.

A particular sub-field of zoosemiotics is **zoorhetorics**, introduced by semiotician Stephen Pain in the 1990's (see Pain 2002 and 2009), which interprets animal communication as "natural argumentation" that employs some kind of tropes and figures like in classical rhetorics.

Still within the humanities, an important, and more recent, field is certainly **anthrozoology**. Partly an umbrella term, and partly a discipline

with a specific paradigm, anthrozoology is an interdisciplinary field of inquiry originating within social sciences, and that nowadays comprises studies in anthropology, art, education, ethology, history, literature, philosophy, psychology, sociology and veterinary medicine. It is defined quite simply as the scientific study of the relationship between human and nonhuman animals – a relationship that, of course, is very often based on communication (as we can for instance see in the case of human interaction with dogs or cats). Among the topics most often investigated by anthrozoology, there are human-pet relationships and their link with physical and psychological health; animal assisted therapy; abuse and cruelty to animals; and companion animals as social facilitators. Institutionally, anthrozoology took its first steps in 1987, with the first issue of the journal Anthrozoos, and in 1991, with the creation of the International Society for Anthrozoology (ISAZ) at Cambridge University.

Among the foundational literature on anthrozoology: Serpell 1996 and DeMello 2012.

CHAPTER TWO

PRECONDITIONS FOR COMMUNICATION

Sometimes, when we think about "communication", we tend to be a bit superficial. We imagine this phenomenon as a mere exchange of information, as if this exchange was a simple, mechanical "movement" of a signal (or word, sentence, or otherwise) from a point A to a point B, that is, from one interlocutor to another.

For centuries, the main assumption (best embodied by the notion of "mechanism", promoted by philosopher Rene Descartes) was that animal brains were functioning in a very simple, machine-like, manner. For most of the 20th century, the dominant theoretical trend (originated in psychology) was *behaviourism*, founded on the idea that all actions performed by an organism do not have to be interpreted as the result of internal physiological or mental processes, but are rather the result of a direct contextual conditioning. Key behaviourist scholars were Ivan Pavlov, Edward Lee Thorndike, John B. Watson and Burrhus F. Skinner. Before being challenged (and partly overcome), in the second half of the 20th century, by different approaches, behaviorism was widely popular in the study of animal behavior, affecting the early developments of animal communication studies.

Of course, the reality turned out to be much more complex than this stimulus-reaction scheme: two (or more) subjects engaged in a communication process have a lot of "problems" to solve and "requirements" to meet in order to make that process possible. In fact, realizing this complexity has been one of the major progresses within animal studies as a whole.

To summarize this development in one sentence, we could say that "animals" emancipated from their status as Cartesian machines, to become actual "subjects" ("persons", if we like: in fact, the status of personhood in non-human animals is now becoming an important legal issue, as well).

Two *phenomenologists* (San Martin and Pintos, 2001), following the indications emerging from Edmund Husserl's work, have very clearly explained what it means to be a "subject", in a list of eleven points:

1) Every animal is a living bodily entity, that ‘feels’ and experiences life in an intentional way;
2) Every animal rules its own body. The animal is the entity that moves its own body, that ‘decides’ to move;
3) Every animal experiences a mental life articulated in time units;Every animal experiences its own body in a direct way. Whether aware or not, the animal ‘feels’ its own body (heart beating, illness, etc.);
5) Every animal – to the letter – is alive. In phenomenological terms, this means that the animal is situated in its body first, then in the surrounding environment. The animal lives in the environment because it lives in itself; by consequenceEvery animal is in material relation with the world. Its body is made of matter, like the surrounding environment. It is on a material basis that we are open to something which is not only ‘ourselves’;Every animal perceptually feels itself as the “starting point” of the world. Every animal is egocentric in principle, and perceives the world starting from itself. Things ‘are’, starting from what ‘I’ am and am not. The relation with the world is based on affirmations and negations of our identity, thus starting anyway from ourselves;Every animal perceives the world from one point of view. To mention a trivial example, changing physical position, sensorial perception changes;
9) Every animal experiences a common animal world, and a social horizon of its own community/group/species. The animal knows to be part of a given category and understands who is a member of the same category, and who is not. The way a dog relates with a cat is clearly different from the way s/he relates with a tree, but has several points in common with the way s/he relates with a human being;
10) Every animal has to confront the surrounding environment and its inhabitants: it communicates, understands, misunderstands, etc.;
11) Every animal interacts with each other primarily on an affective and emotional basis.

In this chapter, we shall get acquainted with some of the most important conditions that allow communication to happen. Some of these conditions need to occur simultaneously, some may or may not happen (depending on the situation), and some, finally, may occur in different moments of the process. For these reasons, we shall deal with them in no other order than an alphabetical one.

To learn more about these topics, at least the following books are recommended: Box 1973, Griffin 1976, Beck 1980, Bonner 1980, Fagen 1981, Akimushkin 1988, Bekoff-Jamieson 1990, Gardner et al. 1994, De Waal 1996, Dennett 1996, Vauclair 1996 (if you can read French), Allen-Bekoff 1997, Rogers 1997, Cimatti 1998 (if you can read Italian) and Baber 2003.

Abstraction

Abstraction, or generalization, is the ability to represent an event/entity in terms of general qualities/characteristics, independently from concrete realities, specific instances or actual objects. To abstract means to be able to consider a given object as a case within a category, to mentally represent that category, and finally, on the basis of that representation, to recognize other cases of the same category. For example, abstracting *David Copperfield* as part of the category "Dickens' novels" allows us also to recognize *A Tale of Two Cities* within the same whole.

The process applies also to the capacity of spotting the category even when the second case is merely an alternative example of the first one, or is manifested in another form. In the previous example, not only an actual hard copy of *David Copperfield* can be recognized as Dickens' novel, but also an electronic file of it, or even a picture of the cover appearing in a magazine.

In psychological studies, abstraction is defined as a "higher brain function", and therefore has been long considered a *species-specific* human feature. Already in the first decades of the 20th century, however, and even more effectively starting from the 1950's, an increasing number of ethological studies, in both natural and experimental contexts, found out that abstract representations are extremely common among non-human animals. Subjects of such studies included pigeons, toads, elephants, parrots, ravens, squirrels, rats, monkeys, cats, and of course great apes.

Code

When we communicate, we use various different signs (words, gestures, displays…) that, in principle, do not make any sense, but they do just because we "decided" that they do. In English, for instance, we use the word "book" to describe that particular object with letters written on, pages, cover, etc. But, how come that thing is called "book"? Does this particular word look like, smell like, sound like, and so forth, that particular object? Definitely not: nothing in a book justifies the word

"book". It is just a decision that we took collectively, as English-speaking people. An Italian-speaking community took *another* decision ("libro"), and that other decision, too, has nothing in common with the object itself. We could now gather a few people, and agree that, from now on, that object will not be called "book", but – say – "train". That would be just as legitimate as "book", as long as there is this agreement among us.

Now, a system of "agreements" and "decisions" of this kind is called "code". A code is a set of rules of transformation, shared by at least two subjects (usually a community), through which signs are more or less deliberately associated to one or more meanings. A code requires social interaction in order to be created, and – after being established – enriches such interaction. Within the same community, let alone species, codes may be subject to progressive variations and adjustments, due to different factors: increasing efficiency of a new sign-meaning association, as compared to an old one of the same type; introduction of new subjects from a different community, who carry a different sign-repertoire, etc. We know, for instance, that languages evolve, so these agreements evolve too. If, in the time of Shakespeare, we would say "Thou art", now we say "You are", and the meaning is the same: it is the code that changed.

Needless to say, non-human animals must use codes as well. They also have to "agree" on certain conventions, and these conventions change depending on the species and also on the communities within the same species.

Cognition

"Cognition" is the way we call the totality of mental activities and information processing occurring within an animal, in a fashion partly or totally untied from instinct (a subject we shall also discuss later). The study of animal cognition focuses on at least the following aspects:

1) *Attentive skills* – The capacity of focusing on and discriminating between different stimuli;
2) *Classification and categorization* – The capacity of finding similarities across single items, and grouping them into so-called "semantic fields": for instance, we see a birch, an oak and a pine, and we categorize them in the semantic field of "trees";
3) *Temporal cognition* – The capacity of learning, retaining and transferring past information for (immediate and/or remote) future use;
4) *Spatial cognition* – The capacity of orienteering and navigatin;

5) Production and use of tools;
6) *Problem-solving* – The capacity of pursuing a goal by avoiding especially complex and unusual obstacles;
7) *Language* (which we are about to discuss);
8) *Consciousness* (which we are about to discuss);
9) *Counting and computing* – The capacity of discriminating between quantities and perform basic mathematical tasks.

Consciousness

"Consciousness" is an umbrella-term that may refer to a vast scale of mental states, from subjective experience to simple awareness. When it comes to non-human animals, there are not many data that scholars can use to "scientifically" assess the presence of consciousness: for this reason, scientific inquiry is regularly accompanied by philosophical conjectures. The range of hypothesis goes from a pessimistic, very famous essay entitled "What is it like to be a bat?", whose author, Thomas Nagel (1974), practically answered "No idea!" to the title's question, to the optimistic Cheney-Seyfarth 1990, who instead offered a few hypotheses to their question (ironically referring to Nagel himself) "What is it like to be a monkey?".

A central theme in modern animal studies, consciousness was very interestingly approached in Mortenson 1987, where different anatomic-physiological-behavioral clues for consciousness are gathered as indications for the presence of the phenomenon. Summarizing that whole book we can say that:

1) Indications of consciousness come from *anatomy* (particularly the structure of the brain), *physiology* (particularly the function of the muscles) and *ethology* (particularly the consequences of a given behavioral pattern);
2) In relation to brain, we have three forms of expression: the structural expressions (Cortex, Cortical and sub-cortical areas, Hemisphere, etc.); the electric expressions (Cerebral waves, Induced potentials, Peaks); and chemical expressions (transmitters like adrenaline or dopamine, hormones like hypophysis or thyroid, endorphins, etc.);
3) When it comes to the function of muscles, we have voluntary and involuntary ones;
4) When we consider behavior, we see patterns like sensibility, exploration, learning, communication, and others.

Now, all these elements, together or separately, indicate the existence of consciousness. Cerebral waves, muscles, sensibility… each and all of these get activated only when a specific status of "awareness" exists: the animal is "alerted", "reactive", "sensible", and so forth. It goes without saying, in order to communicate, one must be at least positive that there is something to communicate about and someone to communicate to.

Culture

"Culture" can be defined as the totality of information acquired and developed by a community and transmitted non-genetically from one generation to another. Phenomena of this kind have been observed in some insects, fish, amphibians and reptiles, and in most birds and mammals. With few exceptions, the presence and the quantity of cultural processes are directly proportionate to the degrees of sociality (we shall discuss this concept later) displayed by each species.

At the core of any cultural process, there is the capacity of social learning (this concept, too, to be explained later), which implies the transmission of some information from one or more "demonstrators" to one or more "observers/listeners". Several factors, at different (and interchangeable) stages, intervene in the process. These are (in no specific order): 1) *imprinting* (see later); 2) attention; 3) imitation; 4) memory; 5) *social facilitation*; 6) creativity; and of course 7) communication. One famous case in which all of these factors are operating at the same time is that of the macaques *Macaca fuscata*, closely observed during the 1940's and 1950's by a group of researchers led by Masao Kawai in Koshima, Japan (Kawai 1965). Researchers had the idea of introducing a "novelty" in the life of a group of macaques, by leaving some sweet potatoes along the beach. One macaque began to wash the potatoes in the water, instead of brushing the sand off with her hand as other macaques did. In short time, this habit became popular among the other members of the community and was passed on from generation to generation. In addition, the macaques proved to make a cognitive use of the innovation, as further modifications to this pattern were eventually provided (for instance, they started washing the potatoes in salty, rather than fresh, water, in order to enhance their flavor).

Imprinting

"Imprinting" can be defined as the capacity to learn specific types of information at certain critical periods in development. Although anticipated by the English biologist Douglas Spalding in 1873, the concept became central in science when the famous ethologist Konrad Lorenz had an insight of this phenomenon while observing young geese and chickens spontaneously following their mothers from almost the first day after they were hatched. He then reproduced the procedure with eggs that were incubated artificially, discovering that the stimulus can come from any source and still serve as imprinting, as long as it is presented during a critical period (the few days after hatching).

To an extent, imprinting is the first "official" form of communication between parents and their offspring.

Intentionality

In a general sense, intentionality represents the conscious planning or performance of a given action, aimed at a goal. In philosophy, the expression has been used in a broader sense, designating any mental state provided with a content (e.g. thinking, willing, longing), but in ethology, the concept has been practically overlooked until the coming of cognitive ethology, when – on the contrary – it became central.

In this book, the role of intentionality in communication is very important: as we said at the beginning of this chapter, we should not think about "communication" as a trivial "movement" of a signal from one interlocutor to another. It is a much more complex phenomenon, for which it is also essential to "have intentions". The notion that animals act only by instinct is an obsolete one: for the last fifty years, at least, scholars have explored more interesting explanations.

Learning

The term defines the process of acquiring and retaining information through *ontogenesis*, i.e., the consequence of interaction between an animal and its environment, rather than through *phylogenesis*. While in the past it was often claimed that almost all non-human behavior is due to instinctive predispositions, the current scholarly position generally holds that:

1. All animal species (including protozoa) are provided with so-called "non-associative" learning abilities (i.e. learning based on constant exposure to a unique event or stimulus);
2. Most of them (except for protozoa) are provided with "associative" learning abilities (i.e. learning based on constant exposure to numerous causally related events or stimuli);
3. In many species, particularly the so-called higher ones, there is "complex" learning (i.e. learning based on cognition, rather than simple association).

Further categorizations of the concept concern a) the specific learning processes associated with singing abilities in bird and mammal species (*song learning*); b) the form of learning that occurs without an explicit stimulus, with the animal acquiring information on his/her own environment in an exploratory way (*latent learning*); c) the learning processes specifically tied to an organism's experience (*perceptive learning*); d) the information received and stored by an organism in its prenatal life (*prenatal learning*); e) the acquisition of a (subjectively or objectively) "correct" reaction to a stimulus, after repeated attempts (*trial-and-error learning*); and f) the type of learning specifically emerging from social interaction and parent-to-offspring transmission (*social* or *cultural learning*).

Mental Representation

A mental representation is an inner sign of an external object (which functioned as its stimulus), and that can be reactivated also in absence of the original stimulus. The most typical example of mental representation is the mental map, that is, the capacity of orienting oneself in space and heading towards a certain destination, by using signs available in the environment, therefore being able to solve a consistent number of spatial and temporal problems. Back to communication in a strict sense, the process is more easily enacted (and enhanced in its potentials) when the interlocutors are able to create a mental representation of each other. When we can mentally represent the subject we are communicating with, it becomes easier to understand him/her, to expect certain reactions, to find the best strategy for a successful communication, etc.