

COMMUNICATION:

Definition : Communication is a phenomenon between members of a species or between two species when transfer of information occurs through signals that have evolved for the mutual benefit of the two animals. In communication system, there are two components:

1. Sender: An individual which emits a signal
2. Receiver: An individual which receive the signal and whose behavior is changed due to this.
3. Signal: Physical form in which a message is coded for transmission through the environment.
4. Channels: Path through which normally signal travels.
5. Noise: This is background activity of a channel which is not related with the signal.
6. Contact: This is set up under which a signal is emitted and received.
7. Code: Complete set of signal and contact.

During communication receivers reacts with the senders signal. In most cases the reaction is conducive which helps the senders. In most cases senders is beneficial than receiver but there are some cases such as rat and owl. Here rat is sender but totally beneficial is owl. So, the question is who is beneficial – the sender, the receiver or both. Animal behaviorists have disagreed on this issue also. One classification scheme considers the value of any information communicated to both sender and receiver (Wiley 1983) (Table.1).

1. Both sender and receiver benefit = true communication
2. Sender benefits, receiver is unaffected or harmed = manipulation or deceit.
3. Neither sender nor receiver benefits, both may be harmed = ignoring or spite.

Table.1: Terms used to describe interactions, depending on the value of the information to sender and receiver

Sender Value of Information	Receiver Value of Information	
	Positive	Zero (or Negative)
Positive	True communication	Manipulation (deceit)
Zero (or Negative)	Eavesdropping (Exploitation)	Ignoring (spite)

How do signals convey information: The signals may be divisible into two types- Discrete signal and Graded signal. For example, zebras, communicate hostile behavior by flattening their ears

and communicate friendliness by raising their ears (discrete signals). The intensity of either emotion is indicated by the degree to which the mouth opens (graded signal). The mouth opening pattern is the same for both hostile and friendly behavior. Graded signals thus vary in intensity in proportion to the strength of the stimulus.

Beside this, a signal may also be described in the followings.:

1. Composite: When two or more signals can be combined to form a composite signal with a new meaning. In the zebra example, the meaning of the open mouth depends whether the ears are forward (friendly) or backward (hostile).
2. Syntax: Animals can convey additional information with a limited number of displays by changing the syntax, or sequence of displays. For, example, two signals A and B would have different meanings depending on whether A or B came first.
3. Context: The same signals can have different meanings depending on the context; that is , depending on what other stimuli are impinging on the receiver. For example, the lion's roar can function as a spacing device for neighboring prides, as an aggressive display in fights between males or as a means of maintaining contact among pride members.
4. Meta-communication: Increasing the information content of displays by meta-communication, or communication about communication. For example, play in dog.

Methods for communication of animals:

1. Chemical Signal: Certain chemicals produced by the exocrine gland may change the behavioral pattern of others. This may be produced from the endocrine glands and known as pheromones. Pheromones can be classified into two basic categories. e.g. In social animal, chemical signal plays an important role. In Honey bee, behavior of the worker is controlled by pheromone (9-Oxydec-2-ionic acid) which is secreted by the mandibular gland of the fully grown Queen.
 - a. Signaling Pheromone: Which produce immediate effect on the recipient animal. e.g. *Bombyx mori*.
 - b. Priming Pheromone: Which trigger the hormonal activities of the recipient. E.g. *Bombyx mori* release a sex pheromone bombykol (From Female) which is detected by males from several Km. away.
2. Tactile Communication: A number of informations are transmitted by tactile communication which is more developed social animals. In many mammals and certain

insects tactile signals such as nose rubbing or rubbing of antennae like in bees used to identify different members of groups. Tactile communication is highly developed in monkeys. Where one monkey groom another by touching and passing some information. Cockroach and Lobster have long feelers which helps them to know each other and their sex.

3. Visual Communication: This is common in few arthropods, certain fishes, birds and mammals. The visual information is communicated by color, identification, posture or shape of the body, movement, timing etc. e.g. Male peacock display its plumage coloration by dancing during breeding season. In Octopus, sexual display are made by rapid color changes.
4. Auditory Communication: Auditory signal for sending information from one member to another is a common phenomenon in animals where acoustic or vocal signals are produced. E.g. Cricket, Grasshoppers, rub their body parts for producing sound signals. Many fishes vibrate their swim-bladder to emit information. In the Rattle snakes, the rattle which is a modification of the skin in the tail region vibrate to produce sound. Animal use sound signals for finding food or to locate predator. Birds make alarm call for alerting the flock about the presence of enemies.

Functions of Communication;

1. Group spacing and co-ordination. e.g. Lost call of *Cebus howler* monkey.
 - a. Distance increasing signal: e.g. branch shaking of *Cebus* monkeys which may result another group's moving away.
 - b. Distance maintaining signal: e.g. dawn chorus of howling monkeys (*Alouatta* spp.), which regulate the use of overlapping home ranges.
 - c. Distance reducing signal: Such as lost call of *Cebus* monkeys.
 - d. Proximity maintaining signal : Such as those that occur during social grooming within groups.
2. Recognition : This includes the followings.
 - a. Species recognition. For example , songs of *Drosophila*.
 - b. Deme recognition. For example, White crowned sparrow.
 - c. Individual recognition: For example, Indigo bunting.
 - d. Neighbor recognition. For example, White throated sparrow.

- e. Class and Caste recognition. For example, Social Insects.
- f. Kin recognition. For example, Tadpoles of *Bufo americanus*.
- g. Reproduction/ Display recognition. For example, 3-spined stickle back fish.

Channels of Communication: The sensory channel is the physical form used to transmit the signal from sender to receiver. From an evolutionary perspective, there are costs and benefits associated with different channels, depending on their environment and the information being transmitted. Table 1. summarizes costs and benefits of four major channels.

Table 1.: General properties of the major sensory channels of communication

Signal property	Olfactory	Auditory	Visual	Tactile
Range	Long	Long	Medium	Short
Transmission rate	Slow	Fast	Fast	Fast
Travel around object?	Yes	Yes	No	No
Night use?	Yes	Yes	Little	Yes
Fade out time	Slow	Fast	Fast	Fast
Locate sender	Difficult	Varies	Easy	Easy
Cost to send signal	Low	High	Medium	Low

Honey Bee Dance: Honey bees have an elaborate communication system to signal other bees of the hive about the location of food. Carl Von Frisch (1968) first revealed the dance language and orientation of bees.

1. Round Dance: If food is near the hive (less than 90 m), a scout bee performs round dance (Studied in *Apis mellifera*). In round dance the scout turns in a circle first to the left and then to the right. Round dance alerts the workers that food is nearby but gives no clue about the direction. Thus, the fellow workers have to search for the food source.

- 1. Tail Wagging Dance: If the food is far away (more than 90 m), the scout bee performs waggle dance or tail dance. It indicates both the direction and distance of food and is known as the language of honey bees. The dance is performed on the vertical surface of the hive or horizontal surface at the entrance of the hive.
 - a. The waggle dance is shaped in a figure of "8". First to the left and then to the right with wagging of the abdomen.

- b. A typical waggle dance consists a middle of straight run with the abdomen waggled vigorously then the bee makes a semicircular turn to the left and waggle in straight line again. This is followed by another straight waggle dance. The dance is repeated many times.

Remark:

1. The speed of the dance is inversely related to the distance of food from hive. If the food is 335m away from the hive bee makes 30 run/ min, if it is more 670m away only 22 run/min are made.
2. Direction of the straight run indicate the direction of food. Bee use the sun as compass. If the sky is clouded, they can locate the position of sun by the scattered light.
3. When the food is forward the sun, the dance is typical, the middle run is vertically up the hive. If the opposite the sun, the middle run is vertically down ward.
4. If the food is at and angle in respect to the position of the sun , the angle of waggle run to the vertical line equals to the angle of food & sun and food & hive.
5. Bee may run for the long period of time f the food source is rich. During this time the sun changes the position of the sky. Bee's have biological clock mechanism which compensate such changes as the sun at its apparent position the direction of waggle dance changes so, accurate flight directions are always given.
6. Since, the waggle dance performed in the darkness of hive where vision is impossible. The worker bees follow the dancing pattern by the antennae.

Conclusion: the ability to communicate in this fashion increase the efficiency of honey bee to exploit resource in the environment. In the large colony the foraging behavior of worker is so co-ordinated that they spent maximum amount of time in cropping of flower (Manning & Dawkings, 2005)

Recording of call of a birds (viz. Oriental Magpie Robin: *Copsychus saularis*)

1. Recording by ultra-sensitive microphone and tape-recorder.
2. Editing by selection of cuts of high quality recording.
3. Physical analysis (by oscilloscope and sonograph) by minimum and maximum frequency duration, no. of elements, phrases etc.

The unit of sound is KHz. The pattern of sound is known by sonograph. Then the pattern is divided into different elements. Elements is a sound preceded and followed by a pause. If there is one element in a call then it is called simple and if there is more called complex. Most of the songs are complex calls and having several phrases. Phrases are those which give a melodious sound of the song.

On the basis of the call, it is established that Oriental Magpie Robin gives 8 different calls and they are the followings:

1. Territorial Call (Mainly by male birds): he did this when everybody watch him.
2. Begging Call (Infant birds/Nestling 3-4 days in Nest): Calls for food.
3. Juvenile Call: Who can fly.
4. Emergence and Roosting Call: Early morning call because it can perceive infrared.
5. Threat Call: Entry in a territory which is occupied by others.
6. Submissive Call : One bird enter into a territory but he soon realize that it faces some danger of other bird present in that territory. So, it is a realization call.
7. Distress Call: When a bird see a predator, a small bird gives a call (Distress call) by which other bird can know the presence of the predators. As a result all birds gives a call. It is also known as mobbing call.
8. Escape Call: Mainly given by infant birds to escape from a predator.
9. Anger Call: When a female calls for a male to escape from anger , the it is anger call.

The first seven calls are called Major call and the last two calls are called Minor Calls. The difference between Territorial and Threat call is that in case of territorial call , the bird is visible but in case of the other it is not.

Table 1. Physical Characteristics of different types of calls in Oriental Magpie Robin

Types of call	Phonetics	No. of call	No. of elements /call	Types of elements/call	Fq. Range (Am)	Duration (sec)	Rate (calls/min)
Territorial	Swee....Swee	Simple	1	1	1.93	0.63	17.91
Juvenile	Sweerr...Sweerr	Simple	1	1	4.33	0.35	18.80
Emergence and Roosting	Charr....Charr	Simple	1	1	5.24	0.61	20.18
Threat Call	Charr...Charr	Simple	1	1	4.58	0.82	23.6
Submissive	Cheo..Che...Che	Complex	4.8	2	3.67	0.76	21.0
Begging	Chee..Chee	Simple	1	1	2.48-6.01	0.16-0.35	20.55-37.33
Distress	Teze..Cheer Cheer..Cheer	Simple	1	1	7.56	0.53	38.22
Escape	Che...Che						
Anger	Chick..Chick (feeble slow)						