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Safety Training: The Elimination of Avoidance-Motivated Aggression in Dogs

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SUMMARY

This study sought to identify the behavioral characteristics and appropriate treatment of a form of instrumental aggression in companion dogs, herein recognized as avoidance-motivated aggression. In Experiment 1, retrospective data on 92 cases of dangerously aggressive dogs demonstrated the avoidance nature of the aggressive response and its intractability to established counterconditioning treatments. In Experiment 2, safety training, a modified avoidance-learning procedure, resulted in complete and permanent elimination of aggression in all of the 36 dogs tested. In addition, it produced extremely extinction-resistant prosocial avoidance responses, significant increases in the dogs' emotional stability, an avoidance-learning and safety acquisition response set, and improvements in measures of the dog's "carriage." Experiment 3 showed how effective safety training is when compared with other behavior modification techniques that, in theory, should have an impact on avoidance-motivated aggression. Experiment 4 demonstrated the critical importance of using the conditioned safety cue as a positive reinforcement. The relationship of avoidance-motivated aggression to other forms of aggression is discussed. The success of safety training compared with the failure of electrical aversion therapy is analyzed. The theoretical concepts of behavioral balance and an avoidance-learning set are presented. Suggestions to improve the effectiveness of counterconditioning for human avoidance-motivated pathologies are offered.

All in all, the data seem to suggest that safety training may create in dogs a sense of control over environmental stressors. By teaching the dogs a behaviorally balanced battery of prosocial "coping" responses, they may be developing the canine counterpart of "self-efficacy" or "courage." It is suggested that this cognitive modification may provide the antithesis of "learned helplessness" and may be of prime importance to the success and stability of the results.

This article is concerned with the description and treatment of avoidance-motivated aggression, a form of instrumental aggression (Feshback, 1964, 1971; Moyer, 1968) as exhibited in companion dogs. Avoidance-motivated aggression in dogs involves biting attacks or threats of attack directed toward one or more of the dog's human caretakers. As the name implies, these threats and bites are assumed to be avoidance responses that are acquired and maintained by the prevention of anticipated aversive events.

Avoidance-motivated aggression can be discriminated from two other forms of aversively motivated aggression in dogs—pain-elicited aggression (Ulrich, 1967a; Ulrich & Azrin, 1962) and fear-motivated aggression (Tortora, 1980)—by a number of criteria. First, the eliciting stimuli differ. In pain-elicited aggression, the bite occurs while the animal is exposed to pain or discomfort. Fear-motivated aggression occurs when the animal is exposed to conditioned aversive stimuli that have been directly associated with pain or discomfort. Avoidance-motivated aggression, on the other hand, can occur during stimulation that has never been directly associated with pain or discomfort. Through higher order conditioning and generalization, a variety of apparently neutral and unrelated stimuli come to elicit the avoidance response of aggression. This gives avoidance-motivated aggression the appearance of unpredictability when compared with the other two forms.

Second, the behavior of a dog before, during, and after an aggressive episode differs for the forms of aggression. For pain- and fear-motivated aggression, the dog's general demeanor is fearful and submissive, and the dog appears panicked during the aversive stimulation. Thus, in these two cases, it is relatively easy to predict an aggressive episode. On the other hand, avoidance-motivated aggressive dogs do not produce signals that indicate aggressive potential. The behaviors preceding an aggressive episode vary over time and have been described as everything from friendly, playful, care soliciting, and calm to fearful and submissive. The pet owners' typical claim is that their dog "just turned on them without warning and for no reason" that they could ascertain.

Third, the morphology of the aggressive response appears to differ for the three forms of aggression. In fear- and pain-elicited aggression, the bite is usually singular and self-terminating. It has been described as an abbreviated snap followed, if possible, by retreat. Avoidance-motivated aggression usually involves multiple bites, a sustained attack, and is not self-terminating. After the aggressive episode, the animal is likely to attack again under minimal provocation. Whereas in pain- and fear-motivated aggression, the attack appears defensive, in avoidance-motivated aggression, the attack appears offensive as if "calculated" to incapacitate the victim. Winkler (1977) summarized 11 case histories of human deaths induced by dog bites. All of these cases histories are compatible with a diagnosis of avoidance-motivated aggression.

Fourth, case histories of avoidance-motivated aggression (Tortora, Note 1) indicate that biting begins as an elicited response, develops into classically conditioned response, and finally matures into instrumental avoidance response. This naturally occurring learning curve seems to mirror the acquisition of hurdle-jumping avoidance in normal dogs with traumatic shock (Solomon & Wynne, 1953). Case histories also indicate that avoidance-motivated aggression is very resistant to naturally occurring extinction. Once acquired, avoidance biting appears more or less permanent despite years without exposure to aversive stimulation. This level of resistance to extinction also mirrors the data on resistance to extinction of avoidance of traumatic shock in normal dogs (Solomon, Kamin, & Wynne, 1953; Solomon & Wynne, 1954).

Finally, techniques useful in extinguishing fear-motivated behavior, such as flooding (Marks, 1972; Stampfl & Levis, 1967), response prevention (Baum, 1970), systematic desensitization (Wolpe, 1958), and techniques useful in reducing pain-elicited aggression such as adaptation and habituation (Miller, 1960; Tortora, 1977, 1980), seem to have little effect on avoidance-motivated aggression even when used in combination. At best, these techniques yield a temporary reduction in probability of avoidance-motivated aggression, with the probability of complete spontaneous recovery increasing as time from treatment grows.

Avoidance-motivated behavior problems in companion dogs may provide an instructive analogy to some forms of human neurosis. Freud (1936) suggested that neurotic symptoms help individuals avoid or reduce their painful emotions, and some behavior therapists view certain symptoms and defensive maneuvers of psychopathology as avoidance-motivated behavior (Levis & Hare, 1977; Stampfl & Levis, 1967; Wolpe, 1958). Thus, infrahuman studies of learned avoidance behavior and its extinction have been viewed as models of the acquisition and treatment of human psychopathology (Levis, 1979). Avoidance-motivated aggression, due to its resistance to naturally occurring extinction and treatment by behavior therapy techniques for extinguishing fear-motivated behavior, may provide an animal model of the forms of human psychopathology that remain resistant to behavior therapy (MacCulloch, Feldman, Orford, & MacCulloch, 1966; Miller, Hersen, Eisler, & Hemphill, 1973; Yates, 1975).

In addition, the diagnosis and treatment of avoidance-motivated behavior problems in the companion dog may provide an animal model of "neurotic" symptomatology that has higher fidelity than laboratory studies of

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avoidance learning or induced "neurotic" behavior in animals (Masserman, 1942, 1943; Mowrer, 1940; Seligman, 1975; Seligman, Maier, & Greer, 1968; Shagass, 1975; Thomas & deWald, 1977). Since the dog resides with a human family and, for the most part, is treated like a family member, the pathology of the pet produces disruptions in the family structure, conflicts between family members, and accommodations in the members' behaviors that may be analogous to the problems created when a human family member exhibits extremely neurotic behavior.

Experiment 1

From 1974 to the present, I attempted to eliminate behavior problems in companion animals, mostly dogs, applying behavior therapy techniques and principles of operant and classical conditioning. In the first 3 years various modes of administering this service to the public were explored. By 1978 a modus operandi was established, and detailed information was collected on each case.

The behavior problems were diverse, the most common of which was aggression in dogs. The modal assumption was that behavior problems are learned responses. Thus, given an understanding of the learning history, the controlling stimuli, and reinforcement contingencies, one could devise a counterconditioning procedure that would have a high probability of eliminating or mitigating the behavior problem (Tortora, 1977, 1980).

Method

Subjects. There were 476 case histories of problem dogs taken between the years 1978 and 1981. All case histories concerned companion dogs that exhibited one or more behavior problems. All dogs were referred by a veterinarian after medical diagnosis revealed no discernible medical pathology.

Procedure. All canine behavior problems were first subjected to behavioral analysis and diagnosis. A detailed description of the diagnostic process is presented elsewhere (Tortora, 1977, 1980). In short, a behavioral diagnosis involved interviewing all family members and observing the dog in and out of the family situation. A behavioral description of each presenting problem response included the notation of antecedent stimulus conditions and relevant reinforcement contingencies.

A behavioral history of the problem response included the development of the problem in question, changes in stimulus, reinforcement, and punishment contingencies over time, and a description of the variety of other correlated changes in behaviors including changes in patterns of feeding, drinking, sexual behavior, fighting, fears, eliminating, exploring, playing, care of the body surface, care of the young, resting, nesting, instrumental responses acquired, and training techniques employed.

An attempt was made to ascertain how the dog functioned with each member of the family and within the family as a whole. The family members' feelings and cognitions concerning the dog, the dog's problems, and changes in these feelings were also explored.

A typical behavioral diagnosis required between 1 to 3 hr. and was performed in one continuous session. At the end of the behavioral diagnosis, the family members were informed of the hypothesized cause or causes of the problem, given an estimate of the severity of the problem, provided with an outline of behavior therapy procedures that could possibly eliminate the problem, instructed on the conditioning logic behind the procedures, and provided an estimate of prognosis.

Depending upon the severity of the problem, pet owners would be encouraged or discouraged to be directly involved in a behavior therapy procedure. Minor problems, those that an average pet owner has a reasonable chance of handling, were treated by the family members while maintaining contact with me. Dogs with major behavior problems were taken into my care and treated. In this report the designation *treated* refers only to the latter cases.

For the purposes of this report, behavior problems were classified as aggressive or "other." Aggression was defined as a case history in which the dog exhibited facial threat display (lip curl), vocal threat display (barking and growling), biting, and snapping and/or a lunging response during which parts of the dog's body made direct contact with humans. Aggression was further dichotomized into instrumental and noninstrumental aggression. Instrumental aggression was defined as aggressive responses that had a specifiable learning history, showed a growth function over time, and was modulated by its consequences. Noninstrumental aggressive responses followed Moyer's (1968) classification and included case histories that gave evidence of species-typical aggression in the following classes: intermale (dominance motivated), predatory, territorial defense, irritable (discomfort, pain, frustration, or fear elicited), and maternal.

Instrumental aggression was further classified into approach- and avoidance-motivated aggression. Approach-motivated aggression was defined as aggressive responses that were maintained by positive reinforcement such as play. Pet owners typically refer to this response as "play biting" or "play fighting." They seek help for it because it has become uncontrollable, not because it is particularly dangerous. Avoidance-motivated aggression has already been defined. Mixed-motivated instrumental aggression has elements of both approach and avoidance.

For this report, two other nonaggressive behavior problems were chosen for comparison with aggression. These were unidimensional phobias and playful destructiveness in dogs. These behaviors were chosen because they represent the most common nonaggressive problems in dogs. A phobic reaction in dogs includes autonomic reactions (i.e., salivation, trembling, heart rate increases, pupillary dilation) and escape/avoidance movements (i.e., snapping, hiding under furniture, running away, cowering) to a definable class of stimulation. Brontophobic reactions (fear of loud noises) and anthrophobic reactions (fear of people) represent the majority of phobias encountered.

Playful destruction involves the dogs engaging in play behaviors with the pet owners' furnishings or clothing (running with, jumping over, digging into, chewing, tearing up such articles). Most commonly this occurred in the owners' absence, especially when some of the "high spirited" sporting breeds (pointers, setters, and retrievers) were "cooped up" and unattended for long durations in a house or apartment.

Techniques of behavior modification compared in this study are differential reinforcement for other behavior (DRO), systematic desensitization, flooding and response prevention, time out (TO), and punishment. DRO involved positively reinforcing nonproblem prosocial behaviors with food or play. This last procedure was similar to Stage 1 and 2 of safety training (see Experiment 2 for details). Systematic desensitization included graded exposure to phobic-eliciting stimuli while reinforcing nonphobic behaviors. Flooding and response prevention involved exposure to full intensity phobic-eliciting stimuli while physically preventing phobic escape and avoidance responses. TO involved removing the dog from a reinforcing social environment and isolating it in a time-out chamber (i.e., empty closet) for 2 to 30 min. contingent upon problem behavior. A detailed description of flooding, systematic desensitization and TO for dogs is described elsewhere (Tortora, 1977, 1980) and is similar to the control procedures in Experiment 3. Punishment involved administration of 1,173 volts, 1.2 mA pulsating shock administered to the ventral neck surface contingent upon problem responding. The shock was delivered by a radio-controlled shock source worn by the dog. The shock apparatus is described in detail in Experiment 2.

Results

Figure 1 presents a breakdown of all case histories taken during the years between 1978 and June 1981. As one can see, 71% of these cases were diagnosed as including some form of canine aggression of which 60% were diagnosed as avoidance-motivated aggression. Personal communication with other animal behavior therapists (Houpt, Note 2; Borchelt, Note 3) indicates a similar pattern of problems with aggression comprising about 70% of their canine case load. However, these results should not be taken as representing the incidence of such problems in the population. It is likely that these case loads are biased heavily in the direction of very severe behavior problems.

Table 1 presents the frequency and conditional probability of some potential initiating events drawn from all case histories of avoidance-motivated aggression. These events include reports of early signs of aggressions, trauma and/or severe or repeated punish-

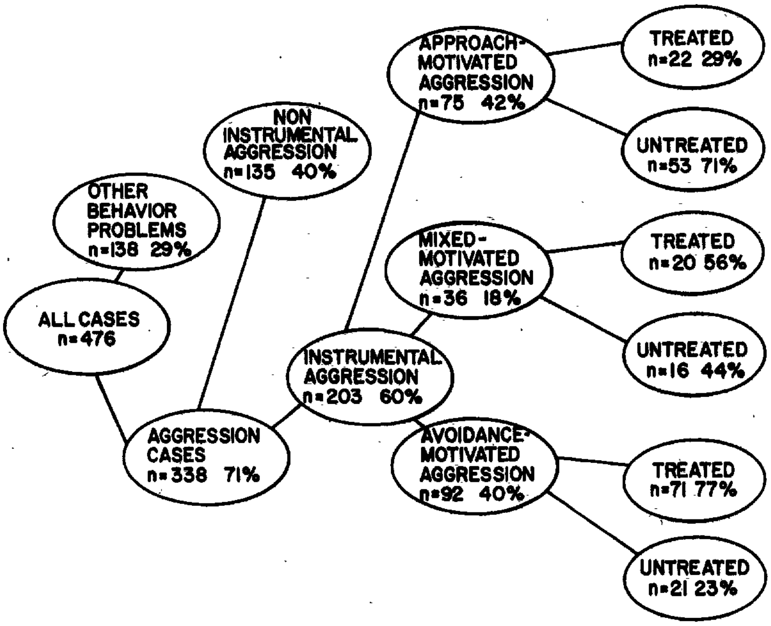

Figure 1. Schematic breakdown of the number and percentage of types of aggressive canine behavior problems referred to me between the years 1978 to June 1981. (The designation treated vs. untreated refers to whether the clients chose to allow their dog to be taken in my care and treated by me.)

ments, and the existence of behavioral control at the time of the consultation.

An early sign of aggression involved a puppy "intentionally biting" one or more humans during the first 15 weeks of its life. As can be seen in Table 1, the conditional probability of an avoidance-motivated biting dog showing early signs of aggression is .696. Of these dogs, 25% (*n* = 16) showed only signs of irritable snapping in which biting occurred to stimuli assumed to cause discomfort, pain, or frustration; 20.3% (*n* = 13) would bite only when exposed to social stimuli that signaled dominance, like turning the dog over on its back; 9.4% (*n* = 6) would bite only when "guarding" an object (chew toy, bone, or food); and 45.3% (*n* = 29) would bite for most or all of these potential eliciting stimuli.

The dogs classified as "no early signs" would not bite as puppies when any of these eliciting stimuli were present. "No early evidence" indicates that the pet owners had never observed their puppies' reactions to these potential stimuli. Eighty-one percent (*n* = 22) of the dogs in these two categories had experienced trauma, punishment, or both before the onset of aggression. Of these dogs, 27% (*n* = 6) developed irritable snapping after a traumatic incident in adulthood, and 73% (*n* = 16) showed signs of dominance-motivated aggression when they reached sexual maturity. The 5 dogs that had not been traumatized or punished exhibited dominance-motivated aggression at or after sexual maturity.

The presence of behavioral control in a dog was defined as the pet owner's ability to control with hand or voice at least four of the dog's responses. Typically, these commands were "Come," "Sit," "Down," and "Stay." However, if the pet owner could demonstrate control over any four of the dog's movements with three repetitions of each command, the dog was scored as "controlled." Even given this liberal definition of behavioral control, 85.9% (*n* = 79) of avoidance-motivated aggressive dogs were classified as "out of con-

Table 1
Summary of the Frequency and Conditional Probability (P) of Events That May Have Initiated Avoidance-Motivated Aggression in Dogs

	Predisposition						
	Early aggression		No early signs		No early evidence		
Aversive experience	BC	NBC	BC	NBC	BC	NBC	Totals
None							
P	0	.043	.011	.022		.022	.098
n	0	4	1	2	0	2	9
Punishment (P)							
P	.033	.033		.033		.011	.109
n	3	3	0	3	0	1	10
Trauma (T)							
P	.033	.065	.011	.043		.011	.163
n	3	6	1	4	0	1	15
P & T							
P	.022	.478	.022	.065	.011	.033	.630
n	2	44	2	6	1	3	58
Subtotals							
P	.089	.620	.043	.163	.011	.076	1.00
n	8	57	4	15	1	7	92
Totals							
P	.696		.207		.087		1.00
n	65		19		8		92

Note. BC = behavioral control; NBC = no behavioral control.

trol." The modal number of responses over which pet owners were able to demonstrate control was two (M = 1.66, SD = .73).

Trauma was defined as any situation in the dog's life history in which the dog was exposed to prolonged or repeated discomfort or pain, with the dog exhibiting classic signs of stress like a reduction in or failure to eat or drink. Trauma alone occurred in 16.3% (n = 15) of the cases. Punishment was defined as repeated beating or striking the dog in response to its aggressive movements or other perceived misbehaviors. Punishment alone occurred in only 10.9% (n = 10) of these cases. Dogs placed in the category P & T had experienced both trauma and punishment for aggression. They occurred jointly in 63% (n = 58) of the cases.

For all three variables taken together, the highest conditional probability within the matrix occurred when dogs showed early signs of aggressions, were out of behavioral control, had had one or more traumatic experiences, and were punished for aggression. The probability of a case history of an avoidance-motivated aggressive dog showing all of these characteristics was .478 (n = 44). In 95% (n = 42) of these case histories, the initiating events occurred in the order just mentioned.

Table 2 presents a summary of the developmental changes for six measures of aggression as a function of time from the first reported aggressive episode. An aggressive episode was defined as any interaction with the dog that included threats of aggression such as growling, snarling, or lip curl, or an attack such as lunging or biting in which parts of the dog's body made intentional physical contact with the owner. The measures of aggression were the pet owner's estimates of the time between aggressive episodes (interepisode interval), duration of an aggressive episode, the number of stimulus situations that could elicit an aggressive episode, percentage of episodes that included an attack, the number of bites per attack, and the modal seriousness of a wound given a bite.

The time course for the development of avoidance-motivated aggression ranged from 2 months to 2 years; however, all cases had a similar pattern of development, all measures showing a progressive increase in the severity of aggression. Thus, in the beginning, episodes of aggression were widely spaced, of short duration, and mostly self-terminating; they involved few eliciting stimuli; they were unlikely to include an attack or bite; and, if a bite occurred, it typically caused no physical damage. At the end of the growth period, the aggressive episodes were closely spaced, of long duration, and not self-terminating; the episodes involved numerous unspecifiable eliciting stimuli, equally likely to include or not include an attack or bite; and, if a bite occurred, it typically caused extensive physical damage. These changes are consistent with growth functions for avoidance habits described in the animal-learning literature.

Table 3 compares the relative effectiveness

Table 2
Summary of Developmental Changes for Six Measures of Aggression

	Beginning		Middle		End	
Estimated measures	Mode	Range	Mode	Range	Mode	Range
Interepisode interval (in days)	60	30–90	14	7–21	2	1–3
Duration of episode (in sec)	<1		2	1–3	10	2–30
No. of eliciting stimuli	1		3	1–5	[a]	[a]
Percentage of attack per episode	0	0–10	10%	0–30	50%	30–100
No. of bites per attack	1		2	1–3	4	1–10
Modal seriousness of wound	no physical damage		cuts and scratches		deep punctures and lacerations	

[a] unpredictable (too many to enumerate).

Table 3
Percentage of Remediations or Exacerbations of Four Behavior Problems in Dogs

Behavior problems	DRO	Systematic desensitization	Flooding	TO	Punishment	Combination
Unidimensional phobias	20	30	60	[a]	[a]	95
Playful destructiveness	22	[a]	[a]	5	52	88
Approach-motivated aggression	48	[a]	[a]	36	42	96
Avoidance- and mixed-motivated aggression	5	10	−10	0	−40	12

Note. Positive values indicate remediation; negative values, exacerbations. DRO = differential reinforcement for other behavior; TO = time out.
[a] inappropriate.

of five treatment techniques in eliminating four typical canine behavior problems encountered in practice. Each technique in isolation and appropriately combined are evaluated, and only those problems directly treated by me are included. A case was scored a success if the dog showed at least a 75% reduction in the probability of problem manifestation during the course of 8 weeks or less of treatment as well as showing indications of a continued decrease. A negative value indicates the percentage of cases that showed a 50% or greater increase in problem manifestation during the treatment procedure.

It is of no particular surprise that established learning contingencies have predictable effects on behavior problems for which they are appropriate. When combined, their effectiveness is substantially increased. Of particular interest is the lack of effectiveness of established learning contingencies for avoidance-motivated aggression. This result would seem to place avoidance-motivated aggression in a class by itself.

What is not indicated by these results are the changes in the probability of avoidance-motivated aggression during treatment as compared with other problems. The expression of all other problems declined progressively over a course of combined treatment. Avoidance-motivated aggression tended to wax and wane over the course of a combined DRO and systematic desensitization treatment regime. A typical case showed a progressive decrease in the probability of aggression and then a sudden increase followed by a progressive decrease. The interval between peaks of aggression varied across dogs but was constant for a particular dog. The mean "interpeak" interval for 20 typical cases was 3.60 days, the mode was 3 days, the standard deviation was 1.17 days, and the range was from 2 to 6 days. In any of the cases the daily probability of aggression given inducement did not decrease below .3. This pattern of changes suggests that avoidance-motivated aggression is self-sustaining and may provide interesting parallels to certain self-sustaining forms of human psychopathology.

Experiment 2

The Theory of Safety Training

The results of Experiment 1 suggest that avoidance-motivated aggression in companion dogs is a habit that is unresponsive to a variety of behavioral treatment techniques. If dogs are to be treated for aggression directed toward their human caretakers, a counterconditioning procedure is needed that can reliably, permanently, and completely eliminate the response. Safety training evolved in this context.

The theories that most influenced the development of safety training are elicitation theory (Denny, 1967; Denny & Adelman, 1955), relaxation theory (Denny, 1971), opponent-process theory (Solomon & Corbit, 1974), and safety signal theory (Bolles, 1970). Taken together these theories suggest that an avoidance response is reinforced through both the reduction of fear (Mowrer & Lamoreaux, 1942, 1946; Rescorla & Solomon, 1967) and the attainment of safety or relief and relaxation. The addition of the safety process, although not parsimonious, is in accord with data found when this process is manipulated in studies of escape-avoidance learning in laboratory animals (Dinsmoor & Clayton, 1966; Franchina, Kash, Reeder, & Sheets, 1978; Grossen & Bolles, 1968; Hammond, 1966; Hendry, 1967; Leclerc & Reberg, 1980; Modaresi, 1978; Murray & Strandberg, 1965; Rescorla, 1969; Rescorla & Lolordo, 1965; Weisman & Litner, 1969).

It was hypothesized that because the aggressive habit was acquired through avoidance learning, the most effective way to countercondition it would be through avoidance learning. The "counter" responses would have to be nonaggressive, prosocial habits useful in controlling the dog's movements and position such as those required by American Kennel Club (AKC, 1977) rules for Companion Dog Excellence (CDX) obedience trials. Furthermore, it was hypothesized that the probability of aggression would be an inverse function of the number and proficiency of prosocial avoidance habits acquired.

Consequently, safety training involves the conditioning of many prosocial avoidance habits so that they are all more likely to occur than aggression. In addition, it involves the use of a conditioned "safety" signal to reinforce these prosocial habits and to help extinguish any fear reaction that may have initiated the aggression or that may have been conditioned during the treatment. The final outcome should be a compliant, unaggressive animal with a range of highly motivated and proficient prosocial habits and a significantly reduced fear reaction.

This training is likely to prevent the reoccurrence of aggression even if the animal is subjected to new stresses or traumas because the dog has acquired a battery of prosocial "coping" behaviors to escape or to avoid these events. In short, the animal will no longer manifest aggression because threats or stresses have been programmed to motivate compliant behavior.

Method

Subjects. Subjects were 26 male and 10 female dogs ranging in age from 12 to 60 months. Breeds, in order of decreasing bulk ratio (weight [lbs.]/height [in.] at shoulders) were 1 female St. Bernard; 2 male Great Danes; 1 male Rottweiler; 1 male English Bulldog; 1 male Giant Schnauzer; 1 male German Shepherd; 1 male Alaskan Malamute; 1 male Chow Chow; 1 female, 2 male Doberman Pinschers; 1 male Dalmation; 2 male Labrador Retrievers; 2 male Rhodesian Ridgebacks; 1 male Standard Poodle; 1 female Bull Terrier; 1 male German Shorthaired Pointer; 1 female German Wirehaired Pointer; 1 female Springer Spaniel; 1 female, 1 male Cocker Spaniel; 1 male Kerry Blue Terrier; 1 male Wheaton Terrier; 1 male Fox Terrier; 1 male Miniature Schnauzer; 1 female West Highland White Terrier; 1 female Lhasa Apso; 1 male Yorkshire Terrier; 2 male Toy Poodles; and 1 male, 2 female medium-sized random-breed dogs.

All subjects were household pets referred by a veterinarian for showing signs of aggression. Neurological and medical examinations including blood, urine, and fecal analysis revealed no physical pathology in all dogs. Five males and 3 females had been surgically neutered, and 10 males had been administered psychoactive drugs and/or progesterones in an attempt to treat the aggression. All subjects were drug free during and after safety training.

A behavioral history of the aggression in which the stimulus and response characteristics of each aggressive episode was described by the pet owners revealed that all dogs had been exhibiting extreme forms of avoidance-motivated aggression for at least 2 months before treatment, during which time the probability of biting given minimal inducement was at or near 1.0. In addition, all dogs showed a progressive increase in biting frequency for at least 6 months before treatment.

During treatment, all dogs were housed individually in a 9 × 12 ft. (2.7 × 3.7 m) room furnished to simulate normal living conditions of a household pet. All dogs had ad libitum access to dry food (Science Diet Growth or Stress Formula, IAMS or ANF) and water, and they were exercised for at least three 15-min. sessions per day.

Apparatus and materials. Materials were various dog-training paraphernalia used as stimuli or as a means of physically controlling the dog's movements. These included whistles, leashes, ropes, training choke collars, wood and rubber retrieving dumbbells and boat bumpers, and portable barrier jumps of adjustable height.

The conditioning apparatus was a radio-controlled electronic and auditory stimulator manufactured by Tri-Tronics, Inc., of Tucson, Arizona. The stimulator included:

1. An Al-90 remote-controlled electronic collar. The collar consisted of a radio receiver and electronic circuitry housed in a 9 × 4 × 5 cm rectangular, anodized aluminum box mounted on a canvas-reinforced rubber collar so that the two 2-cm long, blunt, chrome-plated electrodes separated by 3.3 cm protruded up through the collar with the receiver box below the collar.

The Al-90 could produce two auditory stimuli. Measured by a Gen Rad Precision Sound Level Meter (Model No. Gr 1982) set at weighting C, it produced a 78 dB, 150 Hz vibrating and buzzing sound of a 400-ms duration (warning buzz) and a 53 dB, 5 kHz tone (safety tone). It also produced electrical stimulation of 8 pulse trains per sec ± 5%, 50% duty cycle. Each pulse within the pulse train was .4 msec ± 25% in width. A pulse train had a 255 Hz ± 25% repetition rate. The output impedance of an unmodified Al-90 was 100 k ohms. Peak voltage measured across a resistive load of 100 k ohms was a maximum of 1,134 volts ± 10%.

The intensity of the electrical stimulation was adjusted by attaching exposed fixed ± 5% resistors in parallel with the neck electrodes to act as a voltage divider. The resistances used varied in equal steps from 1 k ohms to 730 k ohms and then infinity (no resistor).

The collar was positioned snugly on the dog so that the electrodes rested on the ventral side of the dog's upper neck.

The A1-90 included a portable radio transmitter with a ¼ mile range housed in a 19.7 × 4.6 cm diameter aluminum cannister with an antenna extendable to 121.9 cm. When one of three buttons on the transmitter was depressed, it produced coded radio signals that caused the remote-controlled collar to emit auditory or electrical stimulation independently or in combination. The transmitter and remote-controlled collar circuitry were programmed so that pressing the conditioning button would expose an animal to a .5-sec warning buzz followed in 10 ms by electrical stimulation. Release of the conditioning button terminated the electrical stimulation and automatically initiated a 3-sec safety tone. Thus, pressing the conditioning button automatically presented the dog with a delayed conditioning paradigm in which termination of each stimulus was contiguous with the onset of the next stimulus in the sequence. The duration of electrical stimulation could be sustained by maintaining pressure on the conditioning button. A circuit breaker in the collar automatically terminated electrical stimulation at 10 sec and activated the safety tone.

2. A "dummy collar," identical in appearance, size, shape, and weight to the remote-controlled collars. It was used to habituate the dog's responses to wearing a collar during Phase 1 of safety training.

3. Portable cassette tape recorders (Lanier, Model #MS-60) for recording the events occurring during training and generating random intervals.

General procedure. The study was run over a 2½-year period during which squads of three or four dogs were trained at one time with a comparable number of subjects in a waiting list control. After an initial consultation with the pet owners, all subjects were placed on a waiting list for 6 to 8 weeks before being run through the procedure.

During this consultation, pet owners were informed of the diagnosis, given information concerning the nature of avoidance-motivated aggression, and taught techniques to manage the aggression while the dogs remained on the waiting list. In addition, pet owners were taught how to keep a behavioral diary in which they were required to make daily entries concerning the dog's behavior including specific descriptions of the time, circumstance, and nature of aggression or threats of aggression.

During treatment, all dogs were trained to produce 15 operands (i.e., responses to verbal and/or hand signal commands) over nine stages of safety training. Each stage of safety training had the following common characteristics. There were from 5 to 20 twice-daily sessions per stage. Each session lasted 90 min. and consisted of an average of 15 command–response trials. The intertrial interval (ITI) was a variable 5 min., ranging from 2 to 8 min.

Fifteen operands were shaped to progressively higher performance criterion at each stage. The operands were chosen from the AKC (1977) standard for CDX obedience. The criterion for choice of operands was that they would be useful in controlling the dog's movements in a home situation and that taken together they would balance each other on the dimension of direction, type, and amount of movement required to perform the operand. For example, "Stand" was balanced by "Down," "Come" was balanced by "Go," and "Hold" was balanced by "Drop." The operands were "Come" (run to and sit in front of trainer); "Sit" (place hindquarters on the ground while maintaining an erect head posture); "Down" (place all fours on the ground such that the breastbone is resting on the ground while maintaining an erect head posture); "Stand" (stand up squarely on all fours with head and tail erect); "Go" (run in the pointed direction until commanded otherwise); "In" (enter a designated enclosure); "Off" (step off an elevated platform, chair, sofa, or lap); "Stay" (maintain whatever position the animal happens to be in when the command is given); "Heel" (come to, stay by, walk, or run by the trainer's left side so that the animal's neck remains parallel with the trainer's left knee despite changes in trainer's movement and turns); "Hold" (grasp, hold, and carry an object placed in front of the animal); "Drop" (release a held object); "Hup" (jump up onto a platform or over a hurdle); "Place" (locate and lie down in a place designated by a bath mat); "Fetch" (chase, grasp, or catch and return to the trainer a thrown object or locate and return to the trainer a hidden object); "No" (suppress all ongoing activity); "Play" (run, romp, wrestle, and play tug-of-war with trainer).

In order to assess the development of "learning set" (Harlow, 1949) or learning to learn, dogs were presented with tests of their speed of acquisition of a new response and their speed of suppressing an established problem response throughout safety training. If a learning set was being established, then as training progressed, dogs should need progressively less trials to learn a new response or to suppress a problem response. Thus, the "Place" operand was the only response taught at different stages of safety training for different dogs. In addition, a problem, nonaggressive, high base-rate response was selected for punishment with full-intensity electrical stimulation for different dogs at different stages of training. The problem response varied for different dogs and included responses such as barking and howling, chewing and digging destruction, jumping up on and slamming into people or doors.

All dogs exhibited more than one problem response. The criterion for selection of the response was that a particular dog would engage in the particular response more frequently and with greater vigor than any other problem response. After the selected problem response was suppressed, all other problem responses were also eliminated with contingent punishment.

All dogs were tested and trained in the following environments: (a) 125-acre grass and treed field (former golf course) varying in topography from flat land to rolling hills, with sand traps and one pond and one small lake; (b) sidewalks of varying congestion near streets with varying traffic patterns; (c) busy shopping malls; (d) in and around a local pound with approximately 50 kenneled dogs invariably barking continuously; (e) in situations simulating normal household environment; (f) in college classrooms with from 20 to 60 students in attendance. This included moving to and from classrooms across busy college commons, riding elevators, climbing stairs, and occasionally attending faculty meetings. Over the course of this study, weather conditions varied from rain and snow to dry climate, from −5° to 98° (−20°C to 37°C), and from overcast to bright sunshine.

Each stage of training was interlocked with the previous stage so that subjects had to meet or exceed a number of performance criteria to advance to the next stage. Table 4 presents the main characteristics and criteria for advancement for each stage. The nine stages were grouped into three phases labeled pretesting and pretraining, conditioning, and normalization.

Although the nine stages of safety training were interlocked, the cumulative effect on aggression of each succeeding stage could be evaluated independently. Conceptualized this way, the safety training procedure could be considered an example of a large sample size, changing-criterion design (Craighead, Kazdin, & Mahoney, 1976). This single subject design is frequently used to evaluate sequentially presented behavior modification treatments.

Phase 1: Pretesting and pretraining. This phase included three stages. The purpose of these stages was to (a) measure the dog's operant level of aggression and the performance of operands, (b) condition a play response to a verbal command, and (c) train the dog so that the performance of operands was essentially equated for all dogs before conditioning with electrical stimulation.

During the first half of Stage 1, all subjects were pretested on the baseline probability and latency of performance on each of the 15 operands, their reactions to the conditioned stimuli, and the probability of avoidance-motivated aggression given inducement.

During this and subsequent stages, the dog wore a dummy collar. This collar was placed on and taken off the dog at least three times per day on a random schedule with regard to feeding, exercise, testing, and training schedules. Thus, those stimuli associated with wearing a collar were adapted to, and those stimuli associated with the introduction and removal of the collar were made irrelevant.

Each subject was led to the testing area on a leash and given every command in an authoritative voice twice in each of two 90-min daily sessions. The two pretesting days were run consecutively. During a session, the order of commands was randomized. The latency of compliance was recorded if the subject performed the operand within 30 sec after the command. Noncompliance was assigned a 30-sec latency.

Aggression was measured by noting the frequency of biting and/or biting attempts during commands and during 10 stimulus presentations per session designed to elicit the aggression. These aggression-inducing stimuli were randomly presented and differed for each subject since they were drawn from the pet owner's description of those stimuli most likely to cause aggression. In general, they involved rapid hand or foot movements toward the dog or raising a hand, foot, or object simulating a potential blow.

Response to 10 warning and 10 safety conditioned stimuli (CSs) presented randomly over the 2-day testing session were also noted. Notation involved the presence or absence of a reaction and a verbal description of the reaction in terms of changes of head, ear, tail position, body posture, and muscle tonus.

Play conditioning was started after the pretesting was completed. A play trial involved verbally giving the play command and immediately inducing the dog into a play bout by throwing play objects; running with, jumping with, and chasing the dog; and inducing it to play tug-of-war. Aggression and threats of aggression were met by a 30-sec to 2-min time out in which the trainer ceased all movement and interaction with the dog. Sessions of play conditioning were continued until subjects would play immediately on command and maintain play throughout the trial.

Stage 2 involved the initial acquisition of the 15 operands with a play bout as a positive reinforcer. During this and subsequent stages, latency of operands were sampled on a variable 9-min schedule signaled by a pocket-sized cassette tape recorder. Every instance of compliance within 30 sec and 2 sec was recorded per trial. Every instance of aggression or threat of aggression and other observations of the dog's behavior were recorded.

Commands were randomly distributed throughout a session. After a command, the dog would be gently guided with the aid of a leash or rope into performing the operands and then immediately reinforced by a play trial. As operands were acquired, guidance was faded, and subjects were placed on a progressively increasing variable ratio (VR) schedule of play reinforcement for each operand. When all operands were on a VR 5 schedule, the dogs were advanced to Stage 3.

Stage 3 involved maintaining the operands on a VR 5 schedule of play reinforcement and introducing mild negative reinforcement on a continuous reinforcement (CRF) schedule. Negative reinforcement involved the termination of choke collar pressure. In this stage, a command was given and then followed immediately by a sudden constriction and then by a progressive increase of pressure of the choke collar. The pressure was relieved immediately when the dog began to perform the operand. All adjunctive behavior, such as flailing about at the end of the leash, biting, or other aggressive attempts, yelping, and so on, resulted in maintenance of choke collar pressure. As the dogs acquired the operands, the initial force of choke collar pressure was increased. Since latency of operands decreased with acquisition, the net result was a maintenance of an approximately constant density of pressure over trials.

Phase 2: Conditioning. In this phase all subjects were trained to perform the operands first to escape progressively increasing electrical stimulation (Stage 4), then to avoid electrical stimulation (Stage 5), and finally to attain the conditioned safety tone (Stage 6). The phase progressed in three stages.

Stage 4 involved an escape conditioning paradigm with electrical stimulation as the main aversive stimulus. In this and subsequent stages, all previously described measures were maintained, and the trial on which the first avoidance and last escape occurred was noted. At the beginning of this stage, the performance of an operand was ensured by the use of leash and choke collar as in Stage 3. The "leash control" was discontinued in 10 to 15 trials per command ($M = 13$) for all subjects. The criterion for discontinuing "leash control" for a particular operand was the occurrence of 3 correct trials in a row in which the unassisted operand (latency ≤ 10 sec) was performed to escape electrical stimulation.

On an escape trial the trainer gave a command simultaneously with pressing the conditioning button on the remote-controlled transmitter and then released the conditioning button as the dog began to perform the operand. Since there was a 200-msec delay between

Table 4
Main Characteristics and Criterion for Each Stage of Safety Training

Phase and stage	Objective	Criterion	No. of sessions *M*	No. of sessions *SD*	No. of shock escapes *M*	No. of shock escapes *SD*
Pretesting and pretraining						
Stage 1	Operand & aggressive baseline and play conditioning	P(play/command) ≈ 1.0	10	1.8	—	—
Stage 2	Shaping of operands with play reinforcement on an interlocking schedule culminating with a VR 5	P(operand ≤ 30 sec) ≈ 1.0 P(operand ≤ 2 sec) ≈ .25	14	3.4	—	—
Stage 3	Development of operands with play reinforcement on VR 5 and negative reinforcement on CRF	P(operand ≤ 2 sec) ≈ .5	10	2.4	—	—
Conditioning						
Stage 4	Escape training with play reinforcement on VR 5 and escape from progressing increasing shock on CRF	P(operand ≤ .9 sec) ≈ .5	16	2.0	203	25
Stage 5	Avoidance training same as Stage 4 without shock	P(operand ≤ .6 sec) ≈ .5	14	3.8	21	5
Stage 6	Safety training same as Stage 5 without warning stimulus, play reinforcement on VR 5, safety tone on CRF	carriage ≈ 2	14	4.6	12	3.1
Normalization						
Stage 7	Stress testing & generalization; play & safety reinforcement progressively increased to a VR 15 shock punishment for noncompliance, aggression, and remaining problem responses	same as Stage 6	10	3.7	23	8.2
Stage 8	Phase out; same as Stage 7 without remote collar	same as Stage 6 for three consecutive collarless sessions	8	1.6	7	2.3
Stage 9	Transfer of training punishment for noncompliance or problem response	clients voluntarily return remote trainer	2 weeks	1–4 week range	5	2

Note. CRF = continuous reinforcement. VR = variable ratio.

depression of the conditioning button and the presentation of the warning stimulus from the remote-controlled collar, the conditioning sequence was as follows: Command—CS warning buzz—unconditioned stimulus (US) electrical stimulation—Operand—CS safety tone. Adjunctive behavior or aggression during electrical stimulation resulted in continuing electrical stimulation until the operand was performed. A circuit breaker in the remote-controlled collar terminated electrical stimulation exceeding a 10-sec limit; however, this limit was not reached in any of the subjects.

Figure 2 diagrams the temporal relations of stimuli, responses, and reinforcers in an escape trial.

In the beginning of the escape learning phase, the intensity of electrical stimulation was adjusted to the lowest level possible to just produce neck muscle contractions in synchrony with the burst rate of electrical stimulation without eliciting yelping or flinching or other adjunctive behavior. Over sessions the intensity of electrical stimulation was gradually increased to full intensity. The rate of increase was adjusted to minimize adjunctive behavior. For all dogs full intensity was reached on or before the ninth escape-conditioning session. All subjects were maintained on a VR 5 schedule of positive play reinforcement throughout this and subsequent stages of the conditioning phase. All dogs were maintained on escape learning until the latency for beginning the performance of each operand was 900 msec or less. This latency terminated the conditioned avoidance stimulus (CAS) and prevented electrical stimulation. When a subject maintained a 900-msec or less latency over half of the trials for one full session, it was advanced to Stage 5, or avoidance learning.

Stage 5 was identical to the previous stage with the exception that avoidance trials were run without electrical stimulation. An avoidance trial involved stimuli and responses in the following sequence: Command—CS warning buzz—Operand—CS safety tone. Stage 5 is conceptually similar to the extinction phase of an avoidance-learning study; however, the performance of all subjects continued to improve throughout this stage.

During this stage, pet owners were required to work with their animals for at least one session per week. In essence, the pet owners modeled the trainer's voice and hand signals while the trainer remotely activated the warning and safety signals at appropriate times.

All subjects were maintained on avoidance learning until the latency for beginning to perform all operands was less than the delay of the warning buzz. This delay included the trainer's reaction time, which was approximately 400 msec, and the 200-msec delay time between button depression and onset of warning buzz. Thus, a latency of approximately 600 msec or less prevented the CAS. The CS safety tone was maintained throughout Stage 5 on a CRF schedule. When subjects maintained an approximate 600-msec latency over half of the trials for one full session, it was advanced to Stage 6, or safety training.

Stage 6 was identical to the previous stage with the exception that the safety trial was run without the CAS. A safety trial involved stimuli and responses in the following sequency: Command—Operand—CS safety tone. Since the latency of performance for subjects was approaching their physiological limit, performance was also assessed and rewarded qualitatively; that is, subjects were rewarded for progressively more precise execution of operands in which correct posture was also a requirement for positive reinforcement.

Posture and precision of performance was assessed throughout various stages of training by rating subjects for carriage on a 7-point scale from −3 (slow, cautious, defiant, or submissive performance) to +3 (eager, prancing, alert, and jaunty performance). Safety training was continued until the subjects performed all operands precisely and with correct posture; that is, they obtained a performance rating from both the trainer and the pet owner that equaled or exceeded +2.

Phase 3: Normalization. The purpose of this phase was threefold: (a) to facilitate and test for the generalization of behavioral control so as to eliminate aggression in stimulus situations originally designed to induce aggression and breakdown in control, (b) to phase out the use of the remote-controlled collar, and (c) to ensure complete transfer of training to the pet owner's home environment.

Stage 7, or stress testing and generalization, was identical to the previous stage except that:

1. The safety tone reinforcer was placed on a progressively increasing VR schedule terminating in VR 15.
2. Play bout reinforcement was placed on a progressively increasing VR schedule terminating in VR 15. The presentation of the safety tone and play bout were independent and at the end of Stage 7 equaled one each per session.

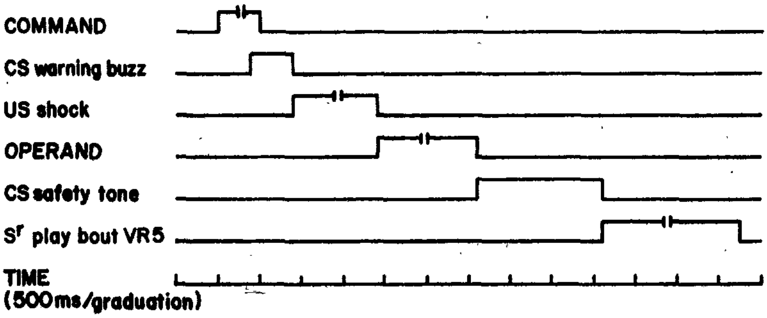

Figure 2. Schematic representation of the timing of the presentation and termination of auditory and electrical stimulation and the contingent relationships occurring during a shock escape trial of Stage 4 of Experiment 2. (CS = conditioned stimulus; US = unconditioned stimulus; S^r = reinforcement; VR = variable ratio.)

3. Subjects were tested for generalization of behavioral control under maximally distracting stimuli, for example, when other untrained dogs were allowed to roam free in the training area while the subject was being tested and when trained distractor dogs harassed the subject during tests by attempting to play with, bump into, jump over, and run past the subject undergoing testing. The generalization test always included four distractor dogs (two trained and two untrained).

4. Subjects were tested for the absence of aggression under maximally stressful and aggression-inducing circumstances, for example, while the animal was roughly handled and beaten about the body with a rolled-up newspaper or switch.

5. Subjects were tested for the maintenance of behavioral control and the absence of aggression in environments selected to be maximally different from the training environments.

6. Punishment with full-intensity electrical stimulation was scheduled for every incorrect response or aggression. The punishment terminated upon compliance or the cessation of aggression. A subject was advanced to the next stage when Stage 6 level of performance was regained, and a zero frequency of aggression was maintained for three consecutive stress and generalization sessions.

Stage 8, or phase out, was essentially the same as the previous stage except that a dog was ultimately required to maintain the previous performance level without wearing a remote-controlled collar. The phase out was gradual with progressively more sessions accumulated without the collar. This stage was completed when the subject could maintain all previously mentioned criteria in three consecutive collarless sessions.

Stage 9, or transfer of training, occurred in the pet owner's home. Prior to this stage, all adult members of the pet owner's family were instructed in the operation of the remote-controlled collars. The dogs were returned to their original environment with the remote-controlled collar. Pet owners were only required to punish improper operands or aggression with electrical stimulation and to note the dog's performance. This stage was considered complete when pet owners voluntarily returned the radio-controlled collar. Follow-up testing was scheduled for all dogs 3 months, 6 months, 1, 2, and 3 years after Stage 9 to assess the longevity of the behavioral control and the absence of aggression. The number of dogs tested at each follow-up period was 36, 36, 36, 18, and 8 respectively.

Results

A tape recording made by the trainer of each training session contained a record of the commands given, mechanical sounds indicating the warning buzz, electrical stimulation and safety tone, vocalizations made by the dog and an ongoing verbal narrative using single-word descriptions of the dog's body posture, muscle tonus, and responses. Thus, the tape recording contained objective data on latency of operands by measuring the time between onset of a command and the onset of the safety tone reinforcement, as well as frequence and proportion of operands and proportion of yelping during electrical stimulation. Data subject to the trainer's judgment were narrative descriptions providing frequency and proportion of induced aggression and play, observations of muscle tremor presession and postshock, play postshock, and verbal descriptions of the dog's carriage.

In order to assess reliability of recording, 10 out of each batch of 100 recorded sessions were randomly sampled for reliability checks. A reliability check involved a trained listener transcribing the tape-recorded data onto a behavioral recording sheet. The trained listener was unaware of the stage and session being transcribed or the specific nature of the dog being trained. The data obtained by the trained listener were averaged for the session, and these mean scores were correlated with the means generated in the same way by the trainer. This resulted in 346 pairs of means (listener and trainer) for each of eight measures of behavior taken over the entire length of the study.

Reliability of measurement was assessed by having an observer, trained to classify behavior in the same way as the trainer, make independent tape recordings of every 100th session. The trainer and observer independently transcribed the results of the observation on behavioral recording sheets. These data were averaged for the session, and the mean scores obtained by the trainer and observer were correlated. The correlation resulted from 35 pairs of means (observer and trainer) for each of eight measures of behavior taken over the entire length of the study.

Table 5 summarizes the Pearson product-moment reliability coefficients for recording and measurement for eight measures of behavior taken over the entire duration of the study. All correlations but one were significant at $p < .001$. Although significant ($p < .02$), the reliability of measurement coefficient for mean latency of operands was the lowest, most likely because of the difficulty of accurately assessing in an open field situation the exact time of onset and offset of the behavioral events involved in timing latency. However, when the data were transformed into proportions, the reliability coefficients

Table 5
Pearson Product-Moment Reliability Coefficients for Recording and Measurement for the Means of Measures of Behavior Taken Throughout Experiment 2

Measurements	Reliability of recording	Reliability of measurement
Latency of operands	.68**	.43*
Proportion of operands	.92**	.86**
Proportion of aggression	.81**	.72**
Proportion of induced play	.76**	.65**
Proportion of muscle tremor		
Presession	.82**	.78**
Postshock	.75**	.73**
Proportion of yelping	.98**	.93**

* $p \leq .02$. ** $p \leq .001$.

were increased to an acceptable level. Thus, only proportions were used in analysis of the data.

Six categories of results were analyzed: (a) the effect of safety training on avoidance-motivated aggression, (b) the acquisition of operands over stages, (c) Stage 4 escape and avoidance acquisition for each operand, (d) evidence for the development of a learning set over stages, (e) changes in the dog's emotionality over stages, and (f) changes in the dog's carriage over stages.

Avoidance-motivated aggression. Figure 3 presents the mean proportion of aggression when the dogs were given inducement. Aggression by the dogs during their stay on the waiting list and by the same dogs during the nine stages of safety training is compared. The measures during safety training were calculated by obtaining the mean proportion of aggression (frequency of aggression/frequency of inducements) for each dog for each stage and then the mean of all of these individual proportions for each stage.

The measures for the waiting list controls were derived from the pet owners' diaries by calculating the mean proportion of aggression for each dog over a period equal in length to each stage of subsequent training. The mean of these individual measures was computed.

This way of treating the data resulted in a repeated measures within-subjects design in which data on the same subject was taken

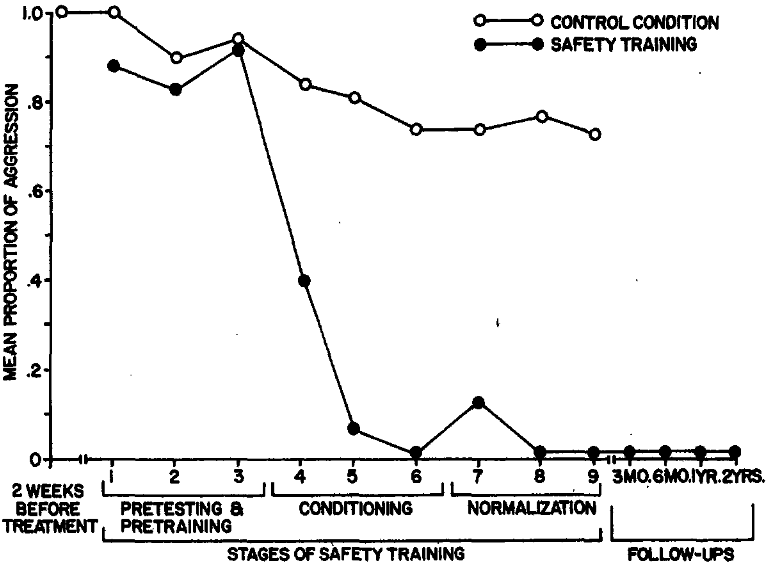

Figure 3. Mean proportion of aggression as a function of phases of training (pretraining, conditioning, and normalization), stages within phases (1–9), and follow-up data for the waiting list control condition and the safety-training condition in Experiment 2. (The point 2 weeks before treatment was assessed from clients' estimates of the proportion of aggression on or about 2 weeks before their initial contact with me.)

across conditions (safety training vs. waiting list) and over stages within conditions. A 2 × 9 analysis of variance (ANOVA) for repeated measures yielded significant conditions, $F(1, 34) = 46.01, p \leq .001$, significant stages, $F(8, 272) = 21.4$, $p \leq .001$; and a significant Stages × Conditions interaction, $F(8, 272) = 10.4$, $p \leq .001$. The main effect of stages was nonsignificant for the control condition, $F(8, 272) = 2.07$, $p > .05$, and significant for safety training, $F(8, 272) = 42.6$, $p \leq .001$. The aggression score for all safety-trained animals was zero by Stage 8 and stayed there. Thus, it can be concluded that safety training eliminates avoidance-motivated aggression for substantial periods of time.

Dunn's test (Keppel, 1973) for differences between the means of the stages of safety training indicated no significant differences between Stages 1, 2, and 3 and no significant differences between Stages 5 through 9. Stage 4 was significantly different from all other stages, *ps* $\leq$ 01. This pattern of results suggest that the major impact on aggression of the entire training procedure occurred over Stages 4, 5, and 6; that is, the change was due to learning operands in the escape, avoidance, the safety paradigms.

Since escape, avoidance, and safety procedures were nested in Stage 4, it is not possible to separate their respective contributions to the total change. The effect of safety training could not be assessed in this study because the level of aggression was already near zero when Stage 6 began. Experiment 4 assesses the effects of safety training on aggression.

Acquisition of operands. Figure 4 presents the mean proportion of correctly performed operands with a latency of 2 sec or less across stages of training. Mean proportion was based on the mean proportion (frequency of operands with latency $\leq$ 2 sec/frequency of commands) for each dog for a particular stage and the mean of these means for all dogs tested.

The ANOVA for repeated measures over the nine stages of training showed a significant stages effect, $F(8, 272) = 143.2$, $p \leq .001$, in keeping with the observation that the dogs obviously learned what they were taught and performed these operands at a rather high level of proficiency.

An analysis of difference between pairs of means indicates a significant difference between Stages 1 and 2, $F(1, 44) = 26, p \leq .001$; between Stages 2 and 3, $F(1, 34) = 15$, $p \leq$

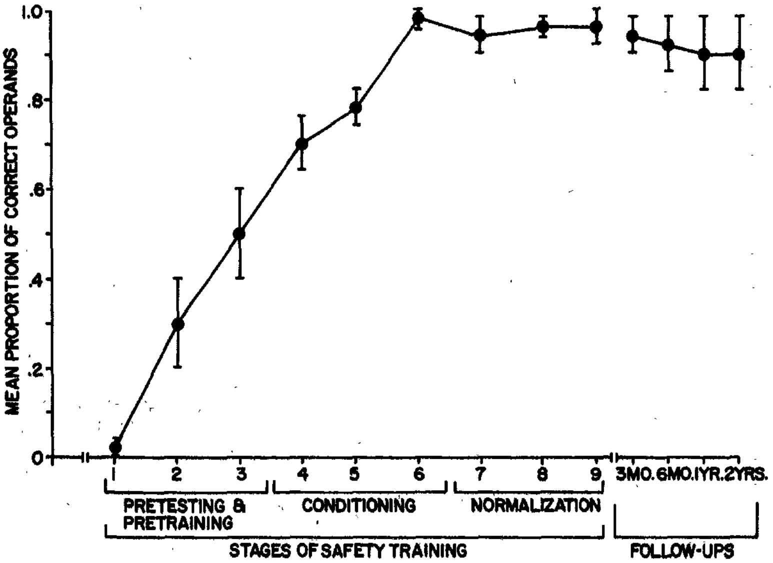

Figure 4. Mean proportion of a correct operand given a command as a function of phases of training (pretraining, conditioning, normalization), stages with phases, and follow-up in Experiment 2. (The lines above and below the data points for this and subsequent figures represent a ±1 standard error of the mean.)

.001; between Stages 3 and 4, $F(1, 34) = 21.6$, $p \leq .001$; no difference between Stages 4 and 5, $F(1, 34) = 3.65$, $p > .05$; a highly significant difference between Stages 5 and 6, $F(1, 34) = 72.8$, $p \leq .001$; and no difference between the means of the remaining stages.

To put these performance data in perspective, it should be pointed out that all operands except "Place" were presented during every session of every stage. In a sense, on any one trial a dog was required to perform a conditional discrimination between 15 vocal and 15 hand–body signals and correctly select 1 response from 15 in order to perform correctly on that trial. Ultimately they had to perform this discrimination and selection in 2 sec or less. In addition, they had to learn to ignore a wide variety of distracting stimuli.

Modal instrumental learning studies usually require two-choice discriminations with one specified operant. Thus, this is a far more complex learning situation than is typical of the animal-learning literature.

Learning set. "Learning set" was assessed in two ways: by the speed of acquiring the "Place" operand and by the speed of suppressing a high base-rate, nonaggressive problem response at various stages of training.

Figure 5 depicts the mean trials to acquire a "Place" operand for different dogs ($n = 6$) as a function of the seven intermediate stages of training. An ANOVA for independent groups produced a significant stages effect, $F(6, 5) = 32.8$, $p \leq .001$. Dunn's test indicated that all differences between the means of all stages were significant at or beyond $p \leq .01$ except for the difference between Stages 3 and 4. These results imply that the dogs were learning how to acquire new operands as they progressed through the training procedure; naive dogs (Stage 2) acquired the "Place" operand in 27 trials, and sophisticated dogs (Stage 8) acquired the "Place" operand in an average of 1.5 trials.

Figure 6 presents the mean number of shocks to suppress a high base-rate problem response for different dogs at the various stages of safety training. A one-way ANOVA yielded a significant stages effect, $F(6, 5) = 75.9$, $p \leq .01$. Dunn's test for differences between means indicated the following significant differences, 3 versus 1 and 2 ($ps \leq .05$), 3 versus 4 ($p \leq .05$); 4 versus 6, 7, 8, and 9 ($ps \leq .05$). This may well be the first demonstration of learning set in which all animals eventually learn to suppress a high base-rate response in one trial.

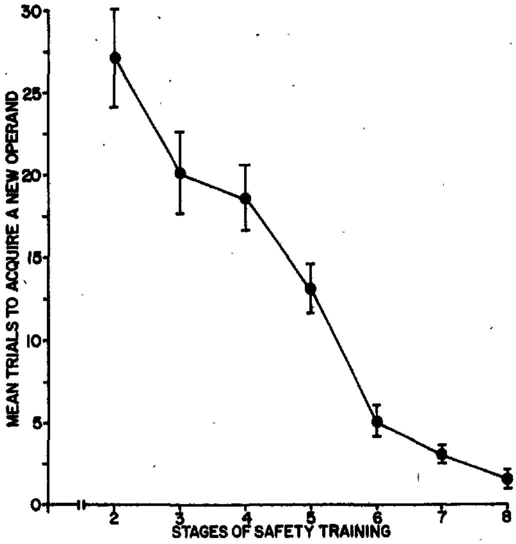

Figure 5. Mean trials to acquire a new operand ("Place") for seven independent groups of dogs as a function of stages of safety training (2–8) in Experiment 2.

To put these learning set effects into perspective, one should realize that each dog was required to perform 15 different operands at each stage of training. Each operand had at least two discriminative stimuli, a vocal and manual signal. The criterion for correct performance of each operand and the amount of environmental distraction increased over stages. The nature of the reinforcement and punishment contingencies changed over stages. The position of the trainer in relation to the dog, and the nature of the external environment was variable over trials within a stage.

For a dog, the performance of any operand, for example, "Sit," constituted a different problem (or conditional discrimination) depending on the trainer's position, type of discriminative stimulus, difference in level of distraction, type of irrelevant external stimulation, and quality of required performance. To get an estimate of the number of "problems" a dog was presented in this study, one has to multiply all these factors by the number of operands. Conservatively, assuming two discriminative stimuli, two levels of distraction, five types of environments, four trainer positions, and two levels of perfor-

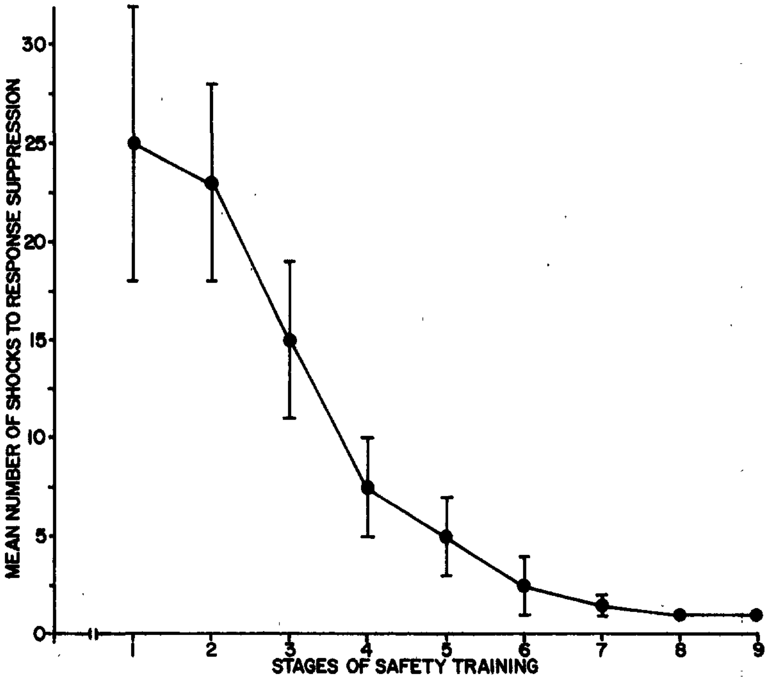

Figure 6. Mean number of shocks to suppress a high base-rate response for seven independent groups of dogs as a function of stages of safety training (1–9) in Experiment 2.

mance, one gets 2,400 related problems over the course of the training. This figure is far in excess of 256, the number of problems rhesus monkeys (Harlow, 1949) needed to form a learning set.

The estimated number of problems presented to the dogs is only a rough approximation; some of the variables just mentioned are continuous rather than discrete and probably interact to form distinctively different constellations of stimuli for each problem. Further research is needed to determine the number of problems necessary to obtain learning sets in dogs through avoidance learning or punishment.

The acquisition of individual operands. Figure 7 presents the data for escape training (Stage 4) in terms of mean trials to the first avoidance and mean trials to the last escape for each operand acquired. Because of the short interstimulus interval, an operand had to be initiated in less than 1 sec to be considered an avoidance response. An additional requirement for an avoidance response was that the operand be successfully completed after it was initiated. Since the "Place" operand was acquired at different stages for different dogs, the mean of this response only includes dogs that acquired the "Place" operand on or before Stage 3 ($n = 15$). All other means have a sample size of 36.

It can be seen from Figure 7 that the speed of acquisition differed across avoidance operands. ANOVAs for repeated measures with different operands as the independent variable and either trials to first avoidance or to last escape as dependent variables produced significant F ratios of 10.2 ($df = 14, 616$; $p \leq .001$) and 12.6 ($df = 14, 616$; $p \leq .001$), respectively. These differences occurred despite the fact that all operands were pretrained in the first three stages of the procedure to a mean response probability of at least .3. As the result of pretraining, the difference in operand base rates at the beginning of escape training was not significant, $F(14, 476) = 1.31$, $p > .25$.

Turner and Solomon (1962) attempted to explain differences in the speed of acquisition of different types of avoidance response in dogs and humans by postulating a dimension of *reflexiveness* of the avoidance response. Reflexiveness had five components: (a) the latency of the unconditioned response (UR)

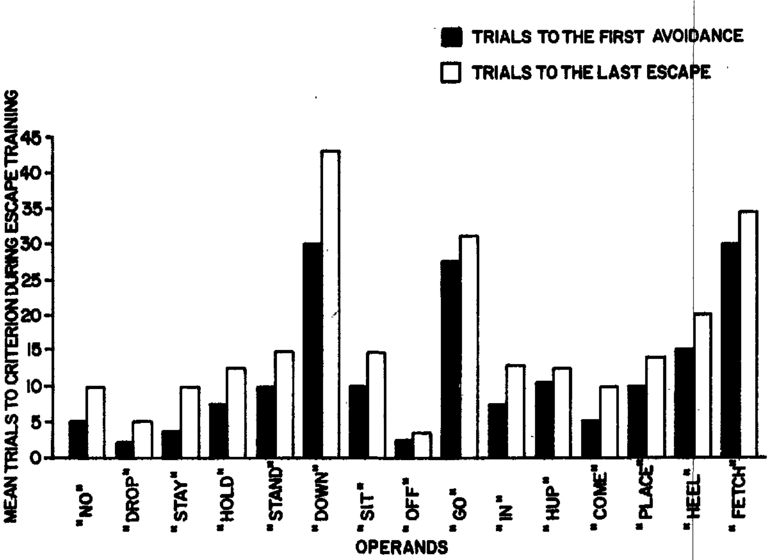

Figure 7. Mean trials to the first avoidance and last escape for 15 operands conditioned during Stage 4 of Experiment 2.

to shock, (b) the amount of body involvement required to make the avoidance response, (c) the amount of change in interoceptive stimulation produced by the response, (d) the amount of change in external stimulation patterns produced by the response, and (e) the relative frequency (probability) of the response with successive presentations of the US (operant level).

Reflexive responses, or what Skinner (1935, 1938) would call respondents, have a short latency, require minimal body movement, create small interoceptive and external stimulus changes, and have a high "operant" level. Nonreflexive responses, the traditional Skinnerian (1935, 1938) operant, are just the opposite. The prediction is that reflexive responses show (a) rapid acquisition of escape responses, (b) slow acquisition to the first avoidance responses, (c) slow development to the last escape response, and (d) rapid extinction of the avoidance response. The converse is predicted for nonreflexive responses.

The logic for this prediction is cognitive. Turner and Solomon (1962) reasoned that because of the involuntary nature of reflexive responses, subjects are not aware of what they did to escape shock; thus, they cannot benefit from knowledge of results and cannot learn a reliable avoidance response.

This hypothesis has never been submitted to a powerful test because most comparisons have been across studies rather than within. The data from this study provide an opportunity for an appropriate test. To accomplish this test, all 15 operands were rated on the five dimensions of reflexiveness just described. Table 6 presents these ratings, together with a rating of morphology of the UR to shock (to be described soon).

Latency and operant level of operands were rated by answering the question What is the estimated likelihood that a naive dog would spontaneously emit the operand during an unlimited duration of neck shock? Because of their complexity, the "Place," "Fetch," and "Heel" operands were assigned a rating of 4 for an infinite latency and a 0 for operant level. Because of their simplicity and numerous observations of dogs undergoing neck shock, the "No," "Drop," "Off," and "Stand" operands were assigned a 1 for a short latency and a 2 for high operant level. Dogs typically stop what they are doing, drop what they are holding, stand if they are sitting or lying down, and jump off a platform when they experience neck shock. The latency and operant level of other responses were rated as intermediate.

The amount of body movement required was rated on a 5-point scale from 0 (little or no body movement as in "No" and "Stay," both requiring cessation of movement) to 4 (maximal movement as in "Come," "Go,"

Table 6
Rating of Operands on Five Dimensions of Reflexiveness

Operand	Latency	Operant level	Body movement & interoceptive stimulation	External environmental change	Morphology
No	1	2	0	0	similar
Drop	1	2	1	1	similar
Stay	1	2	0	0	similar
Hold	2	1	1	1	dissimilar
Stand	1	2	2	2	dissimilar
Down	4	0	2	2	dissimilar
Sit	3	0	2	2	similar
Off	1	2	2	3	similar
Go	1	2	4	3	dissimilar
In	2	1	3	3	similar
Hup	2	1	3	3	similar
Come	3	0	4	3	similar
Place	4	0	3	3	dissimilar
Heel	4	0	3	3	dissimilar
Fetch	4	0	4	3	dissimilar

and "Fetch," which require vigorous long-distance running and many component movements. The amount of interoceptive stimulation was rated by assuming that the more the dog was required to move, the more interoceptive stimulation it would experience. Thus, this dimension was somewhat redundant.

The amount of external stimulus change was rated on a 4-point scale. A 3 was given to operands that altered the dog's location, like "Come," "Off," or "In." A 2 was assigned to operands that altered the dog's position but held location constant, like "Sit," "Down," and "Stand." A 1 was assigned to operands that required movement without changing position and location, and a 0 was used for those behaviors that required a cessation of movement.

Table 7
Gamma Coefficients Describing the Association Between Four Rankings of the Responses and Trials to Criterion

Rankings	First avoidance	Last escape
Latency	.79*	.56
Operant level	−.82*	−.46
Body movement	.21	.15
External change	.32	.20

* $p \leq .05$.

Table 7 summarizes the gamma (Hayes, 1963) coefficient, a measure of association in ordered classes, between both measures of trials to criterion and the four of the qualitative ratings of the operands (change in interoceptive stimulation was not used because it was not possible to rate it independently of body movement). Like a correlation coefficient, gamma varies from +1 to −1. Latency was positively and operant level was negatively associated with both measures of trials to avoidance criterion. The other two measures showed a slight positive correlation.

To the degree that latency and operant level are measures of reflexiveness, this pattern of results refutes Turner and Solomon's (1962) predictions. High operant level, short-latency avoidance operands are learned more rapidly than low operant level, long-latency avoidance operands. This is exactly opposite to the reflexiveness prediction. However, it is possible that the responses required in this study were not "reflexive" enough and thus do not provide an adequate test of the hypothesis.

An alternative explanation of the difference in speed of acquisition of different operands is Denny and Adelman's (1955) postulate of "consistent elicitation." The postulate suggests that the speed of acquisition will be directly proportional to the similarity in response morphology between the UR elicited by neck shock and the required avoidance operand. The morphology of the shock-elicited UR is a function of a number of variables, including the intensity of the US and point of body contact of the US. Full-intensity upper neck shock applied to the ventral skin surface produces a UR in most dogs that includes vocalization, upward movement of the head, upward stretching of the neck, picking the chin up, opening of the mouth, stepping backward, and so on. It looks as if the dog is attempting to pick its head up and away from a source of electrical stimulation, which is directly under its chin. Table 6 also rates the morphology of avoidance operands in terms of their similarity to the UR morphology. Operands with some or all components similar to the UR were rated "similar." Operands with some or all of their components dissimilar to the UR were rated "dissimilar." Lambda B (Hayes, 1963), a measure of predictive association that varies from +1 to −1, calculated between morphology ratings and trials to first avoidance and last escape resulted in λ B = .97 ($p \leq .01$) and λ B = .92 ($p \leq .01$), respectively. Thus, the consistent-elicitation hypothesis provides an adequate explanation of the differences in speed of acquisition of different avoidance operands. However, this ad hoc explanation should be tested further.

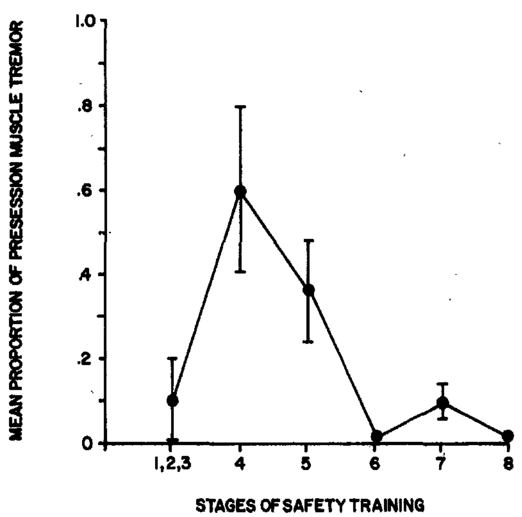

Figure 8. Mean proportion of presession muscle tremor as a function of stages of safety training (1–8) in Experiment 2.

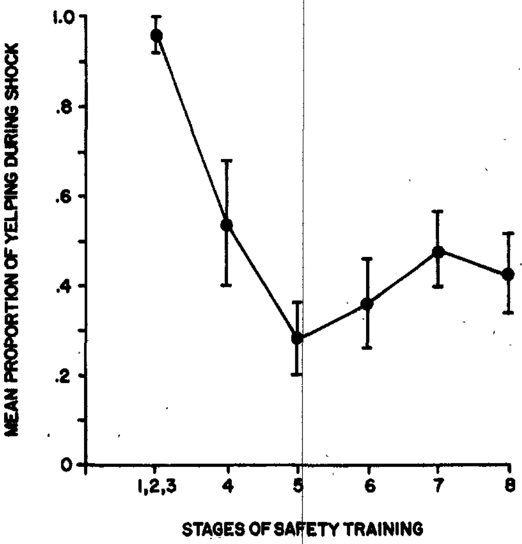

Figure 9. Mean proportion of yelping during shock as a function of stages of safety training (1–8) in Experiment 2.

Emotionality differences. Figures 8 and 9 present two measures of the dog's emotionality as a function of stages of training. The first three stages were collapsed into one because there was essentially no difference between these stages for the measures used.

Mean proportion of presession muscle tremor and cowering (Figure 8) was assessed by noting whether the dog trembled and cowered (i.e., ducked away from trainers) when they were approached, fastened to a leash, and escorted to the training area. An ANOVA for repeated measures yielded a significant stages effect, $F(5, 170) = 13.6$, $p \leq .001$. Dunn's test for difference between means indicated that baseline stages (1, 2, and 3) were significantly different from Stages 4 and 5 ($p \leq .01$), Stages 4 and 5 did not differ significantly from each other, Stages 6 and 8 differed from all but each other ($ps < .01$), and Stage 7 differed from all but the baseline stages ($ps < .01$).

This pattern of results indicates that the dogs developed a conditioned anticipatory fear reaction from the repeated shocks given during the Stage 4 training sessions and that this anticipatory fear reaction was extinguished in subsequent stages. Of particular interest is the apparent complete extinction of this anticipatory fear reaction at Stage 6

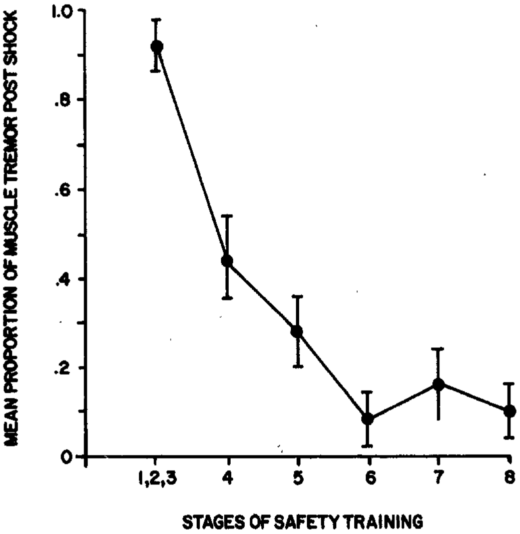

Figure 10. Mean proportion of muscle tremor postshock as a function of stages of safety training (1–8) in Experiment 2.

when the dogs received only the safety tone as a reinforcement. In addition, there was only a minor return of this anticipatory fear reaction at Stage 7 when the dogs received shock as punishment and were presented with high-level distraction, stress, and aggression-inducing stimuli. This fear extinguished by Stage 8.

Figure 9 shows the mean proportion of yelping (a high-pitched canine vocalization presumably indicating pain) during full-intensity electrical stimulation. It must be understood that the number of shocks the dogs received was different at different stages. The majority of shocks (M = 203) were administered during Stage 4. The second most frequent number of shocks occurred at Stage 7 (M = 23) and Stage 5 (M = 21). The remaining stages have a shock density of 12 or less.

An ANOVA of the data on yelping yielded a significant stages effect, $F(5, 170) = 7.6, p \leq .001$, with most of the change attributable to the difference in means of baseline and subsequent stages ($ps \leq .01$). Stage 4 differed significantly from Stage 5 ($p \leq .01$), and Stage 5 differed significantly from Stage 7 ($p \leq .01$). All other differences were nonsignificant.

These results seem to indicate that the dogs' pain reactions to full-intensity electrical stimulation were habituating over trials. The slight but nonsignificant rise in yelping at Stage 7 (as compared with Stages 6 and 8) may be a sensitization effect due to increased stress occurring at this stage.

The relative permanence of the habituation is suggested by pet owners' comments during follow-up interviews about their dogs' behaviors. All pet owners spontaneously have said that their dogs seemed less responsive to painful stimuli and more "hardy" after the treatment.

Two measures that may indicate recovery from shock are the mean proportion of muscle tremor postshock and the mean proportion of induced play postshock as presented in Figures 10 and 11, respectively. An ANOVA of the muscle tremor data produced a significant stages effect, $F(5, 170) = 13.1, p < .001$. The means of baseline and Stages 4, 5, and 6 were all significantly different from each other ($p < .01$). Stages 6, 7, and 8 did not differ significantly on this measure.

An ANOVA of the postshock data on the proportion of induced play yielded a significant stages effect, $F(5, 170) = 15.2, p \leq .001$. The pattern of results was different from the muscle tremor measure of recovery. Baseline was significantly different ($p \leq .05$) from Stages 4 and 5, which did not differ signifi-

Figure 11. Mean proportion of play given inducement to play as a function of stages of safety training (1–8) in Experiment 2.

Table 8
Rating Scale and Polar Descriptive Adjectives Used for Estimating Carriage

Compliant	+3	+2	+1	0	−1	−2	−3	Defiant
Spirited	+3	+2	+1	0	−1	−2	−3	Angry
Trusting	+3	+2	+1	0	−1	−2	−3	Suspicious
Animated	+3	+2	+1	0	−1	−2	−3	Sluggish
Self-assured	+3	+2	+1	0	−1	−2	−3	Confused
Eager	+3	+2	+1	0	−1	−2	−3	Hesitant
Obedient	+3	+2	+1	0	−1	−2	−3	Disobedient
Tolerant	+3	+2	+1	0	−1	−2	−3	Irritable

cantly from each other. The difference between Stages 5 and 6 was highly significant ($p \leq .001$). Stages 6, 7, and 8 did not differ significantly from each other.

Both measures were in essential agreement that the dogs seemed to recover more readily from a shock as training proceeded. The postshock play behavior appeared more sensitive to the effect of reinforcing the operands with a safety signal (Stage 6).

It seems that the impact of safety reinforcement is to make the dog less fearful generally and better able to withstand trauma. This result seems to occur despite the fact that habituation to shock is declining beyond Stage 5. This ex post facto hypothesis is evaluated in Experiment 4.

Qualitative changes. There is one final measure to be discussed. It is an overall judgment about the dog's demeanor, herein labeled *carriage.* Carriage is defined as the manner of holding and moving the head or body. As a dimension, it may provide the basis for inferring response classes such as an assertiveness, dominance, or status.

Pet owners, organized dog fanciers, and professional dog show judges use a concept such as carriage to evaluate the overall quality of a dog's performance. They look for and positively evaluate "perky," "high spirited," "assertive," and a "prancing" type of performance. They negatively evaluate the perceived absence or opposite of such qualities.

In an attempt to measure carriage, a 7-point rating scale was developed for eight pairs of descriptive adjectives (see Table 8). Using these descriptive adjectives, the trainer, pet owner, and a group with no vested interest in the outcome rated the dog at the end of various stages of training. The estimate of carriage was the median rating from all eight pairs of adjectives.

Group estimates of carriage were performed by different classes of 10 to 30 undergraduate psychology majors taking a course in introductory or experimental psychology. The rating task was presented to them as an exercise in measuring reliability of judgments. After familiarization with the rating scale, the students observed a particular dog for 15 min. through a one-way viewing window in an observation classroom. They then marked the scale for each pair of descriptive adjectives so as to "best characterize the dog's overall demeanor." The students were not informed of the dog's behavior problems or stage of training before the rating was performed.

Figure 12 presents the median estimates of carriage for the group, pet owners, and trainer as a function of stages of training. It is clear that the rating increases as training progresses. The rank-order correlation for random pairs of students rating the same dog

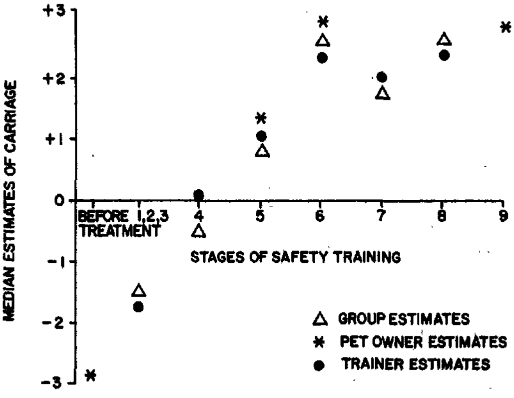

Figure 12. Median estimates of carriage as a function of stages of safety training (1–9) in Experiment 2. (The data point designated as "before treatment" represents the pet owners' estimates of their dogs' carriage during the waiting list condition.)

varied from $.56 \leq \rho \leq .85$ with the lowest reliability coefficient for dogs ranked at Stage 4. The rank-order correlations between trainer and median group estimates varied from $.41 \leq \rho \leq .75$.

Follow-Up

Follow-up data were collected in two ways, by survey and by video-tape analysis. All dog owners were required to complete a written or phone survey at approximately 3 months, 6 months, 1 year, 2 years, and 3 years after the completion of Stage 9. The survey contained 31 questions, one on aggression (Has your dog shown any aggression during the last [3, 6, etc.] months? *Yes/No.* If *yes,* specify the details of each aggressive episode) and 30 on the performance of prosocial operands (Does your dog [come, sit, down, etc.] within 2 sec after you give the hand signal [or vocal] command? [two questions per operand] *Yes/No*). It was planned that the dogs would be tested in the home and retrained if the answer to the aggression question was *yes.* However, this was unnecessary in all cases.

An ANOVA that compared the mean proportion of correct operands for Stages 8 and 9 of safety training with the follow-up survey data showed that the slight decrement after treatment ended was not significant, $F(5, 170) = 1.60, p > .10$.

As a check on reliability of survey reporting, 10 dogs were randomly sampled to undergo video-tape analysis of their performance of operands. A few days after a survey was completed, the selected pet owners were visited, presented with a list of 15 hand signal and vocal commands and required to perform 30 command–response trials with their dog, 1 hand signal and 1 vocal signal per operand, in a predetermined random order. The sessions were video taped. The video-tape sessions were viewed by a trained observer, and the data were collated similarly to training sessions. The dogs were scored as either performing or not performing each operand within 2 sec after the command was given. Percentage of agreement between the pet owner's survey and video tape was calculated. The mean percentage of agreement for the 10 dogs sampled was .94. Thus, it can be concluded that pet owners were reliably reporting their dog's performance.

It should be pointed out that although pet owners reliably reported the likelihood of performance of operands, they severely overestimated the "style" of performance. All pet owners expressed satisfaction with their dog's "style"; however, the video-tape analysis showed that the dogs had degraded to some degree in style, to the extent their posture and speed of execution of operands were below the standard set for Stage 6 of training.

Style notwithstanding, these are the first data to my knowledge that show avoidance habits lasting 3 years. Such results represent a powerful demonstration of the stability of avoidance habits, given the fact that (a) the dogs were returned to the uncontrolled environment of a pet owner's household, (b) the pet owners were "unsophisticated" in dog training procedures, and (c) the pet owners had in the past habitually engaged in behaviors that reinforced both aggression and a lack of behavioral control.

Experiment 3

Experiment 2 demonstrated the effectiveness of safety training as a whole for eliminating avoidance-motivated aggression and establishing a battery of long-lasting prosocial operands. However, safety training, of necessity, is a complex procedure that takes a substantial length of time to complete. It is conceivable that factors unrelated to the logic of safety training such as prolonged interaction with the trainer were responsible for the observed behavioral changes.

This study compared the effectiveness of safety training with two control groups. Both control groups were trained for the same amount of time as the safety-trained subjects; such training involved the early components of safety training. The play-training control subjects received differential positive play reinforcement, DRO, for prosocial operants and time out from play for aggression. The play-training/aversion-relief control subjects were treated like the play-training control subjects except that full-intensity signaled shock was used to punish aggression. It was predicted that the safety-trained group would be superior to the control groups both in the elimination of aggression and the acquisition of prosocial operands.

Safety training involved the acquisition of 15 movements balanced so that neither the dimensions of the direction, amount, nor type of movement were relevant to the escape, avoidance, and safety contingencies. What was relevant to these contingencies was an escape, avoidance, and safety-learning strategy. This strategy, herein called an avoidance-learning set, is that the stress of electrical stimulation can be overcome, prevented, and safety attained by compliant performance. Although the dogs in the control groups were taught to perform the same movements as the safety-trained dogs, they were not taught these movements using escape, avoidance, and safety contingencies. Thus, it was predicted that an avoidance-learning set would develop in the safety-training group but not in the control groups.

Method

Subjects. Subjects were 12 male and 6 female dogs ranging in age from 20 to 35 months. Breeds, in order of decreasing bulk ratio were 5 male, 2 female German Shepherds; 1 male, 1 female Doberman Pinscher; 3 male Chesapeake Bay Retrievers; and 3 male, 3 female Springer Spaniels.

All subjects were household pets referred by a veterinarian for aggression problems and diagnosed as showing extreme forms of avoidance-motivated aggression, thus, matching the characteristics of the dogs in Experiment 2. All dogs were intact, showed no signs of medical pathology, and were not under veterinary medical treatment upon referral. All dogs were housed, fed, and exercised as in Experiment 2.

Subjects were assigned to three treatment groups first by stratifying the animals in terms of bulk ratio and sex and then by randomly assigning the dogs within a stratum to a group. Thus, the groups were composed of dogs with approximately equal bulk ratios and equal sex ratios.

Apparatus and materials. The apparatus and materials for this experiment were identical to those of the previous experiment.

Procedure. There were three groups, a safety-training group and two control groups. The safety-training group ($n = 6$) replicated all details of the procedure described in Experiment 2.

The play-training control group ($n = 6$) replicated all details of the procedure described in Experiment 2 up to and including Stage 2. When these subjects attained Stage 2 criterion, they were maintained on the Stage 2 contingencies of a VR 5 schedule of positive play reinforcement for the performance of prosocial operands and a variable 1–3 min. time out for manifestation of aggression during a play-training session. This combination of reinforcement contingencies might be expected to have an impact on avoidance-motivated aggression. In addition, play conditioning controlled for the variable of duration of positive interaction with the trainer.

The play-training/aversion-relief control group ($n = 6$) replicated all details of the play-training control group. In addition, full-intensity signaled electrical stimulation was administered as a punishment for aggression. The duration of electrical stimulation was variable since its termination was contingent upon cessation of aggression. Following electrical stimulation offset, the subjects received a 3-sec safety tone. In this group prosocial operands were not subject to escape avoidance and safety reinforcement contingencies. This group provided control for the administration of multiple signaled electrical stimulation, the effects of punishment, and exposure to the warning buzz and safety tone.

Subjects were run in squads of three, one subject per control group and one safety-trained subject. Control group subjects were yoked to safety-trained subjects so that they stayed on their respective contingencies for a time equal to the time it took the safety-trained subjects to meet or exceed Stage 8 criterion. Control group subjects were stress tested at the same time the safety-trained subjects entered the stress-testing stage of safety training (Stage 7).

When the safety-trained subject met Stage 8 criterion, each squad of control group subjects was then safety trained by advancing them through the remainder of the training procedure (Stages 3 to 9).

In order to assess the development of learning set, half of the subjects in each group ($n = 3$) were randomly assigned to the acquisition of the "Place" operand when they attained Stage 2 criterion. The remaining half of each group was assigned the acquisition of the "Place" operand when the safety-trained subject attained Stage 6 criterion. This assignment produced six independent groups.

Results

Reliability of measurement was assessed identically to Experiment 2. Only two measures were used, mean proportion of aggression and mean proportion of correct operands. The Pearson product-moment correlation for reliability of recording for each measure was .88 and .96, respectively ($ps \leq .001$) and for reliability of measurement for each measure was .83 and .92, respectively ($ps \leq .001$).

Avoidance-motivated aggression. The left half of Figure 13 presents the mean proportion of aggression for the three groups as a function of stages of training of the safety-trained group. The data from the control groups were collated over a period equal to

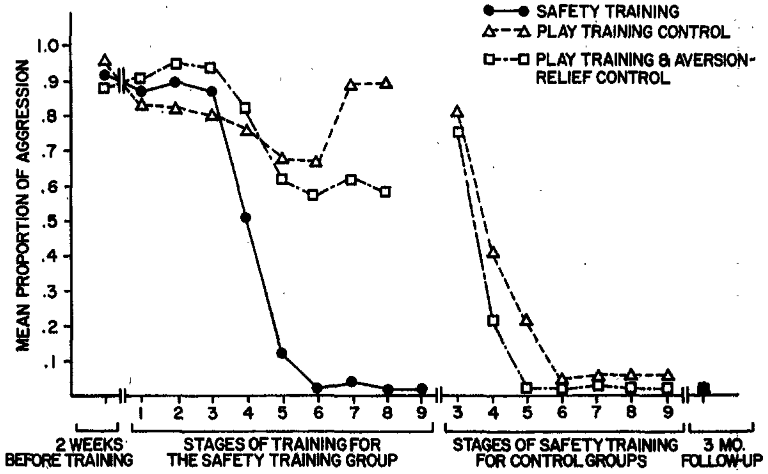

Figure 13. Mean proportion of aggression given inducement as a function of stages (1–9) of safety training for safety training and control groups (left half) and as a function of stages of safety training (3–9) for former control groups (right half) in Experiment 3.

safety-trained subjects for each stage up to and including Stage 8.

Collated in this way, the data over the first eight stages present a mixed 3 × 8 factorial design with repeated measures over the stages factor. An ANOVA yielded significant groups, $F(2, 15) = 5.13$, $p \leq .05$; significant stages, $F(7, 105) = 2.81$, $p \leq .025$; and a significant Groups × Stages interaction, $F(14, 105) = 2.46$, $p \leq .01$.

The simple main effect of stages was significant for the safety-training group, $F(7, 42) = 26.71$, $p \leq .001$, but was not significant for the playing-training control group, $F(7, 42) = 1.62$, $p > .10$, or the play-training/aversion-relief control group, $F(7, 42) = 2.20$, $p > .05$.

This pattern of results suggests that safety training is far superior to play training with or without aversion relief for eliminating avoidance-motivated aggression. Furthermore, the significant increase in aggression in the play-training control group as compared with the play-training/aversion-relief control group during stress testing (Stages 7 and 8) suggests that the slight decrement in aggression that accrues from counterconditioning with play reinforcement is not a robust phenomenon.

The right half of Figure 13 presents the aggression for the control group subjects as they progressed through Stages 3 to 9 of safety training after they had served in the control groups. A 2 × 7 ANOVA with repeated measure yielded a nonsignificant groups effect, $F(1, 10) = 3.62$, $p > .05$; a significant stages effect, $F(6, 60) = 9.51$, $p \leq .001$; and a nonsignificant Groups × Stages interaction, $F(6, 60) = 2.18$, $p > .05$. Dunn's test indicated that the control groups differed significantly only at Stages 4 and 5 ($p \leq .05$). All other group differences were nonsignificant. These differences suggest that the play-training/aversion-relief control group benefited during safety training from its previous exposure to the aversion-relief contingency.

A 3-month follow-up demonstrated that all subjects, once safety trained, remained free of aggression.

Acquisition of operands. The left half of Figure 14 presents the mean proportion of correctly performed operands with a latency of 2 sec or less as a function of groups across the eight stages of the safety-trained group. A 3 × 8 ANOVA yielded a significant groups, $F(2, 15) = 7.02$, $p \leq .01$, a significant stages, $F(7, 105) = 2.30$, $p \leq .05$, and a significant Groups × Stages interaction, $F(14, 105) = 2.21$, $p \leq .025$.

The simple main effect of stages was significant for the safety-training group, $F(7, 42) = 38.61$, $p \leq .01$, and was significant for

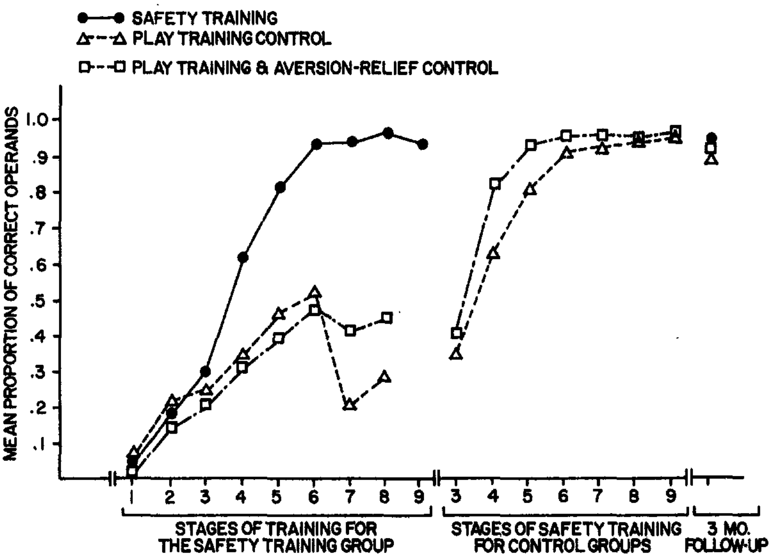

Figure 14. Mean of correct operands given a command as a function of stages (1–9) of safety training for safety training and control groups (left half) and as a function of stages of safety training (3–9) for former control groups (right half) in Experiment 3.

the play-training/aversion-relief control group, *F*(7, 42) = 2.41, $p \leq .05$; main effect of stages was not significant for play-training control group, *F*(7, 42) = 1.69, $p > .10$, due to this group's precipitous drop in proportion of correct operands during stress testing (Stages 7 and 8).

The simple main effect of groups was not significant for the first three stages of safety training, *F*(2, 15) = 1.02, $p > .25$, again providing support for the comparability of the groups in terms of their initial level of performance of prosocial operands. However, the groups did differ significantly from each other by Stages 7 and 8, *F*(2, 15) = 7.53, $p \leq .01$. Dunn's test for differences between the means at Stage 8 indicated that the safety-trained group was significantly different from both control groups ($ps \leq .01$). The means of the control groups at Stage 8 did differ significantly ($p \leq .05$).

This pattern of results suggests that the acquisition and maintenance of prosocial operands was substantially enhanced by the escape, avoidance, and safety-training contingencies provided during Stages 4, 5, and 6, respectively. It also suggests a rather strong correlation between acquisition of a host of prosocial operands through escape, avoidance, and safety-training contingencies and the elimination of avoidance-motivated aggression.

The right half of Figure 14 presents the acquisition data for the control group subjects as they progressed through Stages 3 to 9 of safety training after they had served in control groups. A 2 × 7 ANOVA with repeated measures yielded a nonsignificant groups effect, *F*(1, 10) = 2.47, $p > .25$; a significant stages effect, *F*(6, 60) = 10.62, $p \leq .001$; and a nonsignificant Groups × Stages interaction, *F*(6, 60) = 1.88, $p > .25$. It appears that the acquisition of prosocial operands through escape and avoidance contingencies (Stages 4 and 5) was facilitated by previous exposure to an aversion-relief contingency. However, Dunn's test indicated no significant differences between any group means at any stage.

Learning set. Figure 15 presents the mean trials to acquisition of the "Place" operand trained either at the termination of Stage 2 or Stage 6 for the three groups in this study. As expected, a 2 × 3 ANOVA yielded a nonsignificant groups effect, *F*(2, 4) = .96, and a nonsignificant stages effect, *F*(1, 4) = 1.87, $p > .25$. However, the Groups × Stages in-

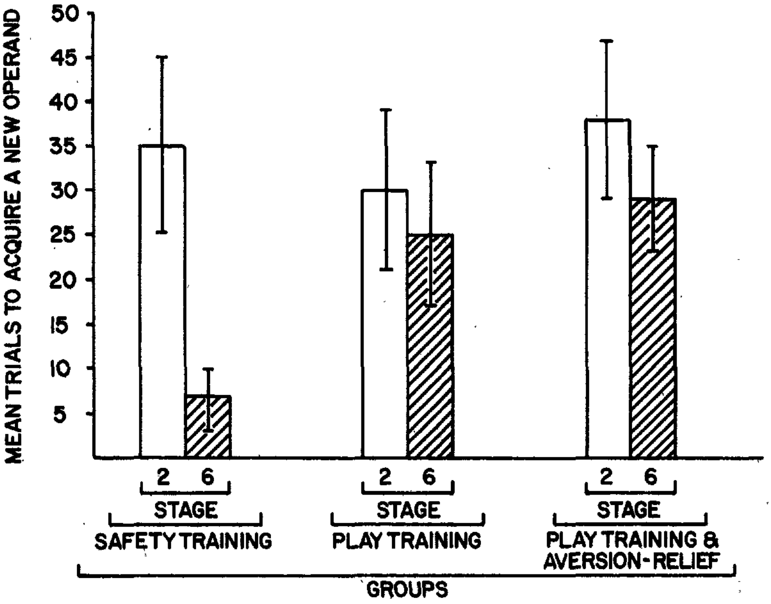

Figure 15. Mean trials to acquire a new operand for six independent groups as a function of groups (experimental vs. controls) and stages (2 vs. 6) within groups in Experiment 3.

teraction was significant, $F(2, 4) = 7.01, p \leq .05$. The simple main effect of stages was significant for the safety-trained group, $F(1, 4) = 16.8, p \leq .025$. Stages was nonsignificant for the play-training control group, $F(1, 4) = 1.67, p > .25$, and was nonsignificant for the play-training/aversion-relief control group, $F(1, 4) = 2.14, p > .25$. These results indicate that an avoidance-learning set was acquired by the safety-trained group but not by the control subjects. Perhaps the learning set created by the acquisition of a large variety of balanced prosocial operands is related to the effectiveness and permanence of the results of safety training.

Experiment 4: The Safety Cue

In Experiments 2 and 3, there were no clear-cut indications that the conditioned safety tone directly affected avoidance-motivated aggression independent of escape and avoidance training. The purpose of Experiment 4 was to examine the independent effect of the safety tone on avoidance-motivated aggression, conditioned fear, and the performance of operands. To accomplish this, the tone was conditioned to be safe in independent groups at different points in the entire safety-training procedure.

Method

Subjects. Subjects were 10 male and 6 female dogs ranging in age from 15 to 48 months. Breeds, in order of decreasing bulk ratio were 2 male Great Danes; 2 female Great Pyrenees; 2 male, 1 female Doberman Pinschers; 2 male Labrador Retrievers; 2 male, 1 female Standard Schnauzers; 1 male, 1 female Cocker Spaniel; and 1 male, 1 female Toy Poodle.

All subjects were household pets referred by a veterinarian for aggression problems and diagnosed by the trainer as showing extreme forms of avoidance-motivated aggression and thus matching the characteristics of the dogs in Experiment 2. No dog had signs of medical pathology or was under veterinary medical treatment upon referral. All dogs were housed, fed, and exercised as in Experiment 2.

Subjects were assigned to four treatment groups ($n = 4$) by first stratifying the animals in terms of bulk ratio and then randomly assigning the dogs within a stratum to a group. Thus, the groups were composed of dogs with approximately equal sex and bulk ratios.

Apparatus and materials. The apparatus and materials for this experiment were identical to those of Experiment 2 with one exception. Depending upon treatment conditions, one of two remote-controlled collars were used. One was identical to the collar used in the previous experiment; the other collar, a Tri-Tronics Al-80, was similar in all details except that it delivered only a warning buzz and electrical stimulation.

Procedure. There were six groups with two derived from Experiment 2. Group M consisted of eight subjects from Experiment 2 that matched the composition of the remaining groups in terms of bulk ratio, and Group R consisted of eight subjects randomly selected from the remaining subjects of Experiment 2.

The four remaining groups replicated all details of the procedure for Experiment 2. All subjects were run in squads of four, one subject per treatment group. The three delayed safety-conditioning groups differed from those of Experiment 2 only in terms of when the safety cue was introduced into training. In Groups M and R, the safety tone had been conditioned during Stage 4, when electrical stimulation had been first introduced, and was then used as a reinforcer throughout the remaining stages.

For Group D1 the safety tone was introduced during a safety-conditioning session between Training Session 5 and 6 of Stage 6 and was used as a reinforcer thereafter. For Group D2 the safety tone was introduced during a safety-conditioning session between Training Sessions 9 and 10 of Stage 6 and was used as a reinforcer thereafter. For Group D3 the safety tone was introduced and used as if it were a reinforcer throughout Stage 6 from Session 9 onward. However, the tone was safety conditioned immediately after the "stress testing" session of Stage 7 and used as a reinforcer thereafter. After safety tone conditioning, Group D3 was again run through a second stress test.

Safety tone conditioning for the three delayed groups (D1, D2, and D3) involved 60 conditioning trials run in three consecutive 90-min. sessions on the same day. Conditioning occurred while an animal was in the room in which it was quartered and fed.

A safety-conditioning trial involved the administration of signaled full-intensity shock of variable duration ($M = 3$ sec, $SD = 2$ sec) followed immediately by a 3-sec safety tone. The distribution of shock durations was constructed to match the average duration of shock a dog received during Stage 4 of Experiment 2. The ITI was identical to the training ITI with a mean of 5 min., ranging from 2 to 8 min. During safety-tone conditioning, the dogs had no control over the onset or duration of shock. It is interesting to note that the safety-conditioning groups (D1, D2, and D3) were similar to backward-conditioning controls used in earlier conditioning studies (Kimble, 1961; Mowrer, 1960; and Osgood, 1953) and to more recent learned helplessness treatments (Overmier, 1968; Overmier & Seligman, 1967; Seligman & Maier, 1967).

Group C ($n = 4$) was used to control the exposure to inescapable shocks and a tone independent of a temporal association between shock termination and the tone. Dogs in this group were treated identically to those of Experiment 2 except that the tone was introduced in a "random conditioning" session between Sessions 5 and 6 of Stage 6. A random-conditioning session was patterned after Rescorla's (1967) and involved 60 trials with the same ITI, shock, and tone duration parameters as the delayed-conditioning groups. Random conditioning included 15 forward, 15 backward, 15 shock only, and 15 tone only trials presented randomly throughout the conditioning session. The tone was then used as if it was a "reinforcer" for Sessions 6 through 9. Then, Group C dogs were given 60 safety-conditioning trials between Session 9 and 10 in a procedure identical to the delayed-safety-conditioning groups (D1, D2, and D3). The safety tone was used as a reinforcer thereafter.

Table 9
Pearson Product-Moment Reliability Coefficients for Recording and Measurement for the Means Proportion of Six Measures of Behaviors Taken Throughout Experiment 4

Measurements	Reliability of recording	Reliability of measurement
Operands	.88	.83
Aggression	.92	.91
Induced play	.82	.82
Muscle tremor		
Presession	.78	.76
Postshock	.87	.82
Yelping	.99	.95

Results and Discussion

Reliability. Table 9 presents the Pearson product-moment correlation coefficients of reliability of recording and measurement for the six measures used in this study. All coefficients were significant at or above the .05 level.

Aggression. The mean proportion of aggression for all groups did not differ significantly up to and including Stage 6 of safety training ($p > .15$). The probability of aggression was essentially zero for all groups by Stage 6. However, group differences in aggression did occur during the stress testing of Stage 7. Figure 16 depicts the mean proportion of aggression before, during, and after Stage 7.

For the purpose of ANOVA, Groups M and R were combined, and the results for Group D3 included data on aggression during the stress testing that occurred before safety conditioning. The analysis yielded a significant groups effect, $F(4, 27) = 2.8, p > .05$. Dunn's test indicated that the groups receiving the conditioned safety tone (Groups M and R, D1, and D2) did not differ significantly from each other ($p > .05$) but did differ significantly from Group D3, which received the "nonconditioned tone" ($p \leq .01$). The mean proportion of aggression during stress testing for Group D3 before safety conditioning was .45, and after conditioning it was .18. A t test

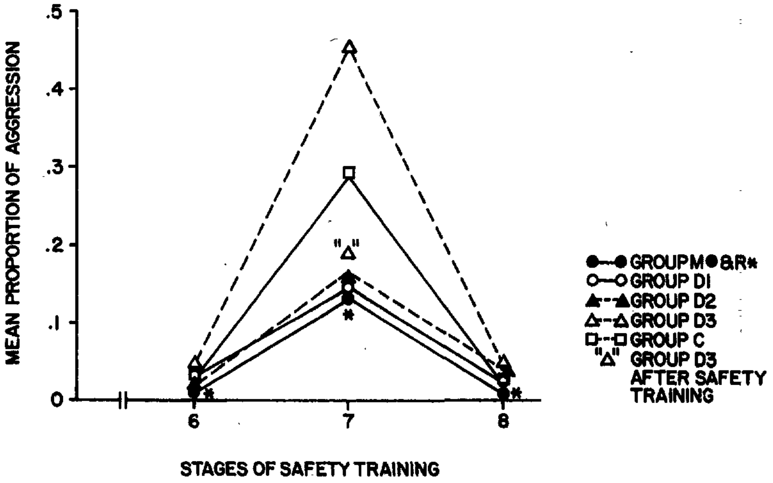

Figure 16. Mean proportion of aggression given inducement as a function of three stages (6, 7, 8) of safety training for four independent groups (M and R, D1, D2, D3, and C) in Experiment 4. (The data point designated by an open triangle without quotes represents the data for Group 3 dogs from their first Stage 7 stress testing before safety-tone conditioning. The open triangle with quotes represents the data for Group D3 dogs from their second Stage 7 stress testing after safety-tone conditioning.)

indicated that the reduction in aggression was significant, $t(3) = 3.36$, $p = .025$, one-tailed.

It definitely appears that the use of a conditioned safety tone as a reinforcer for nonaggressive responses reduces aggression in situations designed to induce aggression maximally. In addition, the fact that the reduction in aggression for Group C was midway between the groups that had been previously safety conditioned (Groups M and R, D1, and D2) and the group that had not been safety conditioned (Group D3) suggests that previous "random conditioning" may retard or block the formation of an association between shock termination and the tone during safety conditioning.

Acquisition of operands. In Experiments 2 and 3 the proportion of correct operands occurring in 2 sec or less after a command was a dependent measure, yielding a mean proportion of .98 and .93, respectively, by Stage 6. In order to assess the effects of the various treatments administered during Stage 6 of Experiment 4, the stringency of the dependent measure was increased so that a correct operand had to occur within 1 sec.

With this measure, all groups overlapped for the first three stages of safety training, yielding a combined mean proportion of 0, .12, and .22 for Stages 1, 2, and 3, respectively. Groups M and R began to diverge from the remaining groups (D1, D2, D3, and C) at Stage 4, yielding combined means of .41 and .35, respectively. A t test of this difference was not significant, $t(30) = 1.12$, $p > .05$.

Figure 17 presents the mean proportion of a correct operand for all groups as a function of stages of training and of sessions within Stage 6. At Stage 5, the combined mean for Groups M and R was .62, and for Groups D1, D2, D3, and C, .48. This difference was significant, $t(30) = 2.56$, $p \leq .01$, one-tailed.

An ANOVA of the data for the first five sessions of Stage 6, treating Groups M and R and Groups D1, D2, D3, and C as two independent groups, produced a significant groups effect, $F(1, 28) = 6.21$, $p \leq .025$; a significant sessions effect, $F(4, 112) = 5.34$, $p \leq .001$; and a significant Groups × Sessions interaction, $F(4, 112) = 2.89$, $p \leq .025$.

This pattern of results indicates that the performance of all groups increased over trials and that the effect of the safety tone was to accelerate the rate of increase for Group M and R, causing the two pooled groups to diverge as training progressed. Similar to the findings of Weisman and Litner (1969), the safety tone acted like an additional reinforcer.

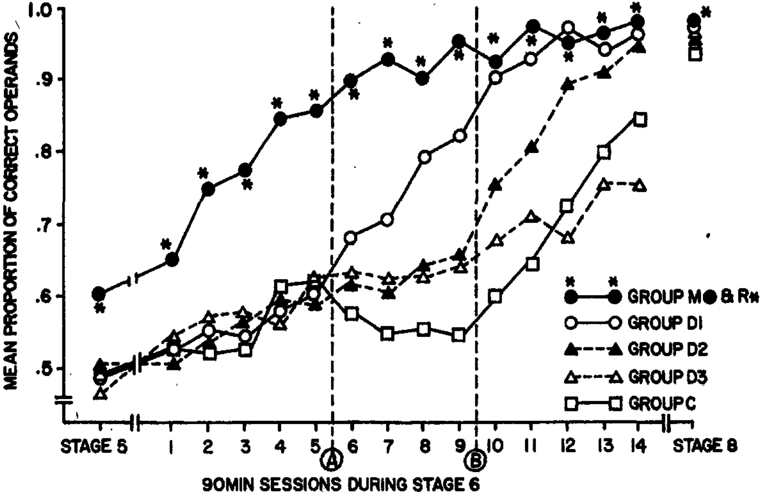

Figure 17. Mean proportion of a correct operand given a command as a function of Stage 5, Session 14 during Stage 6, and Stage 8 in Experiment 4. (The A on the ordinate indicates the period when safety-tone conditioning occurred for Group D1 and random conditioning occurred for Group C. The B indicates the period when groups D2 and C were given safety-tone conditioning.)

Its reinforcing effects became more potent after Stage 4 when the dogs were no longer receiving shock termination as a negative reinforcer.

This result is expected because at the beginning of Stage 4 shock termination would be a sufficient signal for a nonshock, or safety, period. During the portion of Stage 4 the safety tone was a redundant cue. However, by the end of Stage 4 and for all subsequent stages, the safety tone is a unique predictor of safety. The fact that the groups without the safety tone (Groups D1, D2, D3, and C) show slower but progressive increases in performance suggests that other stimuli, such as the response-produced cues of performing the operands, may also signal a safety period. However, given that there are 15 distinctive operands, these response-produced cues must be diverse and thus less distinctive as predictors of safety.

At Point A of Figure 17, Group D1 received 60 safety-conditioning trials, and Group C received 60 random-conditioning trials. Then all groups were trained as before, with Groups D1 and C receiving the tone as a reinforcer and Groups D2 and D3 receiving no tone. An ANOVA of the four delayed conditioning groups (D1, D2, D3, and C) over Sessions 6 through 9 yielded a significant groups effect, $F(3, 9) = 3.97, p \leq .05$, and a significant Groups × Sessions interaction, $F(9, 27) = 4.68, p \leq .001$. The main effect of sessions was not significant, $F(3, 27) = 1.67, p > .10$. The simple main effects of session was significant for Group D1, $F(3, 9) = 7.14, p \leq .01$, but was not significant for Groups D2, D3, and C that produced $F(3, 9), p > .10$, of 1.42, 1.14, and 2.43, respectively. A Dunn's planned comparison test of the difference between the group means for Session 9 yielded significant differences for Groups D1 versus D2, D3, and C ($ps < .01$) and for Groups C versus D2 and D3 ($ps \leq .05$), but Groups D2 and D3 did not differ significantly from each other ($p > .25$).

This pattern of results seems to indicate that the tone can either facilitate or retard improvement in performance, depending on whether the tone is conditioned to shock termination and a safe period (Group D1) or is randomly "conditioned" (Group C). Random conditioning (Group C) does not neutralize the tone but appears to make it slightly inhibitory.

At Point B of Figure 17, Groups D2 and C were given 60 safety-conditioning trials. For these groups the tone was used as a reinforcer thereafter. Group D3 did not receive safety conditioning at this time; however, the

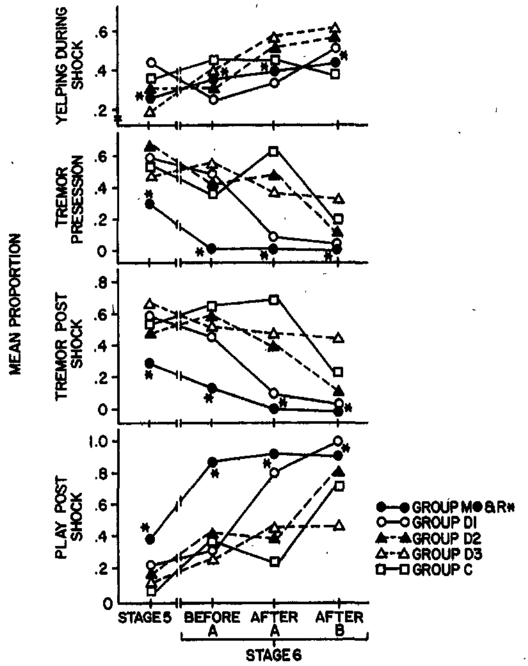

Figure 18. Mean proportion of four measures of emotional stability (yelping during shock, tremor presession, tremor postshock, and play postshock) as a function of Stage 5 and three periods during Stage 6 in Experiment 4. (The period "Before A" designates the mean emotionality score over the first five sessions of Stage 6 before any dogs in the delayed-conditioning groups received safety-tone conditioning. The period "After A" designates Sessions 6 through 9 after Group D1 received safety-tone conditioning and Group C received random conditioning. The period "After B" designates Sessions 10 to 14 after Groups D2 and C received safety-tone conditioning. The data points for Groups M and R were extrapolated from comparable periods of Stage 6 in Experiment 2.)

tone was used during subsequent sessions as if it were a reinforcer. Group D1 continued the training started at Point A. An ANOVA for the four groups over Sessions 10 through 14 yielded a significant groups effect, $F(3, 9) = 5.98$, $p \leq .025$; a significant sessions effect, $F(4, 156) = 3.82$, $p \leq .01$; and a significant Groups × Sessions interaction, $F(12, 156) = 3.65$, $p \leq .001$. Due probably to a ceiling effect, the simple main effect of sessions was not significant for Group D1, $F(4, 12) = 2.16$, $p > .10$. Sessions were significant for the remaining groups producing $F(4, 12)$ of 5.67 ($p \leq .01$), 3.35 ($p \leq .05$), and 5.81 ($p \leq .01$) for Groups D2, D3, and C, respectively.

An ANOVA comparing Groups D2 and D3 over Sessions 10 through 14 yielded a significant groups effect, $F(1, 4) = 8.12$, $p \leq .05$, and a significant sessions effect, $F(4, 52) = 4.92$, $p \leq .01$. These findings replicate the effect seen with Group D1 at Point A. However, in this case the safety-tone group (D2) was compared with a control group that received a tone after correct responding as if it were a reinforcer (Group D3).

Overall, the pattern of results suggests that the safety tone once conditioned to shock termination and a safe period can function as a positive reinforcer, increasing the performance of the responses it follows. This reinforcing effect seems to improve performance above that normally expected from the negative reinforcement of shock or fear termination.

Emotional differences. Figure 18 depicts the changes in the four measures of emotionality used in Experiment 2 across all groups as a function of four periods during safety training. The four periods included Stage 5 and three periods during Stage 6. A separate ANOVA was performed for each measure over different periods before and during Stage 6.

The results of the ANOVAS for the pooled Groups M and R (safety tone) and Groups D1, D2, D3, and C (no safety tone) over the periods of Stage 5 and the combined first five sessions of Stage 6 before safety-tone conditioning (Point A) for the measures of emotionality are summarized in Table 10.

Yelping during shock was not significantly affected by the presence or absence of a safety tone (groups) or repetitions (periods). How-

Table 10

F Ratios for Four Separate ANOVAS Comparing the Combined Groups M and R with the Combined Groups D1, D2, D3, and C Over Periods Stage 5 and Stage 6 Before Point A

Behaviors	Groups	Periods	Groups × Periods
Yelping	2.31	3.02	1.96
Tremor presession	6.42**	4.67*	3.72
Tremor postshock	6.25**	3.60	3.69
Play postshock	8.91***	5.36*	5.42*

Note: For all F ratios, dfs = 1, 30.
* $p = .05$. ** $p = .025$. *** $p = .01$.

ever, the presence of the safety tone significantly affected the three remaining measures of emotionality. The safety tone (Groups M and R) yielded significantly less muscle tremor presession and postshock and significantly greater play postshock.

In addition, two of the three measures, tremor presession and play postshock, show a progressive decrease in emotionality over periods regardless of the presence of the safety tone. Periods, however, interact significantly with whether or not the dogs were receiving the safety tone (groups) for play postshock. The safety tone appears to magnify the occurrence of play postshock over periods.

This difference probably indicates that the use of the conditioned safety tone increases the speed of extinction of a generalized fear response or at least inhibits the fear response conditioned to the entire working session by defining for the dog shock-free periods.

Although aggression was zero for both combined groups (M and R vs. D1, D2, D3, and C) during this period, the two groups of dogs may not have been aggressive for different reasons. The dogs from the combined groups D1, D2, D3, and C may not have been aggressive because they feared the consequences of being aggressive; the dogs from the Groups M and R may not have been aggressive because they felt safe performing prosocial acts.

ANOVAS were performed for each measure of emotionality over the Stage 6 periods before and after safety-tone conditioning (Point A) for Group D1 and random conditioning for Group C comparing emotional scores in these groups to the groups that had not as yet been safety-tone conditioned (Groups D2 and D3). Table 11 presents these F ratios. The changes in the yelping data were nonsignificant; however, the three other measures of emotionality showed significant group effects and significant Groups × Periods interactions. Analyses for simple main effects of groups indicated no significant group differences before safety-tone conditioning but significant differences after it. Dunn's test indicates that the use of the randomly conditioned tone (Group C) increases the likelihood of tremor and decreases the likelihood of play significantly ($p < .05$) when compared with groups that did not receive the tone (Groups D2 and D3) and that the use of the safety tone (Group D1) significantly ($p \leq .05$) decreases tremor and increases play as compared with the no-tone groups (D2 and D3).

ANOVAS of the emotionality scores for Groups D2, D3, and C over the Stage 6 periods after Point A and after Point B were performed. This analysis provided a comparison of emotional changes after safety-tone conditioning (Point B) for a group that had been previously random conditioned (Group C), for a group that had no previous experience with the tone (Group D2), and for a control group that was receiving an unconditioned tone as if it were a reinforcer (Group D3). The significant F ratios included the periods variable for tremor presessions, $F(1, 9) = 5.21$, $p \leq .05$; play postshock, $F(1, 9) = 5.36$, $p \leq .05$; and the Groups × Periods interaction for tremor presession, $F(2, 9) = 4.82$, $p \leq .05$; tremor postshock, $F(2, 9) = 5.24$, $p \leq .05$; and play postshock, $F(2,$

Table 11
F Ratios for Four Separate ANOVAS Comparing Groups D1, D2, D3, and C over the Before and After Point A Periods of Stage 6

				Simple main effects	
Behaviors	Groups	Periods	Groups × Periods	Groups before Point A	Groups after Point A
Yelping	1.27	2.22	.98	—	—
Tremor per session	3.98*	2.45	6.99***	1.86	4.01*
Tremor postshock	3.69*	3.61	6.23***	1.61	4.21*
Play Postshock	3.52*	2.85	5.87**	2.32	5.03**

Note. For all F ratios $dfs = (3, 12)$, except for Periods, $df = 1, 12$.
* $p = .05$. ** $p = .025$. *** $p = .01$.

9) = 5.82, $p \leq .025$. All other differences were nonsignificant.

Dunn's test yielded significant differences between Group C and Groups D2 and D3 at the period after Point A for the tremor postshock and play postshock but not for tremor presession (*ps* ≤ .05). Groups D2 and D3 did not differ significantly from each other for all measures of emotionality. The difference between Group C and Groups D2 and D3 at this point suggests that random conditioning increased emotionality at this stage, at least as it pertained to recovery from a shock experience.

Dunn's test comparing means after Point A and after Point B, that is before and after Groups D2 and C received safety-tone conditioning, indicated a significant decrease in tremor preshock and postshock (*ps* ≤ .05) and a significant increase in play postshock for Groups D2 and C (*ps* ≤ .05) but no significant change in these measures over these periods for the control Group D3. Thus, the change in emotionality scores in D2 and C as compared with D3 must be a function of the safety conditioning Groups D2 and C received at Point B of Stage 6.

Finally, a Dunn's test was performed comparing the means of all groups at the end of the Stage 6 after Point B. Again there were no significant differences with the yelping measure. With tremor presession, the control Group D3 differed significantly from all other groups (*ps* ≤ .05), but the delayed-conditioned groups (D1, D2, and C) did not differ from each other or from Groups M and R. With tremor postshock Group D3 differed significantly from all other groups (*ps* ≤ .05), and Group C differed significantly from all other groups ($p \leq .05$). Groups D1, D2, and M and R did not differ significantly from each other. With play postshock Group D3 differed significantly from all other groups. Group C differed significantly from Group D1 and from Groups M and R. All other differences were nonsignificant. This pattern of results gives further evidence that the conditioned safety tone enhances emotional recovery from shock, facilitating the extinction of fear, and that previous random conditioning decreases these effects.

In summary, the safety tone used as a conditioned reinforcer appears to decrease fear both before a training session and after a traumatic shock. Similarly, the use of a conditioned safety tone increases the likelihood that the dog interacts playfully with the trainer after a traumatic shock (relaxes).

The use of the conditioned safety tone has little apparent effect on URs to shock, for example, yelping. To the extent that yelping measures the aversiveness of a stimulus, the use of the conditioned safety tone as a reinforcer does not seem to alter the aversiveness of shock. Rather, the safety tone seems to make the dogs more willing to enter a training session in which traumatic shock occurs and less fearful during a session despite the aversiveness of the shock. In other words, the dogs take a traumatic shock "fearlessly" as long as there are clearly defined response-contingent periods when they are not going to be shocked.

General Discussion

Avoidance-Motivated Aggression

The animal literature on aggression focuses primarily on its innate or species-typical characteristics (Holloway, 1974; Scott, 1958). The theorizing is mainly concerned with the evolutionary survival value of aggressive behavior (Lorenz, 1966; Wilson, 1975). The research involves the relation of certain emotional states (i.e., frustration effects or fear) to aggression (Azrin, Hutchinson, & Hake, 1966), the nature of external stimuli that evoke aggression (Moyer, 1968), the hormonal modulation of aggression (Rose, Bernstein, Gordon, & Catlin, 1974), and the localization of certain brain foci that may control predatory aggressive reactions (Plotnik, 1974). Taken together the questions these studies seem to be asking concern the psychobiological correlates of spontaneous outbursts of aggression.

Instrumental aggression does not fit neatly into this literature for at least two reasons. First, instrumental aggression has been defined by exclusion (Feshback, 1964, 1971; Moyer, 1968). It is a catchall for aggressive acts that are obviously not "innate," that is, aggressive acts that do not have a clear evolutionary significance, that are not directly related to emotional arousal, that do not have specifiable releasing stimuli, that are not directly modulated by hormones, and that do not have an identifiable focus in the brain. Second, the important question for instrumental aggression is not How is it elicited? but rather What are the learning contingencies that contribute to its development?

In this article, instrumental aggression in companion dogs was defined as aggressive responses that have a specifiable learning history, show a growth function over time, and are modulated by their consequences. The retrospective data strongly suggest that avoidance-motivated aggression in dogs meets these criteria. The data suggest that the initial source of the aggressive avoidance response was one or more forms of elicited aggression such as species-typical aggressive reactions to pain, frustration, discomfort, territorial intrusion, or threats to dominance. Furthermore, it appears that these aggressive responses were exacerbated by trauma or punishment. Finally, the universal lack of behavioral control over these dogs implies that they had few operant alternatives to gain reinforcement by compliance. From the case histories, it seems that these dogs were channeled down a path that allowed their initial innate aggressiveness to come under the control of the negatively reinforcing contingencies in the environment.

The dogs in this study initially behaved as if they "expected" aversive events and that the only way to prevent these events was through aggression. The consequent reactions of the victim and the family, that is, withdrawal, turmoil, and belated punishment, confirmed the dog's "expectation" and reinforced the aggression. This positive feedback loop produced progressive escalation of the aggressive response, and the avoidance nature of the aggression presumably retarded or prevented its extinction.

A possible laboratory analogue for this phenomenon is an extension of pain-elicited aggression research (Hutchinson, Renfew, & Young, 1971; Ulrich, 1967a) in which the presence of the target animal or object predicts shock and attacking the target terminates or prevents shock. Lyons and Ozolins (1970) and Ulrich (1967b) have demonstrated, for example, that pain-elicited attacks can be classically conditioned in rats; Miller (1948) demonstrated that escape training of aggressive postures leads to fighting in rats; and Scott (1958) showed that training mice to escape shock through fighting facilitates conspecific attacks. The data here suggest that if aggression is an avoidance response, it produces attack behavior that at the very least is unresponsive to normal extinction, flooding, or punishment. The research on the effects of response-independent shock and the punishment of avoidance responding (Hutchinson et al., 1971; McKearney, 1972) suggest that these manipulations would increase aggression. Avoidance-motivated aggression, its control and elimination, seems to be a fruitful avenue of experimental investigation.

To the extent that the data on avoidance-motivated aggression in dogs relates to human aggression, they tend to support findings (Geen & Quanty, 1977) that contradict the Freudian hypothesis of catharsis (Konecni, 1975). The case histories suggest that dogs are more likely to be aggressive after an aggressive episode, have more frequent episodes, and actually get "better" at being aggressive (i.e., inflict more serious wounds) with each aggressive encounter. Such results parallel the research on learned conspecific aggression in mice in which the latency to fight decreases (Fredericson, Story, Gurney, & Butterworth, 1955) and the vigor of fighting increases (Kahn, 1951; Scott, 1958) with successful fighting episodes.

Safety Training

Safety training is a procedure specifically designed to increase prosocial avoidance responses and decrease fear motivation in companion dogs that manifested avoidance-motivated aggression. The findings of the present study seem to indicate that safety training (a) permanently eliminates avoidance-motivated aggression, (b) produces a high probability of extinction-resistant prosocial responding, (c) establishes a prosocial avoidance response set, (d) reduces fear and other reactions to stress, and (e) is correlated with positive changes in the dog's carriage.

The effects of using a safety signal were to (a) increase the asymptote of prosocial avoidance responding, (b) reduce fear, and (c) reduce the probability of aggression under stress. The safety signal seems to act as a conditioned positive reinforcer, allowing the trainer to maintain the gains of prosocial avoidance responding while fading out the negative reinforcement contingencies of shock termination, shock prevention, or CAS termination. Thus, a distinctive, response-produced safety signal may provide a method for making avoidance learning positive, changing the learning situation from the termination or prevention of aversive events to one of safety and security.

The effects of safety training have parallels in the behavior therapy literature. Risley (Note 4) observed an increase in acceptable social behavior (eye contact) in an autistic child to whom he had administered electric shock as a punishment for dangerous behavior. Lovaas, Schaffer, and Simmons (1965) used shock to punish autistic behaviors and to establish adults as safety cues for severe schizophrenic children. As a result, he noted a dramatic increase in social contact with adult caretakers. In addition, the children "often smiled and laughed, and gave other signs of happiness or comfort" as well as "molding" and "cupping" themselves to the experimenter's body (Lovaas et al., 1965, p. 104). All these prosocial behavior changes were quite likely a result of safety conditioned to the presence of adults.

However, due to ethical concerns Lovaas et al. (1965) were only willing to "safety train" one response (i.e. approaching adults) and only administered electrical stimulation as a punishment for autistic behavior. This aversion-relief training regime is similar to the play-training/aversion-relief control group used in Experiment 3. The results of the play-training/aversion-relief control group and Lovaas et al.'s training regime are very similar. Lovaas et al. found that the prosocial behavior conditioned by shock termination and by avoidance was situationally specific and often short lived, dissipating in months.

Safety training with companion dogs, however, produces changes of long duration, perhaps even permanent changes. These changes in behavior transfer readily from the trainer to the dog's owners and others. Presumably the difference between Lovaas et al.'s (1965) results and those of the present study involves the number of prosocial avoidance behaviors that were trained at the same time (1 vs. 15). The large number seemed to create an avoidance-response set. In addition, the diversity of environments under which training of the dogs occurred fostered generalization, and the use of warning signal and safety cues facilitated transfer of training to other individuals.

Another concept that may describe the difference between Lovaas et al.'s treatment and safety training I will label *behavioral balance*. In this context behavioral balance means selecting and training a range of operands such that they are equated on the dimensions of direction, amount, and location of movement. Behavioral balance becomes most salient when it is absent in a free-moving organism. For instance, in the pilot work on safety training with a number of dogs (not reported here) an attempt was made to train operands in succession, starting with the "Come" operand. The result was that dogs were so excessively attached to the trainer that they had great difficulty learning any operand that involved separating themselves from the trainer. Like Lovaas et al.'s (1965) autistic child, they would constantly attempt to be in physical contact with the trainer, soliciting almost continuous attention. It could be said that the "Come" operand had been acquired so thoroughly that approaching and staying with the trainer had become the dog's dominant mode of responding. These dogs were not in a state of behavioral balance. The intensity of this attachment was deemed unacceptable and balanced training sessions, including the practice of many operands presented in random order, was adopted.

To create bahavioral balance, operands were chosen to equate movement on a number of dimensions. Direction of movement toward and away from the trainer were balanced by equating the practice trials on the "Come" (toward), "Fetch," and "Go" (away) operands. Amount of movement was balanced by equating practice of operands that involved movement (e.g., "Come," "Go," "Fetch," "Heel") with those that involved cessation of movement ("Sit," "Down," "Stand," "Stay"). Other points of balance were created by selecting and equating practice of operands that were essentially opposite in type of movement (e.g., "Down" balances "Stand," "Hold" balances "Drop," "Hup" balances "Off"). It is hypothesized that this balance was important to the overall success of safety training since it provided the animal with a diversity of movement sufficient to create an avoidance and safety-learning set.

Shock aversion therapy has been explored as a means of managing a variety of compulsive behaviors in adults. Shock aversion therapy involves the use of shock to classically condition an aversion to stimuli related to the compulsive behavior or the punishment of components of the compulsive response (Rachman & Teasdale, 1969).

Overall, the clinically obtained results have been unimpressive and varied. Abramson (1973), reviewing aversion therapy for obesity, concluded that "there is little evidence to indicate that aversive procedures are effective" (p. 548). In determining the varying outcomes of aversion therapy for substance abuse, Hallam, Rachman, and Falkowski (1972) and Miller (1973a, 1973b) demonstrated the importance of extraneous therapeutic factors, such as positive therapeutic set and demand characteristics. A report on aversion therapy (Feldman, MacCulloch, Mellon, & Pinschot, 1966) for homosexuals cited an impressive 60% "cure" rate; however, another report (Birk, Huddleston, Miller, & Cohler, 1971) cited only a 25% (two out of eight) maintenance of heterosexuality at a 2-year follow-up. Best and Steffy (1971), combining electrical aversion therapy and a motivational-building technique for modifying smoking behavior, found that most of the "successes" were smoking again after 4 months.

The unimpressive outcome of aversion therapy in humans is exceeded by the dismal failure of aversion therapy to eliminate avoidance-motivated aggression in dogs, as presented in Experiments 1 and 3. It appears that dogs that are involuntary subjects and perfectly content to continue aggressing without remorse or guilt are not capable of having a positive therapeutic set or of being influenced by therapeutic demand characteristics. In a sense, they were a relatively "pure" test of the logic of using aversion therapy for eliminating internally motivated compulsive habits. A tentative conclusion is that when aversion therapy "works" for people, it does so via processes other than the classical and operant conditioning.

The question, then, is why does safety training with electrical stimulation succeed when electrical aversion therapy fails. A possible answer lies not with the inadequacy of the basic logic of counterconditioning but in the unidimensional conceptualization of most counterconditioning therapy procedures.

Safety training was conceptualized as a multidimensional training program. It embodies response competition by safety training a wide range behaviorally balanced prosocial avoidance operands, emotional competition via the extinction of fear, and motivational or incentive competition via safety acquisition.

In addition, safety training may provide cognitive competition by establishing a compliant avoidance-response set to counteract the aggressive avoidance response. Safety training is designed to transfer this avoidance-response set ultimately into a safety-response set, instructing the dog that it can acquire safety and security by performing a range of prosocial responses. As the dogs proceeded through this transformation from avoidance to safety training, they appeared more self-confident and self-assured. Perhaps safety training constitutes a model for development in animals of what Bandura (1977) has conceptualized as "self-efficacy" or what Rachman (1978) has defined as "courage."

An interesting implication of safety training concerns the ethics of using shock for changing behavior. The ethical considerations that Lovaas et al. (1965) faced in experimenting with children forced them to use "only the minimal amount of shock considered necessary for observing reliable behavior changes" (p. 112). Even so, their study has been criticized on ethical grounds. Safety training for avoidance-motivated aggression or other avoidance-motivated behavior problems in dogs is not presented with the same ethical considerations. However, it does involve the similar challenge of changing the behavior of a free-moving social organism.

Behavior therapy for such dogs has always been the last step before euthanasia. It appears that safety training with electrical stimulation is the only treatment that has potential for success. If the therapy fails to produce permanent and complete elimination of aggression, the dogs are euthanized. Given the dangerous nature of the response, the ethical question is whether the dog should be returned to the family before its aggression is completely and positively eliminated.

In conclusion, it should be emphasized that safety training for dogs is not being recommended literally as a behavior therapy program for avoidance-motivated human psychopathologies. A substitute for electrical stimulation may have to be found. If one were to conceptualize the electrical stimulation as a challenge the dog has to overcome by prosocial responding, then in safety training the dogs learn that they can "beat the challenge." With aversion therapy or punishment, the "challenge beats them."

It seems to me that the basic principle that runs through safety training is a sense of control over environmental stressors. Safety training may provide a way of developing in dogs the anthithesis of "learned helplessness" (Seligman, 1975). Due to the training, an inner strength or "learned invunerability" may develop.

The dogs are taught the general lesson that they can always control the stressors in their environment by a range of prosocial behaviors. The commands can be viewed as "infallible" instructions that when followed invariably lead to successful avoidance and ultimately lead to safety and security. The safety tone can be conceived of as a helping cue that unambiguously marks and facilitates the association between the successful execution of operands and safety. As the safety tone is faded, internal response-produced stimuli become the cues to safety. It could be said that at the end of safety training, the dogs have become "self-assured" by their own actions.

A safety-training program for humans could provide a multitude of progressively escalating but beatable challenges. The challenges should provide controlled but progressively increasing stress on the participant. They would be presented in behaviorally balanced programs of socially desirable experiences that could be provided by a combination of athletic practice, sports competition, nature survival programs, physical fitness programs, and cognitive skill training. The program would involve mastery level education to teach the participant the skills necessary to overcome the challenges and a social milieu that reinforces direct confrontation of challenges. There should be enough diversity and balance in the challenges, including both physical and cognitive components, to allow a person to develop a successful response set and to generalize this set to new life circumstances. Once this response set was formed, the person would be encouraged and guided to overcome his or her ultimate challenge, that is, beating whatever is left of the avoidance-motivated pathology.

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