

9.20 M.I.T. 2013

Lecture #9

Key concepts from Lorenz on fundamentals of ethology:

The “fixed action pattern”

The “**Innate Releasing Mechanism**”

Tool activities = multipurpose movements

- **Major examples:**
 - **Locomotion**
 - **Orienting movements**
 - **Grasping with hand**
- **ASP increases at a rate proportional to the time the animal has to spend performing the movement.**
 - **E.g., a cat's predatory behaviors are a series of FAPs that become linked. Locomotion with searching, stalking, pouncing, killing bite.**
 - **How frequently does a cat perform each of these behaviors?**
 - **Cat must search much more than stalk, stalk more than pounce, etc.**
 - **The thresholds for stimuli to initiate searching (locomotion) are lowered the most quickly.**
- **This can result in a quick lowering of thresholds for very frequently performed actions (see next questions)**

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8. Give examples of **threshold lowering** of releasing stimuli, and its cause. Include at least one example from human behavior. (*Section 7, p 123-125*)
- Hunger and feeding
 - “When in need, the devil eats flies.” (Goethe)
 - Breeding and sexual attraction
 - Males become less and less selective as they are deprived of mating longer and longer. (In animal breeding, including cross-breeding, males are brought to a receptive female.)
 - Lorenz’ example from human behavior
- His story about a sea captain’s perception of women when he returned from a voyage.
9. Closely related is the phenomenon of vacuum activity, or “*in vacuo*” **reactions**. Define and give examples. (*See section 9, p 127-129*)

"Vacuum activity"

- Lorenz' pet starling: catching and feeding on non-existent insects.
- Canary or rat: nest building with own feathers, or tail.
- Mallard drakes attacking own tails
- Ostrich plucking grass, even if non-existent
- Rodent gnawing...

Even very minimal stimuli become effective with very strong drive. The internal reservoir appears to spill over. These are examples of extreme threshold lowering.

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10. What phenomenon which is a major component of most instinctive behavior (FAPs) was defined by Wallace Craig in 1918? (Section 10) Define and give an example. P 129-130

Appetitive behavior

11. Describe examples of an “appetite for aggression” and the emotional reactions to this concept that people have shown. (Section 11, p 130-133)

An appetite for aggression?

- **Examples of an appetite for aggression”**
 - A young man “looking for trouble”
 - A graylag gander likewise may behave this way.
 - Experiments with marine Jewel Fish (see p 132):
 - A male in fighting mood will learn a simple maze where the reward is a visual encounter with a slightly smaller male. (The encounter is an aggressive one.)

An appetite for aggression?

- **Why some scientists, and other persons, have reacted strongly against such an appetite, and against the spontaneity of aggressive behavior in general:**
 - For a long time (especially in America and in Russia) there was a strong bias against the idea that any behavior could not be explained in terms of a stimulus-response model.
 - As we have discussed previously, there was a bias against instinctive behavior in general, especially with regard to humans (and especially in America).

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12. Describe how the internal readiness, or ASP, varies among different FAPs. (Section 12, p 133-136)

Variations in internal readiness (ASP) among different FAPs

- It builds up at a rate proportional to how often the action is needed.
- When it builds up faster, it appears less susceptible to fatigue, and the action is more likely to be discharged *in vacuo*.
- Examples:
 - Flying in various small birds vs flying in greylag geese (*p 134*): How fast does the ASP build up?
 - The various motor patterns involved in prey-catching by cat-like carnivores (*p 134-135*)
 - Paul Leyhausen's studies. What does a cat do in a room full of mice? (if the cat is a hunter)

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13. Is it true that cats and dogs hunt only in order to eat? Describe evidence for your answer.

p 134-135

Describe a simple experiment.

A cat motivated to hunt may be well fed already, and ignore its favorite food in order to be able to hunt mice or other small animals.

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14. Similarly, describe the hunting behavior of at least one species of bird that uses prying movements. How is this related to Q13? (*p 135-136*)

- Lorenz' starlings Drive to poke can be greater than drive to eat.
- Cactus finch of the Galapagos Islands Its drive to find a cactus thorn and use it to poke for insects can be higher than its drive to eat.

What do these birds do, even if well fed?

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Cactus finch using a
cactus thorn to poke for
food (insects, larvae,
etc.)

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1. “The innate releasing mechanism responds to complex stimulus configurations and triggers a behavioral response from the organisms.”

Criticize this false statement, using one or two examples.

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1. “The innate releasing mechanism responds to complex stimulus configurations and triggers a behavioral response from the organisms.”

Criticize this statement, using one or two examples.

- First, the stimulus configuration is usually **simple**.
- Second, “triggers” can be misleading, as it depends on the level of the action specific potential (the level of motivation). (It is not a reflex.)

Examples of the **simplicity** of key stimuli

- Examples from Tinbergen's studies of gulls and stickleback fish (reviewed earlier)
- Examples from Lorenz p 156:
 - The stinging response of the female common tick (example used by Jakob von Uexküll in 1909):
 - Body temperature of about 37 degrees (see next slide)
 - Smell of butyric acid
 - Common cricket female's response to courting male:
 - She responds to specific pitch of male's courtship song.
 - Males of some mosquitoes:
 - Respond to the specific frequencies of the female's wingbeats

The stinging response of the female common tick:

- The tick probably does not detect a surface temperature at a distance. It may respond to the odor of an animal walking below it, but most likely it simply falls from a branch when the branch is moved by an animal.
- Its stinging response, however, is triggered by the surface temperature plus the odor.

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2. Describe MIT's Jerome Y. Lettvin's contribution to the study of IRMs.

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Lettvin, Maturana, McCulloch and Pitts (1959), "What the frog's eye tells the frog's brain." *Proc. Instit. Radio Engineers* 47, pp 1940-1951.

Jerry Lettvin's work at MIT:

- He was recording from microelectrodes in the frog brain.
- Locus of his recording: the optic tectum of the midbrain.
- The recordings were from the terminal arbors of axons coming from the retina.
- Results showed different types of specificity: one group of axons have been nick-named the “bug detectors.” (In the report, they are called “net convexity detectors.”) These axons were part of an IRM for detecting and orienting toward prey.
- Another type: specific to dimming light—important for eliciting avoidance responses to an approaching predator.
 - The axons carrying this information are myelinated and are the fastest conducting of the axons from the retina.

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3. Give an example of maladaptive behavioral responses to key stimuli. (*E.g., see p 158*)

Maladaptive behavioral responses to key stimuli:

The examples point out the parsimony of the information carried by most key stimuli.



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1) Turkey chicks' response to overhead hawk:

- *They respond the same way to a fat fly crawling along the ceiling! (See also next slide)*

2) Young kestrels' response to water:

- *They make the same bathing movements in response to a polished marble table top!*



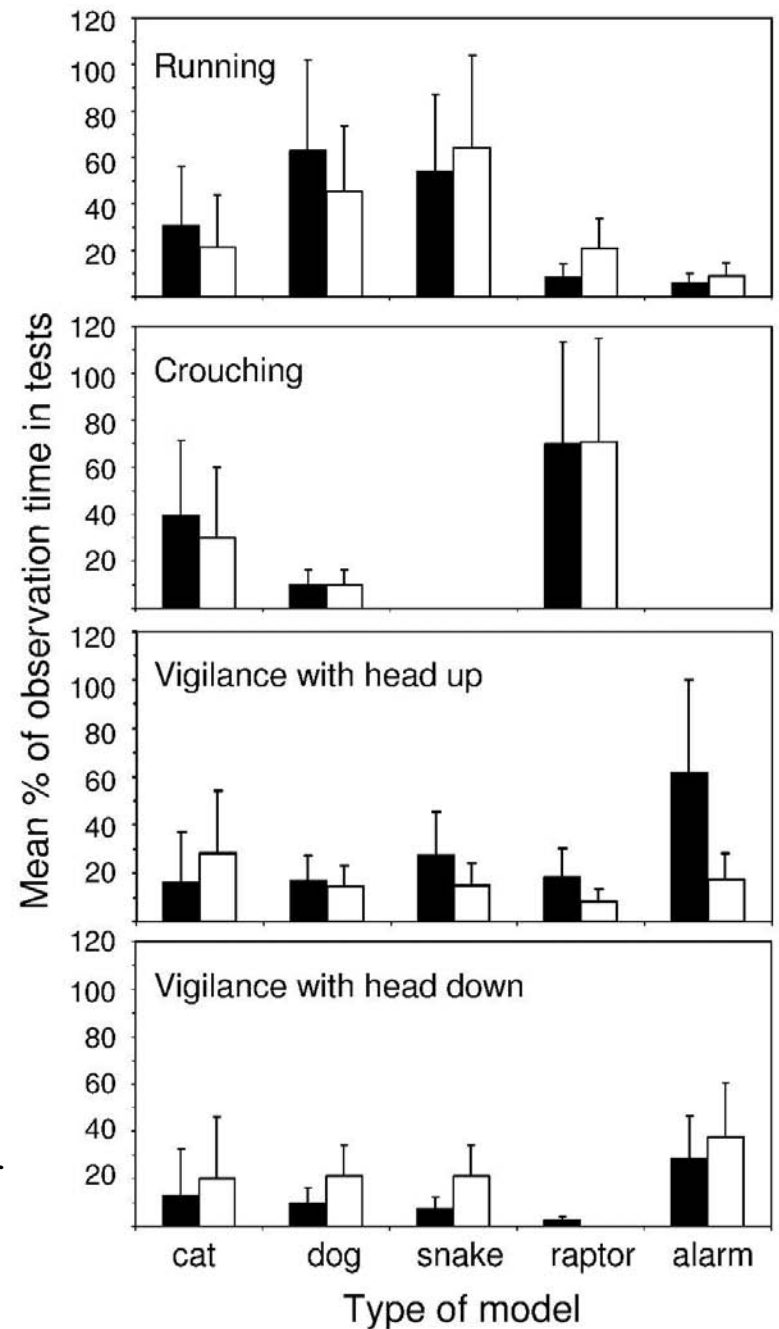
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More about turkey's antipredator responses: evidence for innate components

INNATE PREDATOR-RECOGNITION IN AUSTRALIAN BRUSH-TURKEY (ALECTURA LATHAMI, MEGAPODIIDAE) HATCHLINGS A. GÖTH (2001) *Behaviour* 138, 117-136

“Hatchlings...should respond to predators innately because they hatch independently of nest-mates, have no contact with parents, and initially live solitarily. Their response to predators was tested in a large outdoor aviary set in natural rainforest habitat.”

Black bars: live cat, dog, or models of snake or hawk, or recorded alarm calls of small birds
White bars: control stimuli (cardboard boxes, cylinder, or white noise)



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Do humans show maladaptive responses to key stimuli?

Innate preferences for high fat and sweet foods.

(This was discussed earlier; see also Q6.)

" Like all animals, humans have instincts, genetically hard-wired behaviors that enhance our ability to cope with vital environmental contingencies. Our innate fear of snakes is an example. Other instincts, including denial, revenge, tribal loyalty, greed and our urge to procreate, now threaten our very existence."

--from Eric R. Pianka, "Can Human Instincts Be Controlled?" (found online, 9/26/2012)

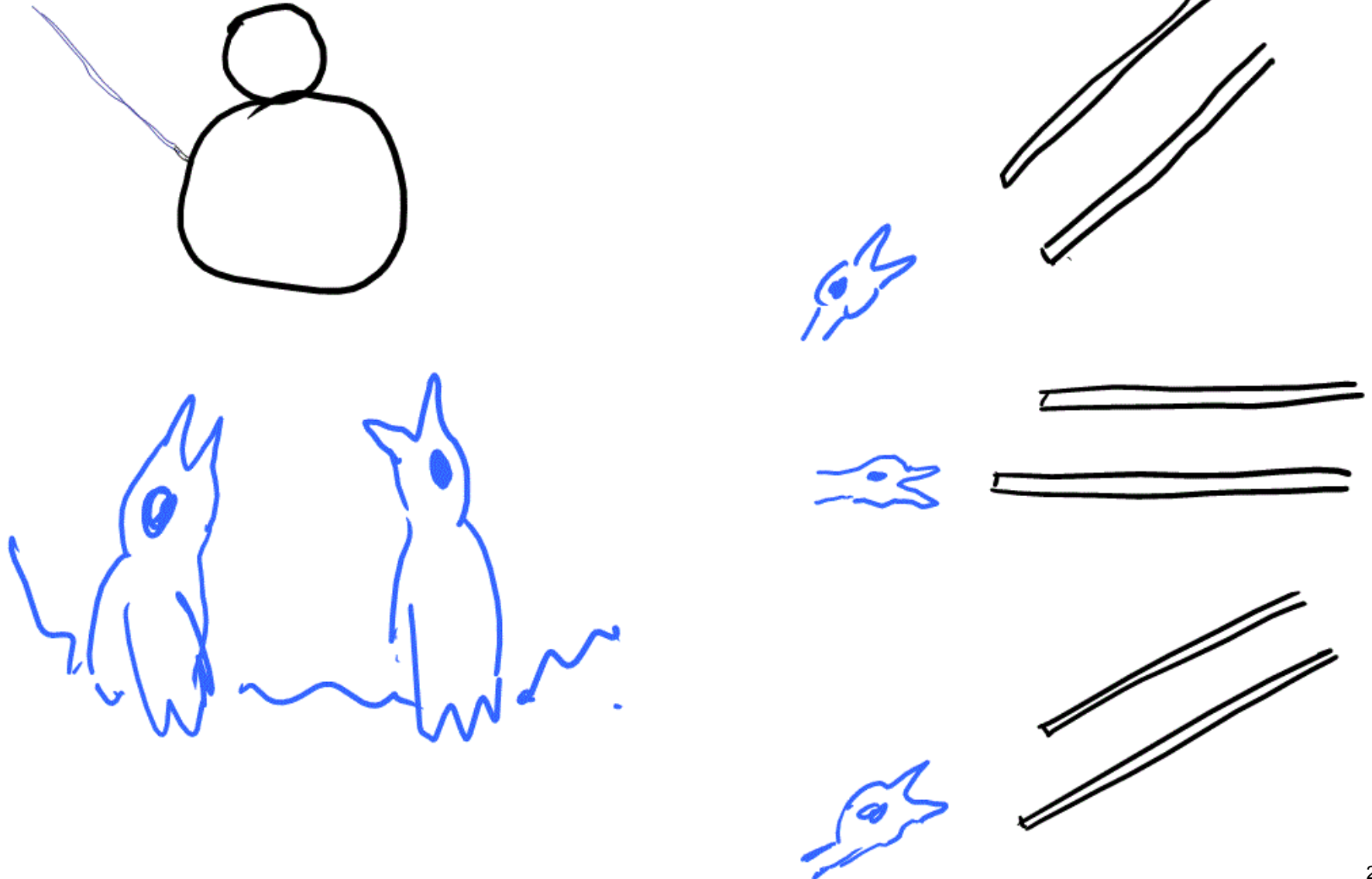
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4. What does Lorenz mean by transposibility of key stimuli? (p 161, 163)

Transposability of key stimuli:

- The relationships among stimuli* are more important than absolute values—like the notes of a melody. (*Examples, p 161*)
 - Experiments using dummy stimuli (see next slide):
 - Gaping in nesting thrushes: Head of parent bird has to be 1/3 size of body.
 - Gaping in nesting blackbirds can be elicited by a pair of sticks: higher element > nearer
- * *Stimuli that are components of one key stimulus configuration.*

Dummy stimuli experiments with blackbird chicks and nesting thrushes



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5. Explain the exploitation of the properties of IRMs by the European cuckoo (p 164). Compare this to the related behavior of whydah birds (p 169).

“Social parasites”



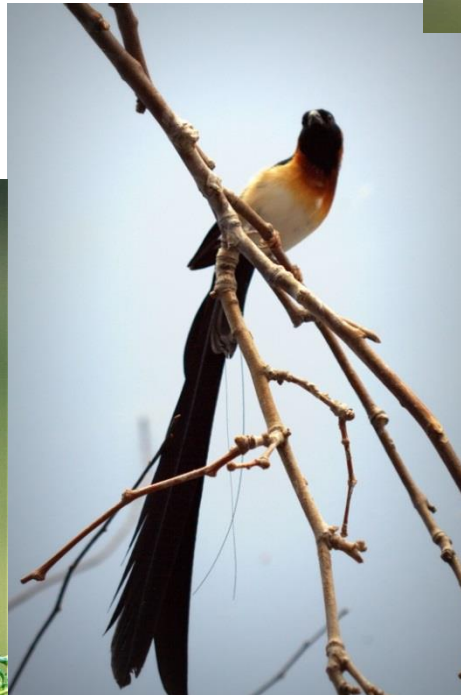
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Shaft-tailed Whydah



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Long-tailed Whydah

European Cuckoo; her egg in a songbird's nest

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5. Explain the exploitation of the properties of IRMs by the European cuckoo (p 164). Compare this to the related behavior of whydah birds (p 169).

“Social parasites”

Concerning the cuckoo, Lorenz writes: “Apparently the huge gape of the young cuckoo represents a supernormally strong key stimulus to the feeding behavior of many kinds of passerine birds. Heinroth remarks, ‘The feeding of a young cuckoo is, in a manner of speaking, a vice of these birds.’—a statement of remarkably deep insight.”

More recent research studies: Why have the birds not evolved better defenses?

- Evidence for the “Mafia hypothesis.”

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