Background information is provided to aid the veterinary practitioner in evaluating the use of radio-controlled electronic stimulators in dog training. Safe electrical stimulation is defined, and the physical damage that can result from unsafe procedures is discussed. The psychophysiological and behavioral changes caused by safe electrical stimulation are presented with emphasis on the effects on peripheral sensory and motor nerves and muscles, autonomic nervous system functioning, endocrine activity and overt behavior.

Understanding Electronic Dog Training: Part 1

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□ In the United States there are over 60,000[1] radio-controlled electronic stimulators currently in the hands of pet owners and dog and horse trainers. In addition, there are over 100,000[2] hand-held electronic stimulators, commonly called cattle prods, in use today as tools for animal handling and training.

Despite their expense, the market for these products is steadily increasing. For example, Tri-Tronics, Inc. (Tucson, Arizona), a company that specializes in designing, manufacturing, selling and servicing electronic dog training aids, has grown since its inception in 1968 from two to over 50 full-time employees and is still growing.[3]

Dog training specialists involved in competitive obedience and utility work, tracking and trailing, Schutzhund training, field trial retrieving and pointing and sled dog racing are adopting the use of electronic stimulators at an ever-increasing rate.

The veterinarian is likely to be asked questions by his clientele concerning these and other training tools that can cause pain and discomfort for the dog. It is important for the veterinary practitioner to form educated opinions concerning the use of these tools.

Continued

A Perspective

The use of electrical stimulation as well as other sources of discomfort to aid training and animal behavior therapy is a controversial issue. There exist organized groups that deplore the use of any form of pain and/or discomfort as a means of modifying a dog's behavior. These groups have been successful in fostering legislation in a few states to ban the sale and/or use of pinch and prong collars on dogs. So far, electronic stimulators have escaped such legislation perhaps due to their inaccessibility and expense.

On the other hand, there exists an equally loud minority that advocates strong punitive measures as the only reliable means of controlling dogs. This group advocates a wide range of punitive devices — everything from spike collars to switches and whips, to slingshots, to air rifles, to even a double barrel shotgun loaded with a half charge of bird shot. For this group, electronic stimulators provide the lowest potential for physical damage to the dog.

My own position resides between these two extremes. I use radio-controlled electronic stimulators quite frequently, but not exclusively, as a means of modifying the behavior of problem dogs and of motivating a high degree of proficiency in the performance of nonproblem dogs. The results are quite satisfactory. In fact, I find radio-controlled electronic stimulators to be my single most powerful tool. However, I do not find remote-controlled electronic stimulators to be magic cures or automatic problem solvers. They do not necessarily make training and problem-solving easier, but they do make possible what was formerly impossible or impractical. My position is that a remote-controlled electronic stimulator is only a tool and a tool is as good as its user.

What Is Safe Electrical Stimulation?

Electrical stimulation involves passing a current through a part of the dog's anatomy, usually the dorsal neck region. Safe electrical stimulation physically stimulates the muscles and nerves of that region without causing direct physical damage to those structures or indirect damage or malfunction to other bodily structures.

Unsafe electrical stimulation can damage the dog's integument, primarily by direct thermal, electrolytic and electrochemical burns and dialectic breakdown of the skin. Thermal burns occur when there is a rapid buildup of heat at the point of contact of the electrodes and the skin. The heat results from the current flow through the resistance of the skin. Any structure that resists electrical current will heat up when a current is passed through it. To prevent thermal burns, external electrical stimulation must be of a low current density. This can be accomplished by using a constant current source and distributing current over a sufficiently large surface area.

Electrolytic burns are caused by electrolysis of the salts in solution in and around the stimulated cells. Electrolysis can cause a breakdown of the cell body and cell wall with the addition of the production of sodium and potassium hydroxide and chlorine. Electrolysis is greatest with DC current that causes the positive electrolytes to migrate toward the cathode and negative electrolytes to migrate toward the anode of the system. To prevent electrolytic burns, electrical stimulation must have a biphasic waveform. One type of biphasic waveform is alternating current (AC) which has a sinusoidal waveform. However, there are many other ways to configure a biphasic wave; each differs in its probability of minimizing electrolysis. Some research in this area has already been conducted, but more is needed.

Electrochemical irritation occurs from the chemical interaction of the electrode material and the substances upon the skin surface. Copper and brass electrodes, which are common carriers of electric current, oxidize on contact with the skin. The products of this oxidation may cause irritation. To prevent electrochemical irritation, electrodes should be coated with chrome or other noncorrosive metal.

Dialectic breakdowns of the skin can occur

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as a result of the separation of smaller molecules from larger ones or the separation of crystalloid particles from collodial particles in a solution by selective diffusion through a semipermeable membrane. High voltage confined to a sufficiently small area can induce dialysis of the skin. To prevent dialectic breakdown of the skin, there must be a low voltage gradient. In other words, the voltage must be spread over a sufficiently large epidermal area. This is accomplished by separation of the electrodes.

Other sources of concern involve cardiorespiratory functioning and the functioning of other organ systems. Obviously, placement of electrodes over the heart may cause fibrillation or other insult; placement over the diaphragm may impede respiration; placement over the bladder may induce contraction of this organ. Less obviously, placement of electrodes over neurological control structures for these organs may also affect their functioning. For example, electrodes placed across the temple can induce seizures and those placed on the spinal column can induce a variety of reflexes depending upon their exact location.

Direct stimulation of internal neurological control systems by external electrodes in other locations is more difficult to accomplish without controlling many parameters of the electrical stimulation. However, this can occur by accident, especially with an uncontrolled and/or unregulated source of electrical stimulation. To prevent insult to the proper functioning of organ systems, electrical stimulation has to be in an anatomical location distant from these areas and of a repetition rate, duration, current level, pulse width, etc. to avoid unnecessary stimulation of neurological control systems. Any source of electrical stimulation that does not meet these minimum requirements can be unsafe.

Many electric prods and electronic fence generators use very high voltage and current density. Electrical devices designed for moving and/or containing livestock do not have to meet criteria that would make them safe for stimulating small animals such as dogs. AC house current is 1000 times too intense;

12-volt DC car batteries are equally dangerous. Even two D-sized batteries can cause burns.

No homemade or jury-rigged device can be assumed to be safe. The technical knowledge necessary to build a safe source of electrical stimulation is beyond the sophistication of average electricians and even most electrical engineers. A bioengineering degree and/or experience designing devices to be used on living organisms are minimum requirements.

Beyond the minimal requirement for safety, a source of electrical stimulation should meet the requirement of field and lab testing. The field and lab tests should ask the question: Is it possible under extreme misuse or malfunction for a device that meets minimal standards to cause burns, permanent impairment to cardio-respiratory functioning or insult to any other organ system? Testing should demonstrate that the source of safe electrical stimulation is physiologically inert in an anesthetized animal. Thus all effects of safe electrical stimulation are caused psychogenically.

How Safe Electrical Stimulation Affects the Body and Behavior

When a dog is stimulated in the ~~dorsal~~ ventral neck region with a source of pulsating safe electrical stimulation, it causes extensive psychophysiological and behavioral changes. The effects of safe electrical stimulation on

- peripheral sensory and motor nerves and muscles;
- autonomic nervous system functioning;
- endocrine activity;
- overt behavior

are discussed here. In all areas, the important effects occur at the *offset* as well as the *onset* of electrical stimulation. The onset of safe electrical stimulation causes direct innervation of peripheral sensory and motor nerves.[6,7,8] Since electrode placement must, of necessity, be variable, it is not possible to specify the exact sensory and motor pathways stimulated. However, it is possible, with some degree of certainty, to suggest that touch, pain, puncture and thermal receptors are stimulated successfully or simultaneously. This pattern of safe stimulation can elicit sensations of discomfort ranging from mild to extreme, depending upon the current, without causing physical trauma to the stimulated areas. In a sense, safe electrical stimulation fools the animal's innate defenses in acting as if physical trauma is occurring.

Other sources of stimulation (*e.g.,* whips, spike collars) may cause pain and discomfort due to the physical trauma to the stimulated area. The degree of discomfort produced by these devices is directly proportional to the amount of trauma. In addition, these sources can cause prolonged discomfort beyond the termination of stimulation. The advantage of safe electrical stimulation is that the discomfort has both a sudden onset and an equally sudden offset. The sudden offset allows the animal to have a relief reaction.

Pulsating safe electrical stimulation also causes the neck musculature to increase in tonus and contract rapidly in synchrony with the pulse rate (8 pulses/second) of the stimulation. This occurs directly through stimulation of the motor nerves and muscles and indirectly through sensory stimulation that activates a spinal muscle contraction reflex. The termination of electrical stimulation produces a sudden decrease in muscle tonus many times below the pre-stimulation baseline level. This is the principle behind diathermy.

Properly scheduled administrations of electrical stimulation can result in deep muscle relaxation during unstimulated periods. Thus, the termination of safe electrical stimulation can cause a peripheral neuro-muscular relaxation response.[9] This relaxation response has been used to generate beneficial changes in the psychological, behavioral and physical functioning of the stimulated organism.[10]

Safe electrical stimulation also can affect the activity of the Autonomic Nervous System (ANS) and correlated endocrine glands such as the pituitary and adrenal. The onset of stimulation activates the sympathetic

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division of the ANS and causes the production of Adrenocorticotropic Hormone (ACTH) from the pituitary and the consequent release of adrenaline from the adrenals.[10,11,12] The sympathetic division of the ANS and its correlated endocrine glands form an activation system preparing the body for fight or flight — that is, a readiness to respond with action.

The termination of electrical stimulation causes activation of the opponent system of the ANS, the parasympathetic division.[13] This system and its related hormones serve a deactivation function, preparing the body for rest, relaxation and the vegetative activities. Frequently, this deactivation goes below pre-stimulation baseline and has been called parasympathetic overshoot.

Experimental psychologists[14] have measured a variety of psychophysical reactions to electrical stimulation. One measure, heart rate changes, has been extensively studied in alert dogs paralyzed with curare. It has been found[14] that heart rate increases at stimulation onset and then decreases below baseline at stimulation termination. This below-baseline excursion is called vagal overshoot. It is a highly replicable and well studied phenomenon. It is interesting to note that the heart rate increase at stimulation onset and decrease at stimulation termination are directly proportional to the intensity of electrical stimulation.

After repeated safe electrical stimulations, the psychophysiological reactions to stimulation onset are progressively reduced while psychophysiological deactivation at stimulation offset is progressively enhanced. Thus, after many stimulations an animal will show minor heart rate increases at the onset and significant heart rate decreases at the offset of stimulation.[14]

The behavioral effects of the onset of electrical stimulation parallel the psychophysiological changes. Initial full-intensity electrical stimulation will activate and potentiate defensive reactions from the dog. These reactions can include yelping; panic movements such as struggling, snapping, biting and freezing; escape movements such as withdrawal, running away, hiding, running for cover and running to the owner or other perceived source of safety; cowering; trembling; rage and direct offensive attack; and, rarely, explosive defecation, urination and vomiting.[11] Altogether, the sight of a dog experiencing full-intensity safe electrical stimulation for the first time is that of an animal under extreme distress.

Interestingly, if the intensity of electrical stimulation is gradually increased from threshold, the violence of the initial reaction to stimulation onset can be substantially reduced. In addition, repeated electrical stimulations cause a progressive decrease in the magnitude of the reaction. After many incremental stimulations, a dog will appear quite subdued, as if passively accepting the stimulation and waiting for its termination.[11]

The behavioral effects of the termination of electrical stimulation are the opposite of those of stimulation onset.[11] Initially, a dog's reaction to stimulation offset will be inactivity, passivity and stealth. With repetition, stimulation offset causes progressively more activity and exuberance. After many stimulations, a dog's reactions to stimulation offset have been characterized as gleeful, playful and happy. These reactions have been called relief and relaxation[15] and safety[16,17] responses. The ability to reliably elicit and use these natural reactions to control behavior is the most beneficial aspect of electrical stimulation. ■

CONTINUED IN THE NEXT ISSUE

NOTE: References to appear at the conclusion of this 4-part series.

CANINE PRACTICE — BEHAVIOR

This four-part series provides background information to aid the veterinary practitioner in forming educated opinions concerning the use of radio-controlled electronic stimulators in dog training. In Part 2, the effects of recent technological advances on the development of safe electrical stimulation are reported. Basic principles of Pavlovian conditioning are presented. The qualifications needed by an operator of an electronic stimulation device are discussed in detail.

Understanding Electronic Dog Training: Part 2

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Safe Electrical Stimulation Update

Rapidly developing technology has necessitated an update on some of the background information on radio-controlled electronic stimulators presented in the first part of this series.

In the past, without user modification which required a high degree of technical sophistication, radio-controlled electronic stimulators could deliver only full-intensity electrical stimulation, and the configuration of electrical impulses was designed to create varying degrees of discomfort. Very recently, however, modifications in amperage and pulsewidth have made possible a "painless" form of safe electrical stimulation. This is accomplished by keeping the duration of the pulses of stimulation below the stimulation threshold of pain nerves in the skin of the ventral surface of the neck while at the same time keeping it above the threshold for neuromuscular stimulation. Thus, painless electrical stimulation does not elicit defensive reactions to stimulation onset, and it seems to provide an instantaneous motivation to respond, energizing the dog's commanded responses without panic or fear.

An equally important benefit of painless electrical stimulation is an enhanced reaction to stimulation offset. Painful stimulation offset initially elicits inactivity, passivity and stealth and — with repeated trials — causes progressively more activity and exuberance, leading ultimately to gleeful and playful behavior. On the other hand, painless electrical stimulation offset induces these reactions with only a few repetitions, and they are pronounced. Furthermore, painless electrical stimulation offset seems to facilitate to a greater degree the development of a peripheral neuromuscular relaxation response. It is the conditioning and use of these opponent reactions to the termination of stimula-

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tion that provide the most powerful applications to dog training and problem-solving.

Conditioning and Electrical Stimulation

Through the process of Pavlovian conditioning, any stimulus that reliably predicts electrical stimulation onset will eventually elicit a similar psychophysiological and behavioral reaction as the stimulation.[18] If a hand movement predicts electrical stimulation and a dog is induced to bite when stimulated, then the dog will bite to the hand movement. However, if a neutral stimulus is reliably associated with electrical stimulation onset and the dog is induced to perform desirable responses, then this *warning stimulus* can acquire the capacity to elicit proficient and rapid performance.

Similarly through Pavlovian conditioning, any stimulus that reliably predicts electrical stimulus offset will eventually elicit similar behavioral and psychophysiological reaction to the offset.[16,17] If a dog acts relaxed, spirited or playful after stimulation is terminated and a pat on the head predicts this termination, then a dog will eventually react similarly to the pat on the head. If a neutral stimulus is reliably associated with a period following electrical stimulation offset, then this *safety stimulus* will acquire the capacity to reinforce responses.[16,17,18]

Finally, through the process of operant conditioning and negative reinforcement,[19] any behavior that consistently escapes or avoids electrical stimulation will be learned and repeated.[20] Thus, a dog can learn to bite or hide or obey to prevent electrical stimulation. A behavior learned in this way is very difficult to extinguish.[21]

The Advantages and Disadvantages of Electrical Stimulation

The advantages of electrical stimulation as a training aid and conditioning tool are exactly its disadvantages. In my experience, safe electrical stimulation is the most powerful source of motivation that can be used. Radio-controlled electronic stimulators with their capability of delivering safe, precisely timed and remotely controlled electrical stimulations are the most powerful tools currently available.

The disadvantages stem from the misuse of these tools. Misuse can occur out of malevolence but is more likely a result of ignorance. Misuse reliably occurs when powerful tools are placed in the hands of a neophyte or amateur.

In my opinion, an expert should meet four criteria to get the maximal advantage of a radio-controlled electronic stimulator for behavior therapy, problem-solving or dog training. These are:

- ► a background in behavioral science;
- ► the skills of a competent animal trainer;
- ► the savvy of a sensitive animal watcher;
- ► experience using radio-controlled electronic stimulation under field conditions.

The behavioral science background should include training in the field of animal learning and motivation with special emphasis in aversive conditioning such as classical fear conditioning and operant escape and avoidance conditioning. Furthermore, an expert should be well acquainted with the clinical area of behavior therapy. Such a background increases the likelihood that the person will be able to form reasonable hypotheses concerning the cause or causes of animal behavior and training problems, to understand the principles underlying old training techniques, to develop new training and therapy programs that are firmly grounded in the behavioral science literature and to make accurate predictions concerning the results and potential complications of any new or old training regimen.

Competence in animal training is necessary to execute training or therapy programs once they are developed. Animal training capabilities include a well developed set of movement skills that allow the possessor to cause the animal to perform the requisite behaviors. Saying the word "heel" to a dog does not guarantee that the dog will sit or walk by your left knee. To get the dog in position, an

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animal trainer has to execute a series of complex and coordinated moves that involve the trainer's entire body.

In my experience, a high level of competence in both behavioral science and animal (dog) training is a necessary prerequisite to the most effective and beneficial use of a radio-controlled electronic stimulator. The animal trainer who has no background in behavioral science is likely to repeat movements and techniques that will have the predictable effect of creating or exacerbating some behavioral problems. When you add the motive force of a radio-controlled electrical stimulation to the repetition of erroneous movements, you have a formula for the creation of behavior or training problems.

An appropriate behavioral science background will, in theory, allow the expert to develop less problem-prone techniques. However, these techniques will be executed ineptly without the animal trainer's movement skills. The deleterious effects of inept movements are magnified by the use of a radio-controlled electronic stimulator. First, the violence of the initial response to full-intensity, painful electrical stimulation can cause anyone with poorly developed or ill-coordinated movement skills to lose control of the situation. Therefore, one advantage of low-intensity, gradually increasing, painless electrical stimulation to motivate behavior is that it does not require such a high level of trainer coordination. Second, electrical stimulation can permanently establish whatever response leads to its prevention or termination. If the behavioral scientist cannot or does not control these responses, the dog can, and most likely will, learn unintended bad habits.

The savvy of a sensitive animal watcher allows the possessor to anticipate the dog's movements and spontaneously modify a movement or technique as the session proceeds. This flexibility is an absolute necessity when working with a radio-controlled electronic stimulator since the most beneficial results occur when the unique reactions of an animal are incorporated into the training session.

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In part, animal savvy can be facilitated by acquaintance with ethological research on the species. Canine ethology is a field that has accumulated a substantial body of knowledge on the behavior of wild canids.[22,23] This knowledge provides the possessor with an evolutionary and species perspective on the behavior being observed and/or modified. However, this background is not sufficient when working with dogs. The fact is that dogs are not wolves. They are a distinct species.[24]

The expert should also be able to make an accurate prediction on how a particular breed of dog is likely to respond to electrical stimulation. In my experience, breeds differ dramatically in their reaction and tolerance to this stimulation.[25] Sexes also differ. Thus, animal savvy skills are necessary to predict how an individual animal will respond to painful or painless safe electrical stimulation and to use these reactions to facilitate a training or therapy objective.

Finally, to get the maximal advantage from a radio-controlled electronic stimulator, the user should have previous experience using the device. Just as a novice driver may be overwhelmed with the mechanical operation of a car and neglect watching the road, the neophyte user of a radio-controlled device may concentrate on operating the device to the exclusion of watching and moving with the dog.

The experienced user should be able to operate the radio-controlled transmitter as proficiently as the experienced driver operates a car. This allows the expert to focus most attention on the dog's behavior while "automatically" operating the control transmitter. Without well-established control transmitter operating skills, there will be, at the very least, a time delay in the administration of radio-controlled stimulation. Such a delay can create havoc in a training session, causing or exacerbating behavior problems.

The newest model of radio-controlled stimulator (the A1-90) manufactured by Tri-Tronics (Tucson, Arizona) can be set at an intensity that is barely noticeable by the dog. At this level, the novice user can gain experience operating the control transmitter during conventional training. Thus, the novice can practice timing and transmitter skills at a level of electrical stimulation where timing delays and errors have only a negligible effect on the dog's behavior and training. ■

CONTINUED IN THE NEXT ISSUE

NOTE: References to appear at the conclusion of this 4-part series.

ERRATA

The following changes should be made in Tortora DF: Understanding Electronic Dog Training: Part 1. *Canine Practice* 9(2):17-22, 1982.

- pp. 18, 20 — The term *dialectic breakdown* should be changed to *dielectric breakdown.* In addition, the description of dielectric breakdown was in error. Dielectric breakdown occurs as a result of the deterioration of the insulating properties of the epidermis. High voltage across the epidermis can cause voltage to arc through the skin, leaving a hole. To prevent dielectric breakdown, there must be a low voltage gradient. In other words, the voltage difference between the outer and inner boundaries of the epidermis should not exceed the insulating properties of the skin at that point. Since many factors influence the voltage gradient, this value must be established by empirical test.
- pp. 18, 21 — When using radio-controlled electronic stimulators, the *ventral* (not the dorsal) surface of the neck is stimulated.
- p. 18 — Electrolysis is greatest with DC current that causes the positive *ions* (not electrolytes) to migrate toward the cathode and negative *ions* (not electrolytes) to migrate toward the anode of the system.

CANINE PRACTICE – BEHAVIOR

This four-part series provides background information to aid the veterinary practitioner in forming educated opinions concerning the use of radio-controlled electronic stimulators in dog training. In Part 3, the uses of radio-controlled electronic stimulators as they apply to the areas of advanced dog training, behavioral control, problem-solving and problem prevention are discussed.

Understanding Electronic Dog Training: Part 3

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The Uses of a Radio-controlled Electronic Stimulator

Five areas where I have found a radio-controlled electronic stimulator to be indispensable are

- Advanced Dog Training
- Behavioral Control
- Problem-Solving
- Problem Prevention
- Animal Behavior Therapy.

The first four of these areas are discussed here; the last area will be discussed in the final part of this series.

Advanced Dog Training

In this context, advanced training refers to preparing a dog for competition or the per-

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formance of a specialized function. In either case, the quantity and quality of skills required of the dog are considerably greater than those of an ordinary problem-free companion dog.

Examples of competitive training where radio-controlled devices can be useful are field trial retrieving and pointing, stock dog training, dog racing, sled dog racing (especially for lead dogs), CDX and UD obedience and advanced Schutzhund and K-9 protection work. At present, radio-controlled devices are used most extensively in training field trial retrievers. I will confine my comments to this area, although they are appropriate to any area of training where a high quality of lead performance is required.

There are three ways to use radio-controlled stimulators in this context. The simplest, least beneficial and most problematic use is providing remote punishment for undesirable responses. Thus, if a retriever is given a "back" command (meaning, run in the designated direction until commanded otherwise) and it fails to respond, drifts to the left or right, stops, slows down or balks at a water blind, it can be punished at a distance for these infractions by activating the radio-controlled device. A highly trained retriever — one that has been taught self-correction — will respond by correcting his path. The problem with remote punishment is that it works well only with highly trained dogs. A poorly trained retriever may freeze, run back to its handler or start running and wind up in the next county — especially if it has never experienced electrical stimulation before its first radio-controlled punishment.

Even though using a radio-controlled device to deliver a remote punishment has disadvantages, it is certainly an improvement over the older and still commonly used practice of "dusting" the retriever. "Dusting" is a retriever-training euphemism which means shooting skeet or bird shot at or near the retriever when it fails to comply or responds incorrectly.

In my experience, it is more advantageous to first train the retriever skills by avoidance and/or relaxation techniques. This means

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BEHAVIOR (Continued from page 9)

teaching the retriever that it can terminate or prevent electrical stimulation by compliance. To avoidance train a retriever,[26] the electrical stimulation has to be reliably predicted by a warning stimulus. Through conditioning, the warning stimulus takes on some of the characteristics of the onset of electrical stimulation in that it prepares the animal for action. If the dog complies after it hears the warning stimulus but before the electrical stimulation, the animal has essentially avoided the electrical stimulation. Habits learned through avoidance are very resistant to extinction.

To relaxation train a retriever, the termination and prevention of electrical stimulation have to be reliably associated with a safety stimulus. Through conditioning, the safety stimulus takes on some of the characteristics of electrical stimulation offset in that it provides the animal with a cue that it is safe and successful. The safety stimulus can then be used to remotely reward appropriate behavior.

Once conditioned, the warning and safety stimuli can be used together to achieve a high level of proficiency with a minimum of electrical stimulation. This results in a high-spirited, confident and proficient performance.

In my experience, it is best to avoidance and/or relaxation train a well-trained retriever's appropriate behaviors rather than to punish inappropriate behaviors. Whereas repeated punishments can demoralize a dog, repeated avoidance or relaxation training has the opposite effect. If punishment is necessary, it should be a last resort, after the animal has shown proficiency due to avoidance and/or relaxation training.

The idea of avoidance and relaxation training is one of the most difficult messages to bring to established retriever trainers. When they think of radio-controlled stimulators, they immediately think of punishment, the least desirable use of the device. Perhaps veterinarians can introduce the idea of avoidance and relaxation training to retriever trainers, thus doing the dog, the sport and the trainer a service. Veterinarians may want to consult a recently published, detailed book[26] on avoidance and relaxation training with radio-controlled devices for further details.

Behavioral Control

There are some breeds and some individual dogs that are not responsive to standard reward and punishment training techniques used by the average dog trainer or pet owner. Typically, these dogs are described by their owners as very high-spirited and/or stubborn.

Many of the sporting breeds like setters, pointers and retrievers fall into the high-spirited category. They have been bred for almost continuous activity. This is a desirable trait in the field, but it can be downright nerve-racking at other times.

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Many of the working breeds, bred for territorial defense and protection, may resist behavioral control and fight the demands of the trainer. Some examples are assertive specimens of shepherds, standard and giant Schnauzers, Dobermans, Rottweilers, bulldogs, Bull Terriers, Chow Chow, *etc.* Their tenacious resistance to behavioral control is exactly the trait that is needed for good territorial defense and protection; unfortunately it is also the trait that can cause serious dominance and training problems.

The herding breeds, such as the English Sheepdog and Komondor, may be both high-spirited and resistant to behavioral control, a combination of traits that facilitates herding but impedes training. In a similar vein, dogs bred for pulling, such as Malamutes and Huskies, may have a difficult time learning to heel.

For these breeds and individuals, I have found no substitute for a radio-controlled electronic stimulator as an aid to training and achieving powerful behavioral control. Again, the best way to use the device is to establish behavioral control skills by avoidance and/or relaxation training, not by punishment.

Avoidance and relaxation training should be used to train in the direction of the dog's natural tendencies. Once a dog has learned to relinquish control of its natural tendencies to a handler, it seems considerably more willing to allow control of other behaviors. For example, I avoidance and/or relaxation train retrievers to retrieve, pointers to point, sled dogs to pull and protection breeds to protect as well as the standard control skills of Come, Sit, Heel, Down and Stay. Once trained in this way, these "hard-to-train" dogs appear much more compliant and willing to please without a loss of their natural spirited tendencies.

A less desirable way to use a radio-controlled device is to try to "break" a dog's natural tendencies through punishment. This route can cause more problems than it solves. First, it is likely to be unsuccessful. Second, it may force total dependence on the radio-controlled device to constantly battle the dog's natural tendencies. Third, it is likely to cause fear, timidity and panic in the high-spirited breeds and defiance in the assertive breeds. Fourth, if successful, the result is an obedient dog with all the desirable traits suppressed — that is, a dog with a broken spirit.

The veterinarian should advise his clients that punishment has a purpose — that is, the elimination of undesirable habits — but it should not be used to try to gain behavioral control over an uncontrolled or difficult-to-train dog. Punishment is only valuable after the dog is essentially under control. A radio-controlled electrical punishment is only valuable after the dog has learned behavioral control skills through radio-controlled avoidance and/or relaxation training.

Problem-Solving

There are some behavioral problems that can best be eliminated by punishment. Radio-controlled painful electrical stimulation is the most precise way to administer punishment without the necessity of physically touching, striking or harming the dog. Its remote operation makes it ideal for this purpose. All that is needed is the ability to monitor the dog's behavior so the dog can be punished in the act of misbehaving. Behavioral monitoring devices are available through electronics stores. One device I use frequently is a tiny radio microphone (*i.e.,* "bug") positioned on the dog's collar. The microphone will broadcast an FM audio signal receivable by any FM radio, allowing the listener to hear what the dog is doing. Some behaviors like chewing and destruction, rambunctious running, excessive barking and even inappropriate urination and marking can be remotely monitored with this device. The radio-controlled device can then be used to remotely punish the problem behavior the instant it occurs.

For relatively silent behaviors, a more technically sophisticated monitoring system may be necessary. This may include everything from photosensors, to ultrasonic echo sensors, to micro switches, to pressure or mois-

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BEHAVIOR (Continued from page 13)

ture-sensitive pads to video equipment. Fortunately, most of these monitoring systems have been developed as parts of burglar alarm systems and are now relatively cheap. They can be modified with a modicum of technical know-how to suit a behavioral monitoring function.

In my experience, it is best to first avoidance and/or safety train a dog with a radio-controlled device before using a radio-controlled device for punishment. This pretraining will prevent panic and limit the dog's option to the performance of desirable behaviors when it experiences electrical stimulation.

If a dog's motivation for destruction, barking or urinating when left unattended is fear of separation, then the use of a radio-controlled punishment will cause only a short-term reduction in the problem and an exaggeration of the problem when it returns or an extreme exaggeration of the problem. With extreme separation problems, the dog's fear must be desensitized first. Second, it must be avoidance trained to perform nonproblem behaviors to avoid fear and stress. Third, it must be safety trained for compliance. Finally, if necessary, it can be safely punished for the problem behavior. In these cases, punishment is the last step, not the first alternative. This procedure is beyond the sophistication of most pet owners. Pet owners seeking a radio-controlled device for fear-motivated separation problems should be referred to an expert, not to the manufacturer of the device.

Very powerful instinctive behavior such as predator aggression, deer chasing and dog fighting cannot be reliably eliminated with punishment unless the animal is first avoidance or relaxation trained to perform a response appropriate to its function. For example, hounds have to be avoidance and relaxation trained to chase appropriate game before punishment for deer chasing can be permanently effective. Fighting dogs must be avoidance and relaxation trained for obedience before they can be punished for fighting. If you punish untrained dogs in the act of fighting, the electrical stimulation will potentiate the fight. If the dogs have been very well trained to avoid electrical stimulation by nonaggressive compliant behaviors, then electrical stimulation has a chance of breaking up the fight and punishing the aggression. With extreme dog fighting, each individual combatant must be trained to perform the avoidance response of ceasing the threats and breaking off the fight when they experience a command, the warning signal or the electrical stimulation. Then and only then can punishment be used to stop the fight. This entails a special double radio-controlled device that will allow the trainer to either simultaneously or individually stimulate the dogs.

The procedure to eliminate dog fighting is quite complex. It involves numerous preparatory steps and can only be alluded to in this report. The use of the device as a source of punishment is only one step in this procedure, the final step. The veterinarian should discourage pet owners who think they can solve this problem with a radio-controlled device alone.

Problem Prevention

Problem prevention involves associating a dangerous situation with electrical stimulation and teaching the dog an appropriate avoidance response to stimuli predictive of danger. In this way appropriate fears can be learned without the necessity of actual endangerment. For example, a dog can be "snake-proofed" by associating the sight, smell and sound of poisonous snakes with safe electrical stimulation and teaching the dog to withdraw from these stimuli to escape or prevent electrical stimulation. It is very important for the dog to withdraw in response to electrical stimulation. Many dogs do this naturally, but some breeds and specimens attack instead. A dog such as this is put in greater jeopardy by an uncontrolled snake-proofing session. In this case, the dog has to be taught a withdrawal response to the warning stimuli and electrical stimulation before snake-proofing.

I find it desirable to teach the dog a special

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avoidance response first, such as backing up and barking, and then an advance command of going forward, giving the snake a wide berth. Thus, the snake-proofing can serve the joint function of protecting the dog and its handler; the dog will not lose control and hightail it to the hills when he sees a snake; and the handler can advance his dog once the snake is identified.

In an analogous way, a dog can be "vehicle-proofed," "fire-proofed," "kidnap-proofed" and "poison-proofed." The requisite avoidance response, of course, differs with the type of stimulus. My "vehicle-proofing" has involved the discrimination of avoiding contact with the external surface of a moving car, lack of fear of a parked car and entering a car and staying quietly inside when commanded and, finally, punishment for chasing moving cars. It can also involve the ability to negotiate crosswalks with safety as done by Seeing Eye dogs and never crossing a street unattended.

A "fire-proofed" dog should be avoidance trained to bark an alert and rouse its owners when it senses smoke or fire. A "kidnap-proofed" dog should be trained to avoid strangers bearing "gifts" unless it is accompanied by its master. A "poison-proofed" dog should be trained to avoid a variety of poisonous plants and potential bait (chopped meat) encountered in the street.

To prevent a dog from stealing food, it can be "human food-proofed." To prevent a dog from destroying property, it can be "property-proofed." To prevent a dog from roaming, it can be "boundary-proofed." To prevent it from digging in flower beds, it can be "flower-proofed." A fence jumper can be "fence-proofed," and so on. Again, the difference is the requisite avoidance response. In my experience, a radio-controlled electronic stimulator is the most expedient way to accomplish these goals. ■

CONTINUED IN THE NEXT ISSUE

NOTE: References to appear at the conclusion of this 4-part series.

CANINE PRACTICE — BEHAVIOR

This four-part series provides background information to aid the veterinary practitioner in forming educated opinions concerning the use of radio-controlled electronic stimulators in dog training. In this concluding Part 4, the uses of electronic stimulation in the area of animal behavior therapy are discussed. An overview of the problems of aggression, fears and phobias and the logic of their solutions by electronic devices are presented. A historical perspective of electronic dog training and a discussion of recent advancements which have changed the emphasis of this field conclude the series.

Understanding Electronic Dog Training: Part 4

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Animal Behavior Therapy

The use of a radio-controlled electronic stimulator as a tool for animal behavior therapy is more complex than the examples in previous sections since it involves the incorporation of the effects of the electrical stimulation with other behavior therapy techniques. It is not possible to briefly outline even a single behavior therapy program in the confines of this report. However, it is possible to provide an overview of some problems and the logic of their solutions.

Aggression

In my experience, radio-controlled electrical stimulation in combination with other techniques has been completely effective in permanently eliminating all forms of aggression I have encountered to date. The most common cases have been dominance-motivated aggression,[27] avoidance-motivated aggression,[28,29] intermale aggression and interfemale aggression (dog fighting),[30] predatory aggression,[31] fear biting and irritable snapping.[32]

In all cases, the dogs must be safety trained first. Safety training is a complex procedure. In essence, safety training involves teaching a dog a host of prosocial, compliant skills by

- using positive play reinforcement to shape the skills
- using mild negative reinforcement of a choke collar to develop the skills
- teaching the dog to escape progressively more intense, painless electrical stimulation by performing the skills
- teaching the dog that it can avoid the warning stimulus and obtain the safety stimulus by correct performance
- rewarding precise execution of its prosocial skills with a safety stimulus.

The type of aggression and the uniqueness of the case dictate the set of skills to be safety trained. For example, the set of skills for dominance-motivated aggression include the safety training of submissive compliance. In the past,[29] I tried to positively reinforce submission in dominant dogs. This produced what I would call "sham" submission." Through positive reinforcement, dominant dogs could be shaped to look as if they were submissive, but they were not in actuality. However, when a dog is safety trained into submission, it is, in fact, submissive to the

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person giving the command.

This difference makes sense if you consider the ethology of wild canines. I am unaware of any examples in nature where the dominant member of the pack or troop positively reinforces its subordinates into submission. All dominant animals negatively reinforce submission in their underlings by threats and attacks. An alpha canine will attack an upstart or intruder until it gives in and submits. The submissive canine escapes discomfort by submitting when attacked and avoids it in the future by submitting when signaled. The radio-controlled device allows the trainer to train the dominant dog into submission and puts the trainer on a more than equal par with large alpha males. However, in the beginning, training sessions are a sheer battle of wills. Even with a radio-controlled device, an alpha male will fight tenaciously to hold his position.

This is not a technique that the average pet owner can hope to accomplish. However, once the alpha male learns a host of compliant avoidance responses, the average pet owner can enforce his dominance over his dog by giving the appropriate commands and backing them up, if necessary, with the radio-controlled device.

Fears and Phobias

My treatment for fears and phobias in dogs is a radical departure from the typically used procedure of Systematic Densensitization (SD).[34] I became dissatisfied with desensitization because its results were limited. SD worked only when I had a clearly defined, monosymptomatic, unidimensional phobia, like fear of loud noises. Even then, its usefulness was limited by the practical contortions that one has to go through to control the phobic stimulus, the protracted duration of treatment and the fact that it does not protect the dog from developing new phobias or reacquiring old ones.

While working with field trial retrievers and hunting dogs, I was faced with the perplexing fact that force training a retriever seemed to, in training parlance, "bold up the dog." I saw it work numerous times, but it did not seem to fit fear conditioning theory. Force training means escape and avoidance training a fetch and other commands. The dog is made to feel discomfort which is relieved when and if it goes for the retrieving dummy or stick. After force training, many "gun-shy" dogs and "bird-shy" dogs ceased being afraid.[35]

With this observation, I started safety training extremely phobic dogs that had failed to respond to SD. At the end of safety training, I added flooding and response prevention. That is, a safety trained dog was required to maintain behavioral control (*i.e.,* panic response prevention) under the presence of the most extreme phobic stimuli (flooding). For example, I would heel a safety trained dog afraid of the noise of moving vehicles up to and past a rapidly moving commuter train and then require it to sit and stay 5 feet from its tracks. The results so far have been quite satisfactory. Polysymptomatic, multidimensional phobias have been eliminated with no sign of return or reconditioning in half the time it has taken SD to eliminate monosymptomatic, unidimensional phobias. Unidimensional phobias disappear in half again the time it takes to eliminate multidimensional phobias.

In retrospect, these results fit a principle of conditioning theory called overshadowing.[36] A typical overshadowing experiment involves conditioning a fear of contextual cues (surroundings) in a laboratory rat. The rat is then given discriminative fear or avoidance conditioning in which a specific stimulus signals a forthcoming shock. The result is the rat acquires a fear and/or avoidance response to the discriminative stimulus but loses its fear of the contextual cues or surroundings. The explanation is that the discriminative stimulus overshadows its context. The discriminative stimulus predicts the shock; the context without the discriminative stimulus predicts no shock and thus safety.

Multidimensional phobic dogs basically have a fear of contextual cues (*i.e.,* their surroundings). The warning stimulus gives them

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a definite stimulus to fear; thus, their surrounding becomes safe through discrimination learning. Eventually even the fear of the warning stimulus is extinguished through repeated exposure without pairing with electrical stimulation. In a sense, safety training transfers the fear from an uncontrollable, multidimensional phobic context to a highly controllable, unidimensional warning stimulus and then extinguishes this more manageable fear. Since the dogs have acquired a battery of desirable coping responses, new stresses and traumas elicit these responses instead of a panic reaction. The dogs simply become more obedient and courageous under stress. This protects the dog from developing new problematic phobic responses in the future.

It must be pointed out that safety training a phobic dog should be done only by an expert. For satisfactory results, all aspects of the training must be under complete control. It is conceivable that an amateur attempting to safety train his shy and retiring phobic dog could inadvertently create a fear biter or avoidance biter. All that is needed is to mistakenly teach the dog that biting instead of compliance avoids danger and creates safety. Almost all phobic dogs I have safety trained with painful electrical stimulation have attempted to bite during their initial electrical stimulation. If they had been successful in terminating the electrical stimulation by biting, they would have learned to bite instead of comply. With the introduction of low-intensity, painless electrical

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stimulation, the likelihood of biting during the stimulation is greatly reduced although not completely eliminated. Care must still be taken to limit the phobic dog's options to performing only the commanded response. However, careful and expert use of this type of stimulation can significantly increase the speed of training even the most phobic dogs, transforming fearful puppies into courageous canines.

Conclusion

Electronic dog training is a new, rapidly growing, high-technology field. Over the past few years, advancements introduced from the behavioral sciences have shifted the emphasis of this field considerably.

In the past, radio-controlled electronic stimulators, designed to deliver sensations of pain or discomfort, were used to mete out remote-controlled punishment when a dog was behaving improperly; and these designs were not tested for safety. Early electronic stimulators were used as a substitute for other implements used by dog trainers as tools of punishment (*e.g.,* whips, slingshots, air rifles and shotguns). Thus, the introduction of radio-controlled electronic stimulators some 20 years ago was a significant advancement. It was the first step toward the development of safe electrical stimulation.

The newest advancement in electronic dog training is painless electrical stimulation and conditioned warning and safety cues which motivate and reward high-spirited and animated performance rather than punishing improper responses. With this advancement, electronic dog training has changed its emphasis from eliminating the negative to accentuating the positive. ■

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