PSY 2364
Animal Communication

Theory of communication

Source

Transmitter

Channel

Noise

Destination

Receiver

Components of communication

- sender and receiver
- signal / message
- channel / noise
- information and redundancy

Definitions

- Communication is an action by one organism that alters the behavior of another organism that is adaptive to either one or both participants (E.O. Wilson, 1975)

Key properties of communication
(Peter Marler)

- **Non-constancy** – communication signals have a clear start and endpoint
- **Specialization** – adaptations for signal production, transmission, or reception
- **Internal processing** – signals must picked up and interpreted by the receiver.
- What about “intention to communicate”?

Types of information

- **Interactional** – intention to attack, escape, initiate courtship or mating; care-giving, attentiveness
- **Identity** – species identity; individual identity; neighbor; sex of signaler; maturity/age class; breeding state
- **Context** – a given signal may be interpreted in different ways depending on the situation and audience.
Ethology and communication

- **Ethology** – study of animal behavior
- Developmental and evolutionary origins of behavior
- Natural environments
- Specialization of function
- Adaptation / ecology of behavior
- Detailed descriptive methods
- Ethogram

Charles Darwin
(1809-1882)

- The origin of species
- Evolution
- Natural selection

"Nothing in biology makes sense except in the light of evolution."
Th. Dobzhansky, 1973

Voyage of the Beagle (1831-1836)

1. **Variation** exists in behavior and structure.
2. Some of that variation is **heritable**.
3. More individuals are born than leave offspring for future generations.
4. Certain inherited traits make individuals better able to cope with environmental conditions and compete for limited resources such as food and shelter. These individuals survive longer and leave more offspring than those with less successful traits (survival of the fittest).
5. Changes in an entire population can lead to the formation of new species (**speciation**).

Darwin’s theory of natural selection

Ethology: The naturalistic study of behavior

- Ethology is an evolutionary approach to the study of animal behavior.
- Naturalistic observation
- Field experiments
- Role of natural selection and adaptation

Ethology

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Niko Tinbergen
(1907-1988)

Konrad Lorenz
(1903-1989)

Karl von Frisch
(1886-1982)
Ethology and communication

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Karl von Frisch (1886-1982)

Honeybee dance communication

- **Round dance**
- **Waggle dance**

Honeybees

**Kingdom:** Animalia

**Phylum:** Arthropoda

**Subphylum:** Uniramia

**Class:** Insecta

**Order:** Hymenoptera

**Family:** Apidae

**Genus:** Apis

**Species:** melifera

Karl von Frisch (1886-1982)

- Austrian ethologist who discovered the “language of the bees.”
- Used marked bees to test the idea that honeybees communicate information about the location and quality of food sources outside of visual range by “dancing.”
**Honey bee waggle dance**

- The angle between the straight line part of the dance and the sun’s position in the sky signals the location of the food source (e.g. 30° west of the hive)
- Other cues (smell, sound, vibration) also help foragers locate the food source.

**Niko Tinbergen (1907-1988)**

- The “curious naturalist”
- Noninvasive field experiments
- Studies of herring gull behavior, spatial learning in insects
Niko Tinbergen (1907-1988)

The Dutch ethologist Niko Tinbergen proposed that the scientific study of animal behavior proceeds by asking four questions.

What were those four questions?

Tinbergen’s four questions

1) What is the mechanism?
2) What is its function?
3) How did it develop (ontogeny)?
4) How did it evolve (phylogeny)?


Niko Tinbergen (1907-1988)

• **Search image**: a hypothetical mental picture of a prey item used by a predator to search specifically for a cryptic, common, edible prey.

Red-tailed hawk

Niko Tinbergen (1907-1988)

• **Sign stimulus** – the component of an action or object that triggers a fixed response in an animal (e.g., herring gull chick’s begging response)

Red dot

Niko Tinbergen (1907-1988)

• **Sign stimulus** – the component of an action or object that triggers a fixed response in an animal (e.g., herring gull chick’s begging response)

Innate or learned?

• Jack Hailman (1967) studied the begging response of herring gull chicks to two different models of adult birds: herring gull models and laughing gull models.
Innate or learned?

- Hailman found that newly hatched herring gulls do not distinguish between the two models.
- However, at 6 days, they can reliably tell the difference.

Niko Tinbergen (1907-1988)

- **Releaser** – a sign stimulus given by one animal to another as a social signal (e.g. *pheromones* – chemical communication signals)

**Yawning – A Releaser?**

Konrad Lorenz (1903-1989)

- Studied how innate and acquired components of behavior are integrated
- Emphasized the importance of behavior for taxonomy
- Studied imprinting in geese
- Origins and basis of animal and human aggression

**Konrad Lorenz (1903-1989)**

- **Fixed action pattern** – innate, stereotyped response triggered by a well-defined simple stimulus. Once activated, the response is always performed to completion.

**Konrad Lorenz (1903-1989)**

- **Imprinting** – form of learning in which individuals exposed to certain key stimuli, usually during an early stage of development, form an association with the object and may later show sexual behavior toward similar objects.
Konrad Lorenz (1903-1989)

- Critical period for learning – a period in the life span of an individual (in birds, a short period just after hatching) where learning or imprinting is greatly facilitated.

- Fixed action pattern: an innate, highly stereotyped response triggered by a well-defined simple stimulus; once activated, the response is performed in its entirety.

Egg rolling in geese
Lorenz & Tinbergen (1939)

- Instinct: a behavior pattern that reliably develops in individuals that receive adequate nutrition, and that is given in functional form on its first performance.
Honesty and communication

• Information conveyed by animal signals can provide information about the environment or the sender’s intentions (future course of action).

Honesty and communication

• Most (but not all) communication signals are “honest” (reliable). Why is this?
• **Zahavi (1975)** argued that receivers will not respond (and hence communication will not evolve) if the signal is “dishonest” or unreliable.

Honesty and communication

• **Handicap hypothesis**: some signals, like the peacock’s tail, are costly to produce. Since they are costly, they are more likely to be reliable (and this is why female peacocks prefer them).
  
  Zahavi argued that costly signals are more likely to evolve; he describes these as **handicaps**.

Intention Movements

• Ethologists proposed that some communication signals originate from movements made when the animal is getting ready to perform a particular behavior. These movements are called **intention movements**.
• Examples: bared teeth display in dogs; upright threat posture in herring gulls.

Displacement Behavior

• Ethologists observed that animals may sometimes engage in “irrelevant” activities when they experience conflict. They called these redirected activities **displacement behaviors**.
• Examples: cat grooms itself when prevented from reaching food; courtship begging in birds.
### Ritualization

- Evolutionary process that transforms an incidental cue/behavior pattern into a true communication signal (Tinbergen, 1952).
  - **Simplification** or reduction in components
  - **Exaggeration** of the remaining components
  - **Repetition** of the signal
  - **Stereotypy** – reduction in the signal variance
    - e.g. courtship feeding in pheasants

### Principle of antithesis

- Darwin proposed that some communication signals arise (evolve) because animals are divided between conflicting tendencies or impulses (e.g. between fear and aggression).
- The principle of antithesis states that signals with opposite messages tend to be opposite in form.

### Antithesis

- Opposition between two conflicting emotional states (attack vs. flee)
- Displays often show extremes in posture, orientation, extent of feather erection in birds, or fur in mammals

### Sign stimuli and releasers

- Male *three-spined sticklebacks* in breeding condition will perform a zig-zag dance in the presence of a female, but a different display (head-down threat posture) when approached by another male.

### Sign stimuli and releasers

- Tinbergen (1951) showed that the cue evoking the zig-zag courtship display was the swollen belly of the female fish; threat was induced by the red color on the underside of a rival male.

- Tinbergen found that simple (inanimate) fish models were sufficient to trigger the response (even a red post office van driving past the window near the fish tank!)
Sign stimuli and releasers

- *Sign stimuli* adapted for communication are called *releasers*.
  - Specialization for *signal production*
  - Specialization for *signal perception*
  - discrimination vs. generalization

Sign stimuli and releasers

- *Innate releasing mechanisms* – “lock-and-key” analogy
- Template and filter models
- Egg recognition in herring gulls (Baerends)
- Supernormal stimuli

Code breaking

- The relationship between the triggering cue and the behavioral response of a FAP can be observed when the behavior is exploited by members of another, parasitic species.
- **Code breaking**: behavior that mimics the triggering component of a FAP to exploit its benefits.

Code breaking

- **Examples of code breaking**
  - colored gape of cuckoo nestling
  - parasitic rove beetle larva mimic the food-begging behavior of larval ants

Supernormal stimuli

- preference for giant eggs by Oystercatchers

Supernormal stimuli

- *supernormal* begging behavior in **brood parasites** (European cuckoo, brown-headed cowbirds)?