

9.20 M.I.T. 2013

Lecture #10

Key concepts from Lorenz on fundamentals of ethology:

- A. Models of FAP and IRM
- B. Hierarchies and chains of behavior
- C. Spatial orientation by reflexes and internal model
- D. Multiple simultaneous motivations

A reed warbler feeds a young cuckoo
that hatched in the warbler's nest.

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Roger Wilmshurst/Photo Researchers, Inc.

6. Explain how the doll industry and the food industry exploit the IRMs of humans. (p 164-166)

❖ Food industry: discussed earlier

❖ Doll industry: next slide from Eibl-Eibesfeldt (1971)
Love and Hate: The natural history of behavior patterns, 1971

The "infant schema": the attributes of a small child (big head in relation to body, high prominent forehead, chubby cheeks, short rounded limbs, small mouth for sucking, etc.) are often greatly exaggerated in the dolls produced by the toy industry, which increases the protectiveness-releasing effect of these "cute" little objects. In commercial art the childish attributes of women are frequently exaggerated as well as the sexual attributes....

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From I. Eibl-Eibesfeldt, *Love and Hate. The Natural History of Behavior Patterns*, 1971 (NY: Holt, Rinehart & Winston).

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7. What is the difference in meaning of the terms “releaser” and “key stimuli”?

How can releasers usually be recognized?

(p 166-168)

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How can releasers usually be recognized?

(p 166-168)

...the term ‘releaser’ connotes a structure or a movement, most often a combination of both, which has evolved in the service of sending a signal, that is to say, of emitting key stimuli.

...every striking or “showy” color pattern or structure found in a vertebrate, as well as any loud and regular sound utterance, or any regular, complicated, and rhythmically performed movement, functions as a releaser.

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8. Describe two releasers in humans, one involving a motor pattern and the other not. (p 168, etc)

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❖ Smiling

❖ Fatty tissue in cheeks of small children

Others? There are many.

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9. Mimickry usually evolves in a species in order to affect the behavior of other species.

Describe cases of mimickry that have evolved to affect other members of the same species (“automimesis”).

(p 169-170)

Investigated by Wolfgang Wickler:

Mouthbreeder fish

Baboons and vervet monkeys (various species)

From Wolfgang Wickler's studies of automimicry:

- Mouthbreeder fish:
 - The role of orange spots on the anal fin of males: a key stimulus in mating behavior
- Baboons and vervet monkeys
 - Rump swellings on males, red in color, imitate the genitalia of an aroused female.
 - The rump is presented to a dominant male as an act of submission, for appeasement. This reduces attacks.

A mouthbreeder male

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Male olive baboon

Photos removed due to copyright restrictions.

Female olive baboon with baby

Male Hamadryas baboon

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Female Hamadryas
baboons presenting
to male

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10. Explain the “dummy rule”. Also explain why it cannot be inverted. (p 171, 175)

The “dummy rule”:

- If a simple model elicits a FAP, then an IRM is involved.
- But if such dummy stimuli fail, it does not mean that there is no IRM: see next Q.

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11. For IRMs, what is the usual role of learning?
(pp 173-175)

Lorenz, K.Z. (1981) *The Foundations of Ethology*

11. For IRMs, what is the usual role of learning?
(pp 173-175)

The selectivity (specificity) is increased

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A: The “psycho-hydraulic” model and the action-specific potential (ASP)

1. Explain the difference between Lorenz’ old mechanical/hydraulic model and his revised model, depicted in figures 18a and 18b.

The Lorenz “psycho-hydraulic” models of an IRM & the ASP

The Foundations of Ethology (1981) p 181

Illustrations removed due to copyright restrictions.

The major difference:

Major difference in the two models: a different role of the releasing stimuli that activate the IRM.

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A: The “psycho-hydraulic” model and the action-specific potential (ASP)

2. The brain-stimulation work of Erich von Holst indicated a relationship between the level of the CNS stimulated and the time course of behavioral effects of the stimulation. Explain. (p 183)

Behavior of chickens and cats with electrical stimulation of the hypothalamus (by von Holst & von St Paul; Hess)

- Low levels of CNS (spinal cord, hindbrain):
 - Behavioral changes only during periods of stimulation
- Forebrain stimulation:
 - Behavioral changes outlast the stimulation. (See also next slides)
- Examples: stimulation of caudal forebrain—the hypothalamus—can elicit the moods of fear and aggression.
 - **In chickens**, depending on specific placement, it could elicit the following:
 - a) reaction to overhead predator,
 - b) reaction to ground predator.
 - **In cats**, depending on specific placement, it could elicit the following:
 - a) quiet biting attack (predatory aggression),
 - b) defensive aggression (claws out, arched back).

As predicted by
Lorenz 2nd model

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A: The “psycho-hydraulic” model and the action-specific potential (ASP)

3. Give examples of the effects of the “inertia of excitation” (p 184) in animal behavior, i.e., behavior that occurs after the sudden removal of the stimulus that elicits a fixed action pattern. Try to think of examples from human behavior.

Lorenz, K.Z. (1981) The Foundations of Ethology

A: The “psycho-hydraulic” model and the action-specific potential (ASP)

3. Give examples of the effects of the “inertia of excitation” (p 184) in animal behavior, i.e., behavior that occurs after the sudden removal of the stimulus that elicits an FAP. Try to think of examples from human behavior.

Easiest examples:

moods that cannot be turned off instantly

- fear,
- aggression,
- sexual excitement

From Disney film: the bear caught in a log that rolls down a hill and crashes into a tree. **Angry behavior ensued, continuing for some time after the crash.**

Lorenz, K.Z. (1981) The Foundations of Ethology

A: The “psycho-hydraulic” model and the action-specific potential (ASP)

Different motivational states can lead to the same or very similar motor patterns:

4. How can we explain the fact that the urination activities of a male dog often do **not** depend on the amount of urine in the bladder? Upon what do they depend? (p 186)

Lorenz, K.Z. (1981) The Foundations of Ethology

A: The “psycho-hydraulic” model and the action-specific potential (ASP)

4. How can we explain the fact that the urination activities of a male dog often do **not** depend on the amount of urine in the bladder? Upon what do they depend? (p 186)

➤ Motivation to mark territory

➤ Motivation to announce his presence to other dogs

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B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

5. Describe the chain of behavior patterns shown by newborn kittens in nursing behavior. Note how an innate motor pattern acts as appetitive behavior for another innate motor pattern, in a “functionally consistent chain”. (p 192)

This example will lead to a discussion of Niko Tinbergen’s view of fixed action patterns.

Nursing behavior of newborn kitten

1. If awake and not suckling: A constant, to-and-fro sideways sweeping movement of head and foreparts of body while creeping forwards
2. Touch of solid vertical surface: Snuggle up to it and maintain contact while continuing #1
3. Contact with fur: Stop forward motion, continue sweeping motions with nose pressed against fur
4. Touch bare spot: Cease sweeping motions, initiate snapping movements
5. Find teat: Stop other movements, initiate sucking and also “milk treading” with forepaws with rhythmic thrusting movements of nose against breast

Each motor pattern serves as appetitive behavior for the next FAP.

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B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

6. Such chains of behavior are very common, and were described by Tinbergen as examples of a “**hierarchical organization of instinct**”. Such a hierarchy can be depicted diagrammatically as in figures 19a and 19b (often reproduced in textbooks).

Note how Tinbergen’s diagrams show a view of IRMs and FAPs that differ from the Lorenz model. What is the major difference?

Tinbergen's model of FAP organization

Figure removed due to copyright restrictions.

Tinbergen's
hierarchy:
a model of
instinctive
behavior

(Male
stickleback
reproductive
behavior)

Figure removed due to copyright restrictions.

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B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

“Note how Tinbergen’s diagrams show a view of IRMs and FAPs that differ from the Lorenz model (seen in slide 3).
What is the major difference?”

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B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

“Note how Tinbergen’s diagrams show a view of IRMs and FAPs that differ from the Lorenz model. What is the major difference?”

They focus on different aspects of FAPs:

- Tinbergen takes a broader view. His model looks like an information-flow scheme.
- Lorenz focuses on the dynamics of the ASP and IRM. His drawings of his model show a hydraulic/mechanical model (that reminds one of a flush toilet!)

Each model has its strengths and weaknesses:

- Lorenz’ model deals with the phenomena of inertia in FAP excitation.
- Tinbergen’s depicts hierarchical organization.
- Tinbergen’s model is easier to relate to neurons, and it organizes many observations. However, it fails as a descriptive model of the inertia phenomenon and other dynamics of FAPs—e.g., the great increase in motivation resulting from key stimuli.

Lorenz, K.Z. (1981) The Foundations of Ethology

B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

More complex chains of innate behavior:

7. What is the major point made by Lorenz in his description of Baerends’ (1956) analysis of the parental behavior of the female digger wasp?
(pp 198-202)

Lorenz, K.Z. (1981) The Foundations of Ethology

B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

7. What is the major point made by Lorenz in his description of Baerends’ (1956) analysis of the parental behavior of the female digger wasp? (pp 198-202)

Note Baerends’ experiments on the influence of inspections of nests by the wasp:

The behavior sequence has great plasticity and adaptability to changing environmental circumstances—although there is little learning. It displays an “intelligence of instinct”.

More on this next week, as we read from Tinbergen again (especially in class 13).

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Female digger wasp (sand wasp), Australia

She digs nest holes in the sand.

Digger wasp inspecting a nest hole



Courtesy of [Valter Jacinto](#) on Flickr. License CC BY-NC-SA.

What she detects in the nest determines her next behavior. Her behavior sequences are complicated by the fact that she digs and uses multiple nests, one for each egg she lays.

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B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

The motivational states underlying the feeding behavior of ducks and geese reveal “a relative hierarchy of moods.”

8. What is the “upending” behavior of ducks and geese?
 - In what abnormal circumstance would such birds be “feeding for the sake of upending instead of upending for the sake of feeding – as is usually done”?
 - Such an example shows how motivation at one level in a hierarchy may be stronger than that from a higher level, and thus indicating some independence. (p 202)

Lorenz, K.Z. (1981) The Foundations of Ethology

B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

8. What is the “upending” behavior of ducks and geese?
 - In what abnormal circumstance would such birds be “feeding for the sake of upending instead of upending for the sake of feeding – as is usually done”? **Well-fed birds deprived of opportunities to up-end.**
 - Such an example shows how motivation at one level in a hierarchy may be stronger than that from a higher level, and thus indicating some independence. **(p 202)**

Recall the cactus finch , already well fed, searching for food in order to poke with a cactus spine—the tool it has evolved to use.

Ducks upending



Courtesy of [Cindy Cornett Seigle](#) on Flickr. License CC BY-NC-SA.

Lorenz, K.Z. (1981) The Foundations of Ethology

B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

8. What is the “upending” behavior of ducks and geese?
 - In what abnormal circumstance would such birds be “feeding for the sake of upending instead of upending for the sake of feeding – as is usually done”?
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(p 202)

Thus: The ASP for upending is separate from that for hunger. Well-fed birds deprived of this method of obtaining food will show upending behavior if given the opportunity.

Lorenz, K.Z. (1981) The Foundations of Ethology

B: Chains of behavior; hierarchical systems; the “relative hierarchy of moods”

With multiple motivations, controlling many different instinctive motor patterns, what controls the organization of the controllers and avoids conflicts?

9. In Lorenz’ view, why did the head, containing the “locus of superior command”, have to be invented in evolution?

(p 206-207)

How, in general, has the function of the “head ganglion” changed in higher vertebrates, with respect to FAPs?

(p 209)

Lorenz, K.Z. (1981) The Foundations of Ethology

B: Chains of behavior; **hierarchical systems**; the “relative hierarchy of moods”

9. In Lorenz’ view, why did the head, containing the “locus of superior command”, have to be invented in evolution?

(p 206-207)

- **To limit behavior to one motor pattern at a time.**
- **To embody the IRMs for selection of a motor pattern (FAP). [Most stimuli come into the brain through the cranial nerves.]**

How, in general, has the function of the “head ganglion” changed in higher vertebrates, with respect to FAPs?

(p 209)

- **Increased linkage between innate and learned aspects of behavior.**
- **Initiation of behavior patterns driven by learned motivations and cognitive decisions.**

B: Chains of behavior; **hierarchical systems**; the “relative hierarchy of moods”

9. In Lorenz’ view, why did the head, containing the “locus of superior command”, have to be invented in evolution?

(p 206-207)

– To limit behavior to one motor pattern at a time: **setting priorities, coordinated planning, system-wide modulation and organization.**

– To embody the IRMs for selection of a motor pattern (FAP). [Most stimuli come into the brain through the cranial nerves.]

How, in general, has the function of the “head ganglion” changed in higher vertebrates, with respect to FAPs?

(p 209)

– Increased linkage between innate and learned aspects of behavior.

– Initiation of behavior patterns driven by learned motivations and cognitive decisions. [**Cognitive level is at the top of a neural hierarchy, but it is not always dominant.**]

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C: Taxis and reflexes; spatial orientation and thinking in higher animals

10. Explain how the “mantle of reflexes” (term from von Holst) tends to conceal the rigidity of fixed motor patterns.

(pp 235-236)

- **Example of egg-rolling behavior by graylag geese.**
- **Example of human locomotion.**

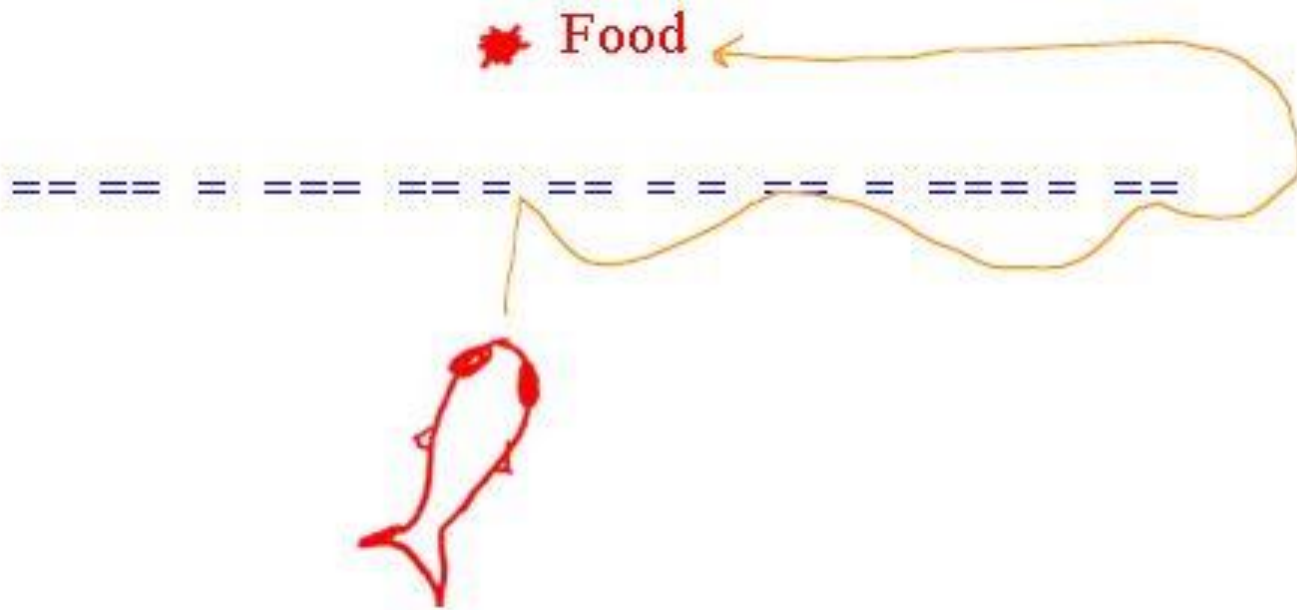
The behavior looks variable and complex because superimposed on it there are various reflexes—vestibular, tactile, visual (avoidance of obstacles, adjustments for variations in terrain, etc.)

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C: Taxis and reflexes; spatial orientation and thinking in higher animals

11. How does a goldfish solve the problem of reaching a bit of food it can see behind an impenetrable obstacle?

(p 237)



Lorenz, K.Z. (1981) The Foundations of Ethology

C: Taxis and reflexes; spatial orientation and thinking in higher animals

11. How does a goldfish solve the problem of reaching a bit of food it can see behind an impenetrable obstacle? (p 237)

Two innate behavior patterns:

- **Positive telotaxis directed towards the prey**
- **Negative thigmotaxis causing the fish to avoid contact with the obstacle (e.g., branches of plants)**

It looks like intelligent behavior. The goldfish seems to figure out how to reach the food. However, its behavior is simply the result of two innate patterns of behavior--reflexes--plus the motivation of hunger.

Why does a dog often fail in such a situation?

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9.20 Animal Behavior
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