

In this brief review, we're going to contrast learned behavior with innate, or instinctive, behavior.

CH. 5: THE CONTROL OF BEHAVIOR -- NEURAL MECHANISMS

FIXED ACTION PATTERNS AND SIGN STIMULI

- A. A major key to understanding the proximate mechanisms of behavior (particularly physiological mechanisms) was discovering the cues or stimuli that triggered behaviors in animals in natural environments.
1. Nikko Tinbergen and Konrad Lorenz were pioneers in this field -- some examples of their studies:
 - a. Herring gull chicks peck at the red spot on the parents' beaks; parents regurgitate fish
 - i. Tinbergen experimented with different "models" of gull heads and beaks to see which specific features triggered the pecking behavior by the chicks
 - ii. discovered that chicks cue in on relatively few features of the parents' heads/beaks
 - 1) chicks preferred long, pointed, mobile objects with high-contrast red dots
 - 2) realistic models (e.g., stuffed gull head) no more effective at eliciting pecking than strip of cardboard
 - b. Incubating greylag geese will retrieve egg removed from nest by reaching out beak, tucking egg under lower bill, and rolling egg back to nest
 - i. birds retrieved artificial "giant" eggs, even though those eggs clearly weren't goose eggs
 - ii. if egg removed while being retrieved, bird would continue the movement of rolling egg to nest anyway

2. From these and similar studies, concluded the following:
 - a. many behaviors do not require learning -- these are called instincts, innate behaviors, or **fixed action patterns** and distinguished from learned behaviors because
 - i. they appear fully functional the first time they are performed
 - ii. once initiated, they “run” to completion
 - iii. they are not modified by experience
 - iv. they are highly stereotyped (show little variation among individuals)
 - v. note that, in “real life”, these distinctions become blurred
 - b. innate behaviors are triggered by relatively simple subset of the total “stimulus environment”
 - i. key stimulus “activating” the fixed action pattern = **sign stimulus** or **releaser**
 - ii. evolutionarily, the sign stimulus consists of a few simple cues reliably associated with conditions/situations in which the FAP will be adaptive -- e.g., high-contrast, moving red spots are, for herring gull chicks, reliably associated with their parents’ beaks
 - iii. in effect, sign stimuli are the result of another evolutionary “stimulus filtering” mechanism -- only this one less flexible than associative learning
 - iv. think about why this would be advantageous
 - c. when the sign stimulus is perceived, some mechanism in the brain triggers the FAP to run to completion, even if stimulus removed; this internal mechanism = **innate releasing mechanism**
 - i. note that innate releasing mechanisms can range from simple -- e.g., interneurons in spinal reflex arcs -- to complex
 - ii. term really represents, for many behaviors, a “black box”
 - d. exaggerated sign stimuli can sometimes lead to exaggerated responses -- these kinds of stimuli are called **supernormal releasers**

3. Other examples of fixed action patterns include:
 - a. human spinal reflex arc:
 - i. sign stimulus = pain
 - ii. FAP = pulling arm away
 - iii. IRM = interneuron in spinal cord connecting sensory to motor neurons
 - b. suckling response, grasping response in human babies
 - c. blackbird mating response
4. The existence of FAP's can be/has been exploited evolutionarily by "code breakers" -- organisms that mimic sign stimuli to produce FAP's to their own advantage
 - a. e.g., nest parasites like brown-headed cowbirds
 - i. sign stimulus for feeding = gape, often with yellow mouth, and calls
 - ii. because cowbirds are generally larger than hosts, chick's gape and call constitutes a supernormal releaser of feeding behavior by host parents
 - b. e.g., rove beetle lays eggs in ant nests
 - i. larvae mimic pheromone that releases FAP in ants causing them to move larvae into brood chamber, where they eat ant eggs and larvae
 - ii. mimic food-begging behavior: tap worker ant's mandibles, releasing food regurgitation behavior by ants
 - c. e.g., mimics of cleaner wrasse (also demonstrates complexity of interactions!)
 - i. cleaner wrasse are fish that clean ectoparasites off other fish
 - ii. set up "cleaning stations" on coral reefs; other fish learn where these are
 - iii. when fish approaches, wrasse performs stereotyped swimming display = sign stimulus
 - iv. in response, fish adopts head-down or head-up posture with mouths and gills open = FAP
 - v. that FAP, in turn, releases cleaning behavior by the wrasse

- vi. mimics mimic the swimming display; when fish open mouths and gills,
mimics bite of chunks of gill
- B. Note that the distinction between learned and innate behaviors isn't always clear-cut; even when it is,
1. The behavioral repertoire of most animals includes both innate and learned behaviors
 2. both require complex neural networks that still develop via complex interactions of genes and environment (see figure 2, p. 131)