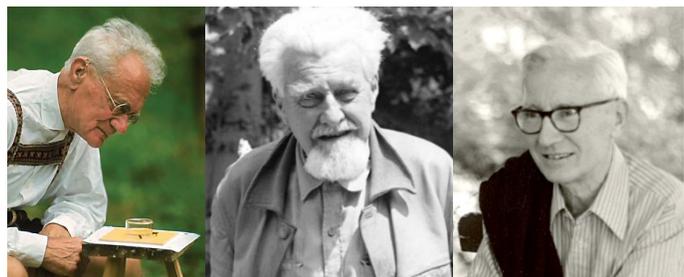


An Introduction to Animal Behavior

The study of animal behavior draws on concepts from **ethology, behaviorism, and comparative psychology**. Overall, behavioral biology focuses on the biological and evolutionary bases of behavior. Ethology and behaviorism are considered sub-topics of biology; each consists of the scientific and objective study of animal behaviors. Ethology focuses on behaviors under natural conditions, viewing behavior as an evolutionary adaptive trait. Comparatively, behaviorism measures responses to stimuli or trained behavioral responses in a laboratory setting without placing a particular emphasis on evolutionary adaptivity. Comparative psychology is a sub-topic of psychology, rather than biology. Research on animal behavior is conducted in the context of what is known about human psychology. The focus concentrates on the study of learning and research done in artificial situations. Overall, these three topics combine help us to understand the complexities of animal behavior.

History of Animal Behavior Theory

- Ivan Pavlov (1849-1936): Known as the father of classical conditioning. Trained as a physiologist, Pavlov's original research showed the nervous system and spinal cord (not the brain) play a dominant role in regulating the digestive system. During his studies, Pavlov noticed dogs would begin to salivate before food was actually delivered to their mouths. He investigated this phenomenon and is now known primarily for his concept of the conditioned reflex.
- Edward (E.L.) Thorndike (1874-1949): Pioneer in behaviorism, known for his studies on animal learning. Using cats as a model organism, he was the first researcher to systematically investigate how an animal's non-reflexive behaviors can be modified as a result of experience. Thorndike built puzzle boxes in which he would place a cat that wanted to escape. Initially the cats would not know how to escape the box, but upon accidentally pressing a switch on the floor, the door would open and the cat would be allowed to escape. Eventually, the cats would recognize they needed to pull a lever or push a switch and they would be able to escape, spending shorter and shorter amounts of time in the box. Through timing how long it took the cat to escape the box each time, he developed the concept of a **learning curve**.
- J.B. Watson (1878-1949): Coined the term behaviorism. Watson believed psychology should become a science and only events that were observable and repeatable should be considered.
- Karl von Frisch (1886-1982): An Austrian ethologist who studied aspects of animal behavior and navigation, primarily in honey bees. He described the "waggle dance" bees use to relay information about distant food sources to colony members.
- Konrad Lorenz (1903-1989): An Austrian zoologist, ethologist, and ornithologist. Lorenz demonstrated geese would **imprint** on the first moving object they see after hatching and that this process is an instinctive bond.



Karl von Frisch (left), Konrad Lorenz (middle), and Nikolaas Tinbergen (right) shared the 1973 Nobel Prize in Physiology or Medicine for their discoveries concerning organization and elicitation of individual or social behavior patterns.

- B.F. Skinner (1904-1990): Considered the father of operant conditioning. Using the “Skinner Box,” he explored and defined how reinforcement influences behavior.
- Nikolaas Tinbergen (1907-1988): Regarded as one of the founders of modern ethology, along with Konrad Lorenz. His studies focused primarily on instinctive behaviors and developed four questions he believed should be asked of any animal behavior.

Tinbergen’s Four Questions

1. Causation (mechanism): What causes the behavior? What triggers the behavior, and what body parts, functions, and molecules are involved in carrying it out? This question examines how parts of the brain, hormones, and/or pheromones interact to produce a behavior.
2. Development (ontogeny): How does the behavior change with age, and what early experiences are necessary for the behavior to be shown?
3. Function (adaptation): How does the behavior impact the organism’s ability to reproduce?
4. Evolution (phylogeny): How did the behavior evolve? How does the behavior compare to those of related species? Why might it have evolved as it did?

Involuntary Behavior

Involuntary behaviors are an immediate, unlearned, mechanical response to a stimulus. These behaviors rely on the use of the autonomic nervous system, which controls bodily functions that are not consciously direct (e.g. heartbeat or breathing). **Reflexes** are an involuntary behavior, they are not learned and depend on the inherited characteristics of the organism’s nervous system. For example, the startle response, is a reflex that serves to protect vulnerable parts of an organism, such as the back of the neck (whole-body startle) or the eyes (eye blink) and prepares the organism to escape from a sudden stimulus.

Stimulus: an external or internal cue/event that has an effect on behavior

Response: elicited by a stimulus; identifiable unit of behavior

Innate (instinctive) behaviors are a class of involuntary behaviors that are inborn and rely on the particular animal’s predispositions and hereditary traits. These behavioral patterns are performed without thought and cannot be modified through learning. Innate behaviors are simple behavioral patterns displayed in response to a specific stimulus or within a specific context. For example, cockroaches will flee to a dark nook for protection when a light is switched on in a room. Additionally, many communication signals are innate; they are produced the same way by all members of a species. The constancy in the signal means the interpretation of the message unambiguous.

Fixed action patterns are a predictable series of actions that are triggered by a cue. Once triggered, the behavior must go on to completion, even if the key stimulus is removed in the meantime. In graylag geese, if an egg rolls away from the nest, it will trigger a fixed action pattern of retrieval in the female. Even if the egg is removed, the female will continue the behavior as if rolling an imaginary egg back to the nest. In fact, any egg-shaped object placed near the nest will trigger the egg retrieval behavior, even if it is a larger object, such as a volleyball.



Greylag goose

Image credit: By Diliff - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=1385555>

Voluntary Behavior

Voluntary behaviors are those which are consciously controlled by the animal's brain. They are internally motivated decisions made by an animal in order to respond and adapt to their environment. This behavioral plasticity is an adaptive mechanism that is critically important for an animal's survival.

Habituation is a simple form of learning in which an animal stops responding to a stimulus after repeated exposure. The stimulus is not linked with any punishment or reward and is a form of **non-associative learning**.

Conditioned behaviors

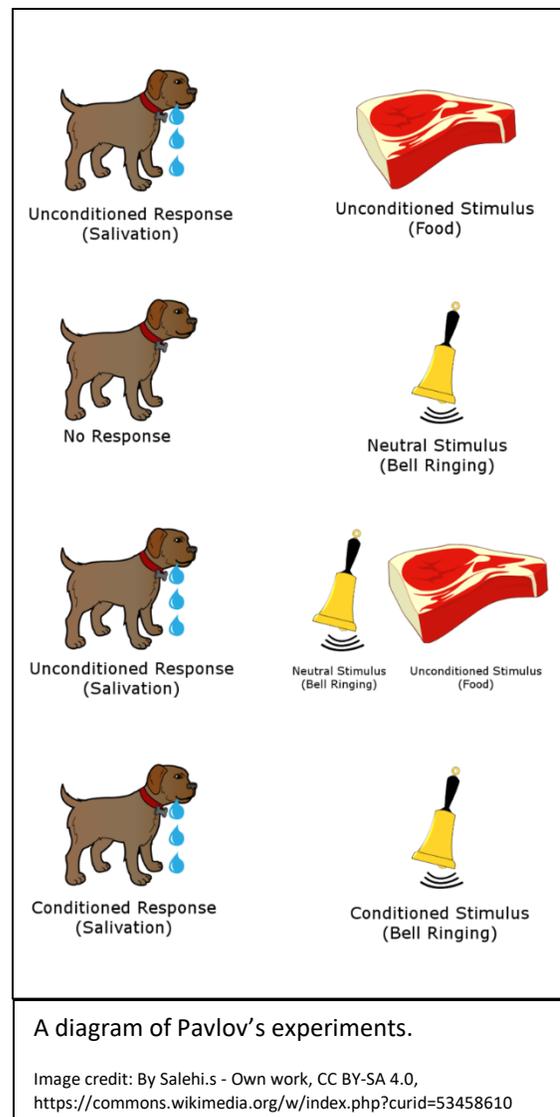
Conditioned behaviors are a form of **associative learning**, in which a new response becomes associated with a particular stimulus. These behaviors take form in two ways: through **classical conditioning** or **operant conditioning**.

Classical Conditioning

As mentioned previously, Ivan Pavlov is famous for describing the process of classical conditioning. It is a form of conditioning in which a response already associated with one stimulus becomes associated with a second stimulus to which it had no previous connection. Pavlov summed this up in a simple equation:

$$\text{Unconditioned Stimulus} + \text{Unconditioned Response} + \text{Repetition} \rightarrow \text{Conditioned Stimulus} + \text{Conditioned Response}$$

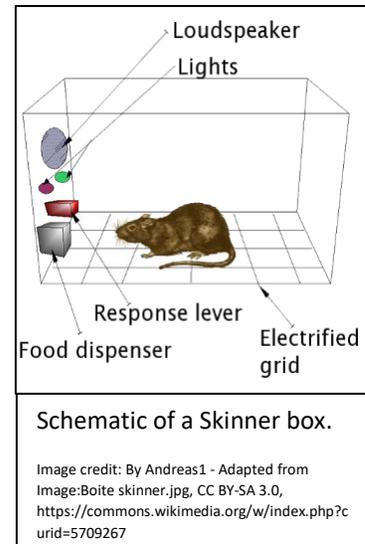
In Pavlov's experiment, he conditioned dogs to drool upon hearing the sound of a bell. This response was previously associated with food. Initially, the sight or smell of food (unconditioned stimulus) would result in the dog drooling (unconditioned response). During the course of the experiments, each time a dog was presented with food, a bell would be rung. The ringing of the bell was the conditioning stimulus. Over time, the dogs learned to associate the ringing of the bell with food and would begin to drool. Eventually, the dogs would respond to the bell by drooling, even when the unconditioned stimulus (food) was not present. Thus, the conditioned stimulus (bell) became associated with the conditioned response (drooling). Interestingly, upon examination of the collected saliva, Pavlov discovered the composition of the saliva in the conditioned dogs was different from that of the unconditioned dogs. This suggests the conditioned response is not exactly the same as the unconditioned response.



Operant Conditioning

Operant refers to operating or acting upon. For example, when an animal manipulates its environment to gain access to food, it is an operant response to hunger. Operant conditioning occurs when a behavior is reinforced with punishment or reward stimuli following a response. Initially, an organism may perform the desired behavior purely by chance, but through reinforcement, the organism is induced to perform the behavior more or less frequently. Reinforcement is obtained through the organism operating on its environment in some fashion.

B.F. Skinner demonstrated operant conditioning in his experiments using an operant conditioning chamber (commonly referred to as a “Skinner box”). These chambers allow researchers to study conditioning by teaching a subject animal (commonly rats, pigeons, or non-human primates) to perform certain actions (such as pulling a lever) in response to a specific stimulus (e.g. light or sound). Additionally, the chambers are sound-and-light-proof to avoid any distracting stimuli. In the case of rats as the study organism, the rat was put in a chamber containing a lever that would dispense food when pushed. Initially, the rat would accidentally push the lever a few times. Over time, the rat would associate pulling the lever with receiving food (reinforcement). In some cases, the bottom of the chamber was fitted with an electrical grid, which would shock the rats upon performing a behavior (punishment). This would then drive the rats to avoid performing that behavior.



Animal Communication

Communication occurs when one animal (the sender) transmits information to another animal (the receiver), causing some kind of change in the behavior of the animal receiving the information. Generally, communication occurs between animals of a single species, but can happen between two animals of different species. Animals communicate via visual, auditory, chemical (pheromones), or tactile signals. These signals help animals find mates, establish dominance, defend territory, coordinate group behavior, and care for young.

- Pheromones are secreted chemical signals used to trigger a response in another individual of the same species.
 - Example: Ants lay down pheromone trails to lead other colony members to food.
- Auditory communication can be used to attract mates, defend territories, coordinate group behaviors, and/or convey warnings.
 - Example: Gibbons use calls to mark their territory.
- Visual communication involves signals that can be seen, such as gestures, facial expressions, coloration, and body posture.
 - Example: To display submission to an alpha, a dog rolls on its back.
- Tactile signals are more limited in range, as two organisms must be right next to each other to touch.
 - Example: Primates groom each other not only to remove parasites, but also reinforce cooperation and social bonds.

An Overview of Animal Training

The ABCs of Animal Training

- **A:** Antecedent-the initial stimuli that triggers the performance of a behavior
- **B:** Behavior- the animal's response to the antecedent. In a trust based system, the response is the animal's choice
- **C:** Consequence- the outcome of the animal's behavior to the antecedent

The Four Consequences

- **Positive Reinforcement:** Immediately after the performance of a correct behavior, something the animal desires is added to its environment
- **Positive Punishment:** Immediately after the incorrect performance of a behavior, something noxious or aversive to the animal is added to its environment
- **Negative Reinforcement:** Immediately after the performance of a correct behavior, something that is noxious or aversive to the animal is removed from its environment
- **Negative Punishment:** Immediately after the incorrect performance of a behavior, something the animal desires is removed from its environment

Positive: adding something to an animal's environment

Negative: subtracting something from the animal's environment

Reinforcement: increases the future form and frequency of the behavior it follows

Punishment: decreases the form and frequency of the behavior that immediately precedes the punishment

Form: what the behavior physically looks like

Frequency: how often the animal performs the behavior

Target Training

A **target** is any object that serves as a focal point for an animal, such as a pole or trainer's hand. Targets serve to minimize the impact of distractions by giving the animal something to focus on. When training new behaviors, targets also serve as a familiar reference point. Over time, as the animal is trained to move toward the target, it can be used to direct an animal's movement, including directing the animal from one place to another. In novel or potentially frightening or confusing situations, past reinforcement history associated with the target serves to reassure the animal.



Zookeeper Beth works with Sparky on targeting. Having Sparky target onto the peninsula gives Beth an opportunity to examine his flippers, face, and belly.

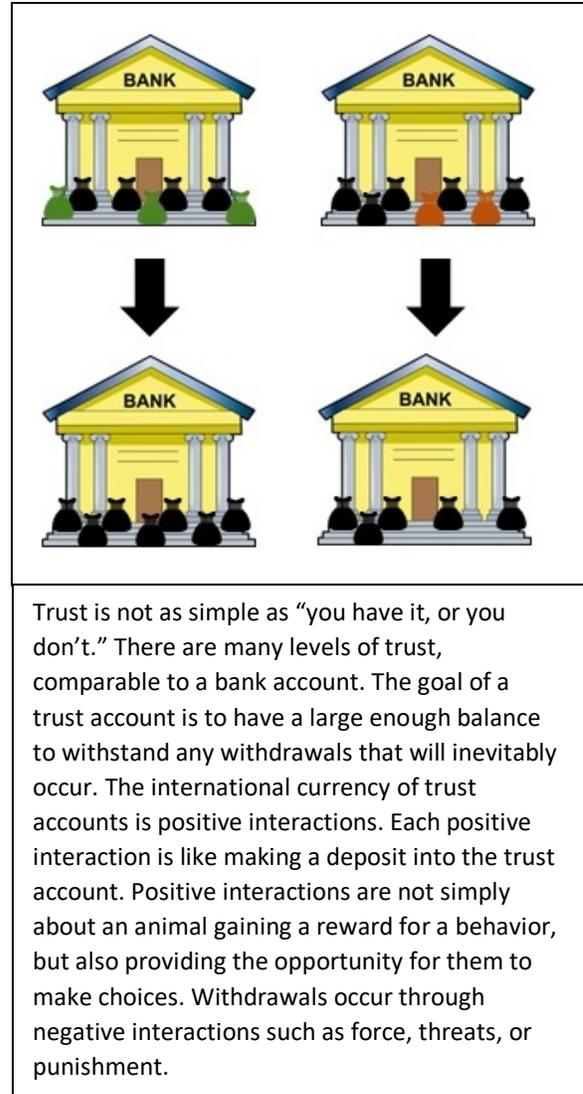
Trust

As with any human relationship, it is just as important to have trust between trainer and the animal they work with. Trust is a level of certainty the animal has that performing a certain behavior will result in a good consequence. Trusting animals use their behavior to confidently approach opportunities to interact with people, rather than attempt to escape the situation. Additionally, trusting animals create opportunities to interact with their trainers. Positive reinforcement strategies are the key to building trust. To maximize the use of positive reinforcers, they must be consistent, immediate, and strong. One major way to build trust with an animal is to give them control. Giving an animal control means providing them with choices, opportunities to make decisions, take actions, and experience the consequences of those actions.

Labels

Behavior is something an individual *does*, not what an individual *is*. A label describes what the individual is, rather than what the behavior looks like. Labeling ascribes motivation behind a behavior that may be inaccurate. For example, if a dog begins growling at a stranger, it may be labeled as mean and/or aggressive. However, that dog may in fact be afraid or feel threatened by that stranger. Labeling limits the search for the motivation behind the behavior,

leading to the feeling the behavior is inside the animal and unchangeable. Figuring out what happened right before the behavior began provides good information about what may in fact be motivating the behavior. By viewing an animal's behavior as a response to their environment, it is possible to see the behavior can change. To practice not using labels, try describing the behavior functionally. Ask "what" rather than "why?" For example, ask, "What does the behavior look like? What does it sound like?" To delve into the motivation behind the behavior, ask, "When did the behavior begin? What was going on around the animal at that time?" Dropping labels and looking at behaviors in terms of functional descriptions provides the trainer with better insight into working with the animal. Functional descriptions also reduce any ambiguity associated with the behavior. What one trainer considers friendly, another may consider needy. Knowing the "what" behind a behavior allows a team to be consistent in training and set the animal up for success.



Tells

Tells are often very subtle behavioral indicators that let us know when an animal is feeling uncomfortable. Understanding and recognizing an animal's tells is crucial to maintaining a high level of trust with that animal. Catching early warning signs prevents the animal from having to react dramatically to get our attention and itself out of a situation. Examples of tells for dogs, pythons, humans, and millipedes are listed below.

Dog	Python	Human	Millipede
<ul style="list-style-type: none">• Tail down• Licking lips• Yawning• Whale eyes• Avoiding eye contact	<ul style="list-style-type: none">• Tensed muscles• Open mouth• Curled up• Moving away• S-shape	<ul style="list-style-type: none">• Looking away• Frowning• Fidgeting• Crossed arms• Biting nails• Laughing	<ul style="list-style-type: none">• Curled in a ball• Exuding liquid• Gripping with legs• Shying away