

Invited Article

## Conditioning Methods For Farm Animals: A Mini Review

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**Abstract:** This review briefly surveys the range of conditioning methods used in the study of learning for economically important farm animals. We begin by discussing the importance of conditioning methods, provide an overview of non-associative and associative learning and follow by showing how these methods are applied to chickens, cows, horses, goats and sheep. Information on general resources is also provided.

**Key Words:** Conditioning methods, Farm animals.

### Çiftlik Hayvanlarında Şartlandırma Yöntemleri

**Özet:** Bu makalede ekonomik öneme sahip çiftlik hayvanlarının eğitilmesinde kullanılan şartlandırma metodları ele alınmıştır. Öncelikle şartlandırma yöntemlerinin önemi değerlendirilmiş, birarada-toplu yaşam ile ilişkili olan ve olmayan öğrenme konusunda bilgiler verilmiş ve ardından bu metodların tavuklarda, ineklerde, atlarda, keçilerde ve koyunlarda kullanımlarına ilişkin genel bir bakış açısı sunulmuştur. Makalede aynı zamanda genel araştırmalar hakkında da bilgilere yer verilmiştir.

**Anahtar Kelimeler:** Şartlandırma teknikleri, Çiftlik hayvanları.

### Introduction

The use of conditioning methods to modify and explore the behavior of farm and other economically important animals seen by veterinarians is important for a number of reasons. First, conditioning methods can be used to ease the transition of animals to unfamiliar circumstances including new environments, unfamiliar conspecifics and/or human workers<sup>40</sup>. Second, conditioning methods can be used to solve practical problems faced by farmers and veterinarians including collection of fluid samples, hoof and nail trims, injections, physical examinations, minor surgical procedures, application of topical medication, reproductive procedures such as artificial insemination, and collecting temperature and weight data. Third, the use of

conditioning methods can assist in the development of environmental enrichment devices<sup>37</sup>. Fourth, the use of conditioning methods is important from a comparative psychological perspective in which the similarities and differences in the behavior of animals is catalog and assessed<sup>16</sup>.

Conditioning methods are designed to study theoretical and practical questions related to learning. Learning is generally defined as a relatively permanent change in behavior potential as the result of experience<sup>42</sup>. To better understand the process of learning, and uncover the underlying mechanisms, comparative psychologists have divided the mechanisms of learning into non-associative and associative categories.

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Non-associative learning is considered the most basic of the learning processes, and only involves a change in the response to an event, such as when the repeated presentation of a stimulus leads to an alteration of frequency or speed of a response. The animal does not learn a new behavior; rather the innate response to a particular situation or stimulus is modified. The two types of non-associative learning that have received the most attention are habituation and sensitization.

Associative learning involves the association of two or more events. Examples include classical and operant conditioning. In associative learning, the animal may learn a new response. Associative learning differs from non-associative learning by the number and kind of events that are learned and how the events are learned. Non-associative learning is considered a more fundamental mechanism for behavior modification associative learning.

### **Non-associative Learning** **Habituation**

Habituation refers to the reduction in some target response to a stimulus as it is repeated. Studies of habituation show that it has several characteristics, including the following<sup>38</sup>:

1. The more rapid the rate of stimulation is, the faster the habituation is.
2. The weaker the stimulus is, the faster the habituation is.
3. Habituation to one stimulus will produce habituation to similar stimuli (generalization).
4. Withholding the stimulus for a long period of time will lead to the recovery of the response (spontaneous recovery).
5. Habituation is a negative exponential function of the number of stimulus presentations.
6. The rate of habituation increases as the number of training sessions increases.
7. Presentation of a strong novel stimulus results in the return of the habituated response (dishabituation).
8. Continued application of a dishabituation stimulus results in habituation of dishabituation.

### **Sensitization**

Sensitization refers to the augmentation of a response to a stimulus. In essence, it is the opposite of habituation and refers to an increase in the frequency or probability of a response. Studies of sensitization show that it has several characteristics including the following:

1. The stronger the stimulus is, the greater the probability that sensitization will be produced.
2. Sensitization to one stimulus will produce sensitization to similar stimuli.
3. Repeated presentations of the sensitizing stimulus tend to diminish its effect.

The study of habituation and sensitization is interesting for a number of reasons. First, habituation and sensitization experiments are easy to perform. Second, habituation and sensitization share many properties with more complex learning phenomena, such as the ability of the response to recover over time, improvement in performance over successive sessions; and sensitivity to such training parameters as intensity, frequency, and pattern of stimulation. Third, there are several well defined characteristics that can be compared across species.

The significance of habituation and sensitization is often underestimated. Though not as glamorous as the behavior change associated with classical or operant conditioning, the behavioral manifestations are just as adaptive. In addition, it must be kept in mind that for many animals, this represents the only type of behavior modification, or the only practical type of behavior modification. Habituation and sensitization increase the chances of survival and reproduction by minimizing wasted energy and by reducing the occurrence of maladaptive behavior. Details on how to design a non-associative learning experiment are available in Abramson<sup>1</sup>.

### **Associative Learning** **Classical Conditioning**

Classical conditioning refers to the modification of behavior in which an originally neutral stimulus – known as a conditioned stimulus (CS) – is paired with a second stimulus that elicits a particular response – known as the unconditioned stimulus (US) – ultimately leading the response also being elicited by the CS. The response that the US elicits is known as the unconditioned response (UR) and the response

to the CS is known as the conditioned response (CR).

Classical conditioning is an example of associative learning in which the behavior of the animal is altered by the pairing of stimuli, one of which is effective in eliciting a biologically important reflex. In a broader sense, classical conditioning is a family of methods for the acquisition of associations between two or more stimuli or between stimuli and responses. Classical conditioning is generally thought to represent the most basic of the associative learning mechanisms<sup>33</sup>.

Studies of classical conditioning show that it has several characteristics, including the following<sup>3</sup>:

1. In general, the more intense the CS is, the greater the effectiveness of the training.

2. In general, the more intense the US is, the greater the effectiveness of the training.

3. In general, the shorter the interval is between the CS and the US, the greater the effectiveness of the training.

4. In general, the more pairings there are of the CS and the US, the greater the effectiveness of the training.

5. When the US no longer follows the CS, the conditioned response gradually becomes weaker over time and eventually stops occurring.

6. When a conditioned response has been established to a particular CS, stimuli similar to the CS may elicit the response.

## Operant Conditioning

Operant conditioning refers to the modification of behavior by changing the consequences for that behavior. Behaviors that produce a pleasant consequence are more likely to occur (reinforcement), while behaviors that produce an unpleasant consequence are less likely to occur (punishment).

Operant conditioning procedures can take many forms. Here we will provide several examples of operant condition procedures with a hypothetical maze for cows. One type of operant conditioning, known as reward training, involves a relationship between a response and a desirable outcome, such as a cow finding food at the end of the maze. The cow may become increasingly efficient at finding the end of the maze if it always receives food for doing so.

A special case of reward training is known as escape training. In escape training a response terminates an unwanted event. The reward is time away from the aversive event. For example, our cow may run through the maze to escape a veterinarian. The reward in this situation is finding a location that is veterinarian free. Our hypothetical cow may also learn to associate other stimuli in the environment with the veterinarian and use these stimuli to avoid the unpleasant encounter completely. In this type of learning, called signaled avoidance, a cow may learn to run through the maze to avoid an encounter with a veterinary as soon as the cow perceives some stimulus associated with the veterinarian, such as the sound of a door opening. Both escape and avoidance are forms of negative reinforcement.

In punishment training, an undesirable consequence contingent upon a specific behavior makes that behavior less likely to occur in the future. For example, if the cow runs through the maze only to find the veterinarian at the end, over time it will refuse to enter the maze.

Operant conditioning is an example of associative learning in which the behavior of an animal is controlled by the consequences of its actions. This type of conditioning is generally thought to be more complex than classical conditioning. These two forms of conditioning are distinct in that classical conditioning describes how animals make associations between stimuli while operant conditioning describes how animals associate stimuli with actions and consequences. Despite these differences, operant conditioning share many properties with classical conditioning including extinction, spontaneous recovery, generalization, and discrimination. Studies of operant conditioning show that they have several characteristics, including the following<sup>18</sup>:

1. In general, the greater the amount and quality of the reward are, the faster the acquisition is.

2. In general, the greater the interval of time is between response and reward, the slower the acquisition is.

3. In general, the greater the motivation is, the more vigorous the response is.

4. In general, when reward no longer follows the response, the response gradually becomes weaker over time and eventually stops occurring.

## Environmental Enrichment

These conditioning methods can be used to accomplish specific training goals as well increase the general well being of captive animals. Any practice that aims to enhance the physiological or psychological well being of a captive animal by providing environmental stimulation is known as environmental enrichment<sup>36</sup>. One goal of environmental enrichment is to reduce stereotypic behaviors. Stereotypic behaviors can occur in all captive animals, especially when confined in small areas. One example of this is when horses that are frequently confined develop “stable vices” such as wood chewing, rocking in place and crib-biting<sup>25</sup>. This type of repetitive behaviors may indicate poor behavioral welfare<sup>28</sup>. Environmental enrichment is intended to provide alternative, healthy stimulation for captive animals.

One form of environmental enrichment is to provide some object or stimulation that is naturally rewarding or reinforcing to that species. One example using naturally reinforcing stimulation to combat stereotypes is providing chickens a container of dirt to use for dust baths, leading to a reduction in feather plucking. The dust bath can be considered naturally reinforcing because chickens actively dust bathe without any special training. Habituation to the enrichment is one concern of naturally reinforcing stimulation<sup>37</sup>. The natural response of an animal can gradually decrease each time the enrichment is presented until it is completely ineffective at maintaining healthy behavior. However, by considering the properties of habituation described by Thompson and Spencer<sup>38</sup> one can use naturally reinforcing enrichment to maximum effect.

Other forms of enrichment involve providing an extrinsic reinforcer, such as food, for as a reward for healthy behaviors. An example of this would be providing grain to a horse only when it is standing attentively, and never when it is gnawing the wood in the stable. For this type of enrichment, healthy behaviors may disappear if reinforcement is not provided. This is known as extinction. One way to counter act the effects of extinction is to provide reinforcement intermittently once the behavior is established<sup>37</sup>. It should be noted that for any form of environmental enrichment an understanding of conditioning methods can make low cost treatment, such as a dust bath, much more effective.

## Mini-Review of Selected Species of Interest to Turkish Veterinarians

Here, we briefly summarize some of the conditioning work with several common farm species. Tables are provided to enable the reader to find review and research articles, instructional videos and training devices. The materials in these tables can be incorporated into formal veterinary courses that focus on behavior or as part of a selected readings course.

### Chickens

Table 1 provides a list of articles on the use of conditioning methods to explore the behavior of chickens. A common concern with captive animals is the size of their housing. To investigate preferences that chickens have housing dimensions Lagadic and Faure<sup>20</sup> constructed an apparatus that could automatically increased in size. Twenty-seven groups of four hens were conditioned to peck a disk inside the cage for a slight increase in cage size. The results showed that the hens preferred cages that provided about 632 cm<sup>2</sup> per bird. Interestingly, the hens did not appear to prefer the maximum cage size (about 1075 cm<sup>2</sup> per bird).

Other work has demonstrated the relationship between the species-typical behaviors of chickens and their emotional state<sup>43</sup>. The researchers found that removing reinforcement for a previously reinforced behavior (extinction) in an automated conditioning apparatus resulted in a large increase in the number of “gackel-calls” and pacing for brown warrens hens, while white leghorn hens produced more alarm calls and jumped more. The authors suggest that these behaviors, particularly the vocalizations, may be good indicators of anxiety and need in laying hens.

**Table 1. Conditioning Research in Chickens**

**Tablo 1. Tavuklarda şartlandırma çalışmaları**

Authors	Year	Title
Lane	1961	Operant control of vocalizing in the chicken
Lagadic & Faure	1988	Operant conditioning and use of space by caged laying hens
Zimmerman & Koene	1998	The effect of frustrative nonreward on vocalizations and behavior in the laying hen, <i>Gallus gallus domesticus</i>

Another experiment investigated if young chickens could learn to vocalize to produce specific consequences<sup>21</sup>. While many experi-

ments use pecks as an operant response, this experiment used vocalizations as an operant response for a food reinforcer. The results of this experiment showed that young chickens are able to learn to produce varying number of chirps, and to chirp only in specific conditions to obtain reinforcement. The birds appeared to be able to control their vocalizations to produce reinforcement in the same manner as other animals are able to control their motor responses.

## Cows

Table 2 provides a list of articles on the use of conditioning methods to explore the behavior of cows. One form of learning that has been explored in dairy cattle is aversion learning. Measuring the extent that an animal avoids an aversive situation is a well-established method to compare and rank handling procedures. In one experiment, Pajor and colleagues<sup>32</sup> used “aversion races” to test the extent that a particular stimulus was pleasant or aversive. In each “race” a cow was walked down the raceway.

**Table 2. Conditioning Research in Cows**

**Tablo 2. Sığırlarda şartlandırma çalışmaları**

Authors	Year	Title
Dabrowska, Harmata, Lenkiewicz, Schiffer & Wojtusiak	1981	Colour perceptions in cows
Foster, Temple, Robertson, Nair & Poling	1996	Concurrent-schedule performance in dairy cows: Persistent undermatching
Matthews & Temple	1996	Concurrent schedule assessment of food preferences in cows
Pajor, Rushen & de Passillé	2000	Aversion learning techniques to evaluate dairy cattle handling practices
Rybarczyk, Koba, Rushen, Tanida & de Passillé	2001	Can cows discriminate people by their faces?
Arnold, Ng, Jongman & Hemsworth	2008	Avoidance of tape-recorded milking facility noise by dairy heifers in a Y maze choice task
Lee, Henshall, Wark, Crossman, Reed, Brewer, O'Grady & Fisher	2009	Associative learning by cattle to enable effective and ethical virtual fences

Once the cow reached the end of the raceway it received some form of stimulation. If the cows became faster at walking through the raceway and required less force to move them, the stimulation was said to be pleasant. If the cows became slower at walking through the

raceway and required more force to move them, the stimulation was said to be aversive. The results showed that cattle moved more effectively when provided a food reward than when aversively motivated with tactics such as hitting, shouting and electric prods. The authors suggest that providing a food reward when moving dairy cattle to milking parlors may be more effective than using aversive stimulation to move the cattle.

Other research has shown that dairy cows will avoid noises associated with milking facilities<sup>2</sup>. In this experiment, cows placed in a Y maze avoided the branch of the maze containing recordings of sounds in a typical milking facility. This general methodology can be used to assess the preference of cows in a wide variety of circumstances.

Conditioning procedures have also been used to demonstrate that cows can discriminate between different people. In an experiment conducted by Rybarczyk and colleagues<sup>34</sup>, eight Holstein cows were trained to discriminate between two people, a rewarder and a non-rewarder in a large operant chamber. The rewarder and non-rewarder were consistent through the experiment and only differed in height and facial features. The cows were able to interact with each individual but only received food reinforcement when they activated a lever in front of the rewarder. The results of the experiment showed that the cows were able to use appear to use multiple cues (body, height and face), to select the rewarder, however the cows were not able select the rewarder face.

Another issue present to the care of cattle is containing a herd on a large grazing area. Some has investigated ways that associative learning can be used to enable easily modifiable virtual fences to contain cattle in a manner similar to conventional electrical fencing<sup>24</sup>. This method used a collar-mounted device to associate an auditory stimulus with an aversive but harmless electrical shock. The researchers found that a 2s audio signal followed by a 3s shock was sufficient to prevent cattle from approaching a feeding trough. The cows did not receive the shock if they turned away from the feeding trough after receiving the audio signal. They quickly learned to move away from the feeding trough using the audio cue alone. This general method was also used to establish virtual fences that lacked any visual boundaries. The cattle learned to stay within the boundaries of the fence, even as the boundaries of the fence were

moved. Additionally, cows that received the audio signal ultimately received fewer shocks than cows that did not receive an audio signal, suggesting that the use of signaled shocks is a more ethical technique to contain cows in virtual fences than the use of un-signaled shocks.

Conditioning methods can also be used to assess physiological abilities. In one study<sup>7</sup>, a discrimination procedure was used to assess the color perception of cows. Cows were simultaneously shown a large grey card and a large colored card. The cows only received food reinforcement when they touched the colored card with their muzzle. The results showed that the cows learned to discriminate between the grey and colored cards, indicating cows have color vision.

Food preferences can also be explored using conditioning methods. One way to study food preferences is to use concurrent schedules of reinforcement<sup>14, 29</sup>. In these experiments, cows were presented with a choice of two food reinforces that were associated with differing schedules of reinforcement. By varying the reinforcement schedules the researchers were able to determine the food preference of the cows as well as how sensitive the preference was to changes in response requirement. Generally, cows preferred crushed barely to meatmeal. Interestingly, these preferences were less sensitive to response requirement than preferences found in other species.

## Horses

Table 3 provides a list of articles on the use of conditioning methods to explore the behavior of horses. Some promising work has been conducted concerning discrimination learning in horses.

Dougherty and Lewis<sup>9</sup> suggested that horses make good subjects for experimental research because even small amounts of grain are potent reinforcer for any healthy horse. Using horses, Dougherty and Lewis have been able to demonstrate many basic learning processes such as discrimination<sup>9</sup>, response matching<sup>10</sup>, and stimulus generalization<sup>11</sup>. Other researchers have used horses to demonstrate basic processes such as the effects of reinforcement schedules<sup>31</sup> and the enhancement of discrimination learning due to differential rewards<sup>30</sup>. Generally, these researchers have found that horses behave much the same as traditional laboratory animals. Experiments on discrimination reversals with

horses have also been conducted. In discrimination reversal experiments, the animal is first reinforced only for responding in the presence of one stimulus while no reinforcement is provided for responding to a second stimulus (a discrimination). After the animal has learned to favor the stimulus associated with reinforcement, the contingency is reversed. Now, no reinforcement is provided for responding in the presence of the previously reinforcing stimulus. Instead the reinforcement is provided for responding in the presence of the second stimulus. Over a series of reversals, the experimenter can examine how quickly the animal can learn to reverse the discrimination. In one such study conducted by Martin, Zentall, and Lawrence<sup>27</sup>, the performance of two groups of horses was compared on a simple discrimination reversal task. The study found that horses that were trained to attend a light as a cue for reinforcement had difficulty learning reversals while horses that were trained to attend an object as a cue for reinforcement learned the discrimination and became more efficient at adjusting to reversals. This suggests that the horses that were trained to attend the object were learning to learn.

**Table 3. Conditioning Research in Horses**

**Tablo 3. Atlarda şartlandırma çalışmaları**

Authors	Year	Title
Myers & Mesker	1960	Operant responding in a horse under several schedules of reinforcement
Dougherty & Lewis	1992	Stimulus generalization, discrimination learning, and peak shift in horses
Dougherty & Lewis	1992	Matching by horses on several concurrent variable-interval schedules
Dougherty & Lewis	1993	Generalization of a tactile stimulus in horses
Miyashita, Nakajima & Imada	2000	Differential outcome effect in the horse.
Ferguson & Rosales-Ruiz	2001	Loading the problem loader: The effects of target training and shaping on trailer-loading behavior of horses
Hanggi	2003	Discrimination learning based in relative size concepts in horses ( <i>Equus caballus</i> )
Martin, Zentall & Lawrence	2006	Simple discrimination reversals in the domestic horse ( <i>Equus caballus</i> ): Effect of discriminative stimulus modality on learning to learn.
Gabor & Gerken	2012	Cognitive testing in horses using a computer based apparatus

An automated apparatus to study higher order learning of horses in the form of matching to sample was described by Gabor and

Gerken<sup>15</sup>. In matching to sample procedures an animal is required to select a stimulus from several choices that matches a sample stimulus. This requires more conditioning than a simple discrimination and thus can be thought of as a higher form of learning. Gabor and Gerken<sup>15</sup> found that horses were able to learn of complex task with sample stimuli and transfer the “rules” of the matching to sample task to new stimuli sets.

Research conducted by Hanggi<sup>17</sup> showed horses may also be capable of learning complex concepts. Horses first received discrimination training with several sets of exemplar stimuli. Each individual horse was trained to either select the smaller or the larger of the two stimuli. After the exemplar training, the horses appeared to learn the concepts larger or smaller and were able to correctly select the larger or smaller of two novel stimuli. Additionally, the horses appeared to generalize the concept of size across other stimulus features and did not appear to be dependent on any characteristics of the training exemplars.

In addition to demonstrating basic and complex learning principles, conditioning procedures can also be used to solve problems related to equine care. Ferguson and Rosales-Ruiz<sup>12</sup> describe a procedure in which several horses were conditioned to willingly enter horse trailers. Before the conditioning procedure, each horse was strongly resistant to entering trailers, requiring several hours to load a single horse, due to a long aversive training history. Instead of using aversive methods, Ferguson and Rosales-Ruiz were able to condition the horses to enter the trailer using food reinforcement.

## Goats and Sheep

Table 4 provides a list of articles on the use of conditioning methods to explore the behavior of goats and sheep.

Langbein, Siebers and Nurnberg<sup>22</sup> investigated if goats would develop an interest in interacting with an automated learning device even when interaction was not required.

The goats were first trained to interact with the learning device; they received a small amount of water as a reinforcer for selecting the correct stimulus from a set of stimuli. After learning how to operate the learning device, a separate waterer was also made available that dispensed the same amount of water for a button press. The researchers analyzed the amount the

goats interacted with the learning device, for both known and novel stimulus sets, when the waterer was also available. Although there were large individual differences, some individuals preferred obtaining water through the learning device suggesting the challenge had some intrinsic reinforcing property beyond the water reward.

**Table 4. Conditioning Research in Goats and Sheep**

**Tablo 4. Koyun ve keçiselrde şartlandırma çalışmaları**

Authors	Year	Title
Wenzel, Baldwin, & Tschirgi	1964	Operant conditioning of goats
Foster, Matthews, Temple & Poling	1997	Concurrent schedule performance in domestic goats: persistent undermatching
Langbein, Seibert & Nurnberg	2009	On the use of automated learning device by group-housed dwarf goats: Do goats seek cognitive challenges
de Almedia, Schild, Brasil, Quevedo, Fiss, Pfister & Riet-Correa	2009	Conditioned aversion in sheep induced by <i>Baccharis coridifolia</i>
Maniellian, Albenell, Salama & Caja	2010	Conditioned aversion to olive tree leaves ( <i>Olea europaea</i> L.) in goats and sheep

Several experiments have investigated the use of conditioned food aversion to solve practical problems with grazing goats and sheep. Conditioned food aversion, also known as conditioned taste aversion, is a form of classical conditioning in which food (CS) is associated with a toxic substance that causes illness (US). The animal will very quickly learn to associate the food with illness and will avoid the food completely.

De Almeida and colleges<sup>6</sup> investigated several methods to prevent introduced sheep from consuming the fatally toxic native plant *Baccharis coridifolia*. In the first part of the experiment, the researchers attempted to create a conditioned aversion to a novel food, corn, by allowing the sheep to consume corn the providing a noxious stimulus to induce illness. After consuming the corn the sheep received a treatment that consisted of either rubbing the plant in the mouth, inhalation of the smoke of the plant, ingestion of a non-lethal does of the plant, or ingestion of LiCl (lithium chloride). The first two treatments were selected because the first two are methods traditionally used by farmers to create an aversion to the plant. Only sheep that

ingested the plant or LiCl developed an aversion to corn, with LiCl treated sheep developing the aversion much faster. Rubbing the plant in the mouth or inhaling the smoke did not appear to be sufficient to develop an aversion to the plant. This suggests that these traditional methods will not prevent sheep from grazing on the plant. In the second part of the experiment was conducted 1 year later; the researchers allowed the sheep to graze in a pasture containing the toxic plant for the first time. Only sheep that previously ingested a non-lethal dose of the plant avoided grazing on it. Other sheep consumed the plant; some became ill.

To address another practical concern, Manuelian<sup>26</sup> and colleagues explored a conditioning procedure to develop a taste aversion to olive tree leaves (*Olea europaea*) in goats and sheep. The olive tree is an important crop in Spain and it has been suggested that goats and sheep by assist in the cultivation of olive trees by grazing on plants between trees. However, goats and sheep will also readily eat olive leaves. The researchers provided animals with olive leaves followed by a LiCl solution. Both sheep and goats quickly developed an aversion to the olive leaves after a single pairing with LiCl. The aversion lasted for 53 days for the goats and 23 days for the sheep.

Goats have also been used for more traditional experimental research. Wenzel, Baldwin and Tschirgi<sup>41</sup> describe an automated procedure to study basic operant conditioning in goats. The researchers found that goats can be quickly be conditioned to press a panel with their snout for food and show much the same learning trends as other laboratory species such as rats and pigeons. They also note that unlike traditional laboratory species, food deprivation is not healthy way to motivate goats. Fortunately, the goats did not need to be deprived of a normal diet of water and alfalfa to be motivated by oats. The authors suggest this may be an advantage to using goats in behavioral research. Goats are also suitable for more complex experimental paradigms such as investigations of the matching law<sup>13</sup>.

## Resources

Much information on practical applications of conditioning methods can be found in the journal *Applied Animal Behaviour Science*. This journal also publishes reviews on selected aspects of conditioning including a paper de-

scribing the importance of learning for animal husbandry<sup>40</sup>, how the study of animal psychology contributes to their health<sup>8, 39</sup>, and how operant conditioning technology can be used to solve various problems facing farm animals<sup>19</sup>.

Other useful journals include *Behavioral Processes*, *The Journal of the Experimental Analysis of Behavior* and *Zoo Biology*. *Behavioral Processes* publishes articles and reviews related to learning and behavior in a wide variety of species. *The Journal of the Experimental Analysis of Behavior* publishes articles primarily related to laboratory research on the principles of learning. Although much of the work uses pigeons or rats as subjects, the general procedures are applicable to other species. The journal also publishes papers on equipment including operant feeding devices for chickens<sup>4</sup> and sheep<sup>35</sup>.

*Zoo Biology* publishes articles on the biology and behavior of a wide range of species in captivity. Although the focus is on exotic species in zoos, the topics are relevant the broader topic of captive animal care. Many papers describe methods to use positive reinforcement in medical and husbandry procedures with large or dangerous species. For example, Laule, and colleagues<sup>23</sup> describe a method to train a chimpanzee to willingly participate in blood draws and urine sample collections, while Broder and colleagues<sup>5</sup> describe a method to train a pregnant snow leopard (*Uncia uncia*) to willingly allow ultrasounds of the developing fetus. Although these species are exotic, the same techniques could be extended to working with stubborn cows and horses.

In addition to these journals, there are a number of excellent instructional videos. Some of the best describe using operant conditioning to train llamas to self-harness, enter and exit a travel trailer, run an obstacle course, and eliminate unwanted behavior such as spitting, and kicking. Other videos show how to use operant conditioning to train dogs, cats, horses, and birds. The DVDs are available at: <http://store.clickertraining.com/birds-and-other-animal-training.html> and based on the applied animal work of Karen Pryor. Free clips from many of the videos are available on You Tube.

## Discussion

This mini review touches only briefly on the many possibilities that the use of conditioning methods offer Turkish veterinarians in both

university situations and private practice. The methods are easy to use, inexpensive and available for a wide range of farm animals and pets. We believe that training in the use of conditioning methods form an integral part of veterinary education in Turkey. Such training can be part of a formal course offered by veterinary schools or informally by referring to the DVDs and articles referred to in this paper. The authors would be glad to assist any interested veterinarian in the application of conditioning principles.

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