



## How Livestock Learn About Foods and Locations

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Anyone who has ever trained animals has wondered what animals learn from different experiences. For instance, a person walks into a pen of animals that have just been fed, catches a lamb or calf, and puts a balling gun containing a capsule with a toxin down its throat. Soon the animal will experience gastrointestinal illness, but will the animal associate the illness with the person who just caught it or with the food it just ate?

Pre-eminent psychologist John Garcia pointed out that, "All organisms have evolved coping mechanisms for obtaining nutrients and protective mechanisms to keep from becoming nutrients." Animals learn about the consequences of eating foods or being at a particular location through two different defense systems. For many birds and most mammals, sight and hearing are associated with feelings of pain or comfort and are associated with the *skin-defense system*. The taste of food and feelings of nausea and satiety are part of the *gut-defense system*. Odors may be associated with either the skin- or gut-defense systems. The smell of predators can warn the skin-defense system, while the smell of a food serves as a cue for the gut-defense system.

### Skin and Gut

The way skin- and gut-defense systems work is illustrated in trials with hawks that were fed colored or flavored mice. When hawks normally fed white mice were given a black mouse, followed by an injection of a toxin that caused gastrointestinal illness, the hawks would not eat either black or white mice. They did not discriminate between mice as food based on color alone because black and white mice taste the same. When a flavor was added to black mice, so that black and white mice tasted differently, hawks learned to avoid black mice on sight after a single injection of a toxin that caused gastrointestinal illness. Hawks learned to discriminate among food sources based on taste-

feedback (in this case illness) pairings first and then used color as a cue to discriminate black from white mice (Brett et al., 1976).

Thus, not all cues are readily associated with all consequences. Animals that get sick after drinking flavored water in a specific location show a strong aversion to the flavor, but not the location where they drank. In contrast, if they received foot-shock while drinking, they show a stronger aversion to the location where they drank than to the flavor of the liquid (Garcia and Koelling, 1966).

Thus, toxins decrease palatability of foods, but they do not cause animals to avoid the place where they ate the food. Food aversions depend on the food and are generally independent of the location where the food was eaten. Conversely, an attack by a predator may cause animals to avoid the place where they were eating, but it does not necessarily decrease the palatability of the food they were eating when the attack occurred. Place aversions are specific to the site or to some physical attribute in the environment. For example, animals trained to avoid an electric fence will avoid the fence even if it is placed in a new location.

### It's Automatic

The formation of a food aversion is automatic. Animals don't have to think about what made them sick to have an aversion to a food. Animals form aversions to foods even if they are under anesthesia when the illness occurs (Provenza et al., 1994). Likewise, people acquire aversions to foods after nausea even when they are certain their illness was caused by the flu or motion sickness and not the food. Once the brain has paired the taste of the food with nausea or vomiting, trying to convince yourself that the food really tastes good will not improve its flavor. Changes in palatability caused by

post-ingestive feedback are similar to digestion. Animals don't need to think about which enzymes to release to digest food. Nor do they need to think about changes in palatability due to positive or negative feedback. Changes in palatability occur because feedback from nutrients (positive) and toxins (negative) are automatically paired with a food's flavor because nerves for taste and nerves from the gut join at the base of the brain (LeDoux, 1994).

## Timing

Skin- and gut-defense systems operate in different time frames. For animals to learn from the skin-defense system, the event and the consequence must be paired closely in time. For example, animals learn that an electric fence produces a painful electric shock and should be avoided because touching the fence causes an immediate shock. Animals would never learn to avoid an electric fence if they touched the fence and were shocked five minutes later (LeDoux, 1994).

In the case of the gut-defense system, food ingestion and feedback from the gut can be separated by long time intervals. Digestion and absorption take place over long periods of time. For example, sheep avoid foods that cause gastrointestinal illness up to eight hours after eating a food. The ability of the body to pair food ingestion with illness that occurs several hours after eating helps the body learn about foods because food related illnesses (nausea, allergies or bloat) may happen long after the food was eaten (Garcia et al., 1985).

## Conclusions

So what does an animal that has just eaten learn when a person walks into its pen, catches it, and gives it a

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capsule containing a toxin with a balling gun? The animal will associate the person with its skin-defense system and will avoid the person in the future, but it will associate the food with nausea and avoid the food in the future. The automatic pairing of foods with feedback means that even if a person could explain to the animal that the toxin, not the food, caused the illness, the animal would still avoid the food. It is the same when we know that the flu or motion sickness, not the food, caused nausea; we still avoid the food even though we know it was not the source of nausea. The gut-defense system is designed to pair eating a food with gastrointestinal illness regardless of what the animal "thinks" caused the illness.

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