

Attacks by Packs of Dogs Involving Predation on Human Beings

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SYNOPSIS

Dog bites are a medical problem for millions of people, children being the most common victims. Human deaths attributable to dog bite injury (not

rabies) are relatively infrequent. There have been some epidemiologic reviews, but this study is the first attempt to arrive at an understanding of bites involving predation on human beings by conducting behavioral examinations under controlled conditions of the dogs involved, and by interviewing victims, witnesses, and people familiar with the animals.

The three cases studied involved two fatalities and an attack that was nearly fatal. The victims were 11, 14, and 81. In each case, owned pet dogs consumed some human tissue. The severity of the victims' injuries was not the consequence of a single dog bite, but the result of repeated attacks by dogs behaving as a social group. Factors that might contribute to a dog's regarding human beings as potential prey were examined, including hunger, prior predation, group behaviors, defense of territory, previous interactions with people, the presence of estrous female dogs, and environmental stimuli. In two of the cases, it was possible, by using similar stimuli, to duplicate the circumstances at the time of the attack.

The results of the observations showed the value of behavioral analysis and simulations methods in evaluating possible factors in dog attacks.

Among the many factors probably involved in severe dog attacks are the size, number, and nutritional status of the dogs; the dogs' previous aggressive contacts with people; the victim's age, size, health, and behavior; and the absence of other human beings in the vicinity.

DOG BITES, according to recent reviews, are a major medical problem, affecting millions of people each year (1-3). Children are the most common victims of the reported dog bites; nearly 2 percent of U.S. children 5 to 9 years of age are bitten annually (1). Although only a small portion of dog bites is reported (1,4), the reported rate among children exceeds the combined rate of all reportable childhood diseases. Aggression (including that manifested in severe bites) when directed by dogs at their owners usually is not reported, but the incidence is high. The most common complaints of dog owners consulting animal behaviorists about their pets' behavior problems is aggression toward people (5-9).

The recent resurgence of dog rabies has increased public concern about dog bites. However, it is often not appreciated that deaths caused by bites of non-rabid, owned dogs are more common in the United States than deaths from rabies transmitted by all other animals combined.

Even so deaths directly attributable to dog attack (not rabies) are relatively rare. The victim's profile in these cases is different from that for dog bite in general. In Winkler's survey of 11 cases of human death from dog attack (10), nine of the victims were infants, one was an elderly woman, and one was an adolescent girl. A more recent review of U.S. newspaper articles (11) revealed an average of

10 human deaths annually from dog bites in the last 5 years. This number, which is based on voluntary answering of questionnaires, yields a conservative estimate; the actual number may be much higher. The majority of the victims were infants and young children.

The cases described in the present report involved two fatalities and one near-fatality. In all three incidents, the victims were attacked by groups of dogs. Attacks by packs of dogs account for less than 1 percent of reported nonfatal dog bites (2) and 18 percent of the fatal attacks reported by Winkler. In all the cases reported here, the dogs consumed some tissue from the victim. This phenomenon has not been reported in previous surveys. The victims in two of these incidents were healthy adolescent males, whereas the typical victim of fatal dog attacks in previous reports has been an infant. In two of the cases, we were able to examine most of the animals that participated in the attack and to observe them under conditions simulating those that may have elicited or contributed to the attack.

Case 1

In the first case, a group of at least 11 dogs carried out a near-fatal attack on an 11-year-old boy (R). Information about the incident was obtained from interviews with the boy, his parents, and eye-witnesses; from affidavits; and from our observation of the animals involved.

On the afternoon of April 24, 1980, R and another boy were playing in an open, sandy area, flanked by woods and fields, several hundred yards from a residential area in a small town. They and other children frequently played in this area.

About 15 minutes after the boys arrived, they heard barking. The victim later described the sounds as "baying, as if the dogs were chasing something." The boys had heard reports that others had been chased by dogs in this area, and they became frightened and climbed a tree. After a few minutes they descended and ran toward a hole they had been digging. They saw a few dogs emerge from the woods and run toward them. Both boys ran. R's companion tripped and fell, while R continued to run. The dogs passed the fallen boy, who remained still, and pursued R. One animal jumped, biting R at the waist. Then the other dogs joined the attack. The second boy, who had been bypassed, observed R alternately running and being dragged by the dogs. The attack continued for an estimated 3 to 5 minutes. As R weakened, he lay still. The dogs lay down around him, growling and biting him when he moved. R

said that he watched one dog eat a chunk of his flesh, but he reported that he was not in any pain.

A young man drove his car into the area and "saw a pack of dogs ripping something apart." It was not until he got closer that he saw that it was a boy. The victim's clothes had been torn off, with the exception of one shoe. The young man chased the dogs away and placed R in his car, which had become stuck in sand. He sent the second boy for help. Soon R's father arrived with a truck. The dogs had returned and threatened both men by growling and lunging at them. The dogs were eventually chased away, and R was taken to a hospital.

R's injuries were described as multiple and complicated—dirty, ragged lacerations all over his face, ears, neck, axilla, arms, trunk, groin, thighs, and back. Arteries and veins were exposed in the left axilla, and the skin of the arm showed multiple, almost circumferential, ragged lacerations. The right and left trunk were lacerated down to the fascia. Muscle mass was missing from several areas of the boy's body.

According to descriptions by witnesses of the attack and by local residents, 12 dogs living at a 60-acre industrial site, 2.7 km from the site of the attack, were implicated in the incident. These dogs (five males and seven females), predominantly German shepherd mixed-breeds, were owned by a resident on the property. The owner and some of the other residents of the area reported that sometimes some of the dogs were friendly and playful. Reports by other people, however, indicated that the dogs had chased, growled at, and bitten people before and that they commonly roamed both on and off the property as a group. Following impoundment at a local shelter, most of the dogs were identified by R, his father, and the young man as having participated in the attack.

Case 2

In case 2, as many as eight dogs engaged in a fatal attack on a 14-year-old boy (K). Information about this case is from the local police and coroner's reports. The animals involved were not available to us for observation.

On December 28, 1980, K was reported missing in a rural area in the Midwest. The next day his body was found in a brush pile about 200 meters from a road and 300 meters from the nearest house. The condition of the body, paw prints on the ground in the area, and other information led police to conclude that the boy's death was due to an attack by a pack of dogs.

There were no witnesses to the incident. The following events, however, were known to have occurred. At about noon on December 28th, K left home on his motorcycle to play football with his friends. On his way to town he passed the car of two local men who were driving home after hunting in the area. The men followed K until he pulled over to the side of the road near the W house. As the men drove past, they saw several dogs that had been lying in the yard near the house jump up and start barking. The owners of the dogs were not home. Around 12:25 pm, four local residents drove by the house and observed the boy's motorcycle parked on the side of the road. They did not see him or any of the dogs. The boy was reported missing that evening, and the motorcycle was found to be out of gas. K was known to have borrowed gas previously from Mr. W. It also was known that K was afraid of the dogs. The area was searched that night and the following day.

The next day clothing was found in a field near the W's house, and K's body was found in a nearby brush pile. The boy was nude except for a sock on the right foot and a shoe and sock on the left. Portions of muscle from the buttocks and from both sides of his legs were missing; the bones of the ischium, both femurs, and the left tibia and fibula were exposed. There were also multiple puncture wounds in the neck, clavicle area, arms, and torso. Dog hair matching that of at least one of W's dogs was found on the body. Clothing was found in the field, and pieces of it were found in the yard of the W's house, near the area where the dogs were housed. Mr. W had previously reported that the dogs had K's cap.

From prints in the field, it was concluded that the boy had circled a telephone pole opposite the house in an attempt to evade the dogs and had then run to the brush pile, the only source of protection in the area. From marks in the field and the distribution of shreds of clothing, it was evident that he had been pulled to the ground at several places. He had not been dragged. The attack apparently had ceased when he crawled head first into the brush pile; no bite marks were on his feet. The cause of death was officially entered as hemorrhagic shock and cold exposure.

According to police reports, eight dogs lived at the W's residence. It was later discovered that one dog had been traded for a sack of feed on the afternoon following the incident. The owner said he was in the process of getting rid of the dogs because he could no longer afford to feed them. There were

reports that workmen had previously been bitten on or near the W's property by one or more of the dogs, and that the W's son had also been bitten. The dogs were reported to have chased cars and motorcycles on numerous occasions.

At the coroner's inquest, a local hunter reported that he had seen several of the W's dogs chasing a deer at about 11 am on December 28, approximately 1 hour before the attack on K apparently took place. He indicated that the dogs had the deer down, but that it had escaped. Police reports described all of the dogs as "lean," and at least one of them as "mean."

Case 3

In the third case, six dogs (shown in the photographs, page 61) carried out a fatal attack on an 81-year-old invalid woman. Information on this case was derived from police and coroner reports; from interviews with the victim's son, neighbors, and officials of the SPCA (Society for the Prevention of Cruelty to Animals); and from our observation and examination of the animals involved.

On January 23, 1981, the 81-year-old invalid, Mrs. L, was attacked and severely injured by dogs that lived in her home in a large eastern city. She died from her injuries the next day.

For the previous year and a half, Mrs. L had been cared for by her 51-year-old son, M. She had suffered a stroke and was usually confined to one room. M had brought the dogs with him when he moved in. Because the dogs barked and growled at Mrs. L, they were separated from her by a plywood barrier between her room and the rest of the house.

On the afternoon of the 23d, M and a friend left the house for about 1 hour. When they returned, they found the barrier down and Mrs. L on the floor in a corner of her room. Her dress had been ripped off. She had severe multiple scalp, trunk, arm, and leg lacerations. Muscle and other tissues were missing from her right and left arms and right leg. The cause of death was multiple injuries of the head, trunk, and extremities.

Six dogs (three males and three females), each weighing less than 12 kg, were in the house at the time of the attack. From interviews with M, the police, and neighbors, it was determined that the dogs typically barked at passers-by and strangers entering the house. Two of the dogs were very protective of M and would threaten anyone who approached him. The smallest dog, a female who had been born in the house, often stayed in Mrs. L's room and was quite friendly to her. The neighbor's

children sometimes played with some of the animals through the backyard fence. The police who arrived on the scene reported that the dogs barked and growled "with a threatening sound" when they arrived. The SPCA officials described all of the animals as docile and as being frightened when they were placed in the SPCA truck. The dogs were impounded at a local shelter.

Investigations Under Controlled Conditions

After the animals in cases 1 and 3 were impounded, questions were raised about whether these dogs were capable of attacking people and about the circumstances that had elicited or escalated the encounters. Our objectives in examining the animals were to determine their overall health, intragroup behavior, responses to people, and responses to stimuli approximating those present at the time of the attack.

Case 1. On June 13 and 14, 1981, 7 weeks after the case 1 incident, we visited the scene of the attack and obtained accounts from the victim, his father, and two witnesses. Nine of the original group of dogs were still in the animal shelter; two had died. All the dogs reportedly ate ravenously at the shelter.

The dogs were taken to a fenced football field. The veterinary examinations of the dogs and their subsequent interactions with one another and with people were recorded on Super 8mm sound film. The veterinary examinations revealed that all of the animals had coats of poor, coarse hair and that all but one were underweight. Several exhibited weak, sloping pasterns and had readily palpable tuber coxae and vertebral processes, and some had enlarged joints at the costochondral junctions. One had tapeworms protruding from the rectum.

During their individual examinations, all of the dogs appeared timid, although one animal briefly bared its teeth. A professional dog trainer and handler approached each dog and assessed the probability of its having had previous attack training. None of the dogs gave any indication of having had such training.

When released onto the field, the dogs engaged in a variety of social behaviors, including greeting, playing, and dominance-subordination interactions. They appeared to be familiar with one another, and most of them stayed close together on the field. They showed no threatening or aggressive behaviors toward any people present, and when given a pack-

age of chicken parts, they engaged in only short bouts of competition with no overt fighting.

The trainer, wearing a padded sleeve, walked among the dogs without eliciting a response from them. When he ran, he elicited a few barks, but no attack. Serendipitously, several people on motorbikes appeared along a hillside road about 100 m from the field while the trainer was conducting his experiments with the dogs. The dogs began barking and ran in a group parallel to the bikes. Most of them redirected their chase to the trainer. After the bikes were stopped and he remained still, the animals moved away.

To simulate conditions that might have occurred if the dogs had encountered people while chasing prey, the trainer stood behind a van parked in the center of the field, out of view of the dogs. A cyclist was instructed to ride along outside the fence, keeping just ahead of the dogs. After the cycle had traveled about 60 m, it stopped out of view of the dogs, and the trainer, wearing a padded suit, ran from his position. Seven of the nine dogs immediately pursued him, and five of them delivered multiple bites to his arms, legs, thighs, and buttocks. Analysis of the films showed that the first and most persistent attacks came from those animals fitting the victim's (R's) description of the dogs that had been most aggressive towards him.

When the trainer stopped moving, all of the dogs eventually released their grip. When he screamed, kicked, or struggled, as the victim had done, the attack escalated. Five of the dogs bit him repeatedly, and he reported that he would have been pulled to the ground had he not been holding on to the fence.

The situations just described were duplicated as closely as possible about 3 hours later in the presence of a group of five other dogs of similar sizes and breeds from the same shelter. These animals had no previous history of interaction with each other and were not known to have been involved in any bite incidents. They exhibited some play, were not competitive for food, did not chase the motorcycle or the running man, and exhibited no aggression under these conditions.

The behavior of the animals involved in the attack was consistent with our hypothesis that the dogs probably had been searching for or chasing prey at the time they had encountered the boys and had directed their attack at R. R's flight and struggle resulted in escalation of this behavior.

Case 2. Although we did not have the opportunity to observe the dogs involved in case 2, the events

that took place were similar to those in case 1. Only an hour before the attack, some of the dogs had caught a deer, which then escaped. The dogs had routinely chased moving objects (cars, motorcycles) near the house of their owner. Since the attack occurred on or near the owner's property, the protection of territory also may have been a motivating factor in this attack.

Case 3. In case 3, there was public skepticism about the ability of these small and timid dogs to inflict serious injury. The animals were examined individually at the shelter by V. L. V. on January 28, 1981, and again by all of us 3 days later. The examinations and other interactions with the dogs were recorded on videotape.

All of the dogs in case 3 were timid, and some



Experimental testing by Dr. Voith of the reactions of the dogs in case 3 (three are shown here) that had attacked the 81-year-old woman



The six dogs in case 3 that were involved in the attack on the 81-year-old woman were rather small animals—terrier, beagle, and dachshund crosses. Generalizing about the size and breed of dogs that may attack human beings is not possible

of them would remain immobile when placed in any posture. All had long toenails, an indication that they probably rarely, if ever, exercised outside the house. Only one of the animals would walk on a leash. One female had recently been in estrus, and one was in proestrus or estrus at the time of examination. All of the dogs appeared reasonably well-fleshed, with no signs of malnutrition. Most of the dogs had coats of short hair, and their ribs were not visible; however, there was no palpable layer of fat under the skin.

During the second examination, the animals were introduced one at a time to a 7 × 15 m room at the shelter while we and several SPCA officials watched. The first dog released hid behind a partition and was joined there by the second. The two animals huddled close together and showed no threatening behavior. When the third dog, a male terrier mixed-breed, was introduced, he began investigating the room and was soon joined by the first two dogs. This animal was one of those reported by the victim's son to have been the most threatening to the victim. When all dogs were present, the group began investigating the room, usually in close proximity to one another and led by the terrier mixed-breed or an older female beagle. The dogs failed to respond to a variety of dog toys and made no attempt to solicit play from any of the people present.

The animals were left alone in the room for 1 hour. When a person reentered, the dogs barked and growled, and the terrier mixed-breed attempted to bite. When directly approached, the animals would retreat under a table. As the person withdrew, the dogs approached with increased barking, growling,

and attempted bites. At times the person found it necessary to fend off the biting dogs with a broom handle.

The animals were allowed to quiet down; then a doll approximately 1 m tall was suspended from a stick and moved towards them. When it was moved quickly, the dogs retreated. If the approach was slow, they barked, and if the doll was kept still, they approached and bit at the legs and torso. When the doll was allowed to fall towards the dogs, as might have happened with the victim, the animals pulled on it. The dogs growled continuously and repeatedly bit and tugged at the doll's head, neck, hair, and arms. They then dragged it beneath a table, where they chewed on it for approximately 3 minutes.

The pattern of this group's attack on the doll was consistent with the injuries to the victim. Most of Mrs. L's wounds were on the arms, scalp, and back of the head.

Throughout this sequence, none of the animals showed any behavior typical of canid play, such as play vocalizations or play solicitation (12-13). The behaviors were clearly aggressive and socially facilitated. The smallest of the animals, a female beagle mixed-breed, did not participate in the attack on the doll or in any of the threatening behavior toward us.

When the animals were provided with fresh food and water, they exhibited no aggressive behaviors over food and no threats toward a person withdrawing the food. In fact, the animals were friendly and tried to get the person retrieving the dog dishes to play with them.

Later that day, the same tests were conducted with a group of four other dogs housed at the same SPCA shelter. No aggression was exhibited toward people, the stick, or the doll. All of this group's interactions with people were friendly.

A few days later, the reactions of the dogs that had attacked the victim were again assessed. When a woman approached and then withdrew with jerky, abrupt movements, waving her arms or feet and vocalizing in a high pitched voice, the dogs escalated their threatening behavior, biting her shoes and the stick she held (see photograph). When the woman ceased moving and vocalizing, the dogs stopped threatening her.

Our conclusion was that five of the six animals, as a group, could easily be provoked into repeatedly biting a human being, despite the fact that individual animals were timid and nonaggressive.

Discussion

As was noted earlier, these three cases differ from previously described fatal dog attacks in that all involved pack attacks on mature people, and all involved ingestion of tissue from the victim. Thus, we should attempt to identify the factors that might contribute to a dog's regarding human beings as potential prey.

Role of hunger. None of the 25 attacking dogs in these cases could be described as emaciated, although all of those for which descriptions were available were characterized as lean, and in case 1 most of the dogs were definitely underweight. If the dogs had attacked to satiate their appetites, however, more tissue should have been consumed. Interestingly, a large amount of tissue was removed from the victim in case 3, in which the attacking dogs were not underweight and in fact appeared to have the best nutritional status of any of the dogs in the three cases.

Role of prior predation and social facilitation of feeding. In cases 1 and 2, the animals were known to have a history of hunting together and probably had been pursuing prey soon before their attacks on people. The dogs in case 3 did not have a history of hunting, but they routinely fed together without conflict. Thus, in all cases, after one or more individual dogs had initiated an attack, previous group interactions could have facilitated predatory behavior by the entire pack. Once the victim was down and bleeding, the animals' previous histories of social facilitation of feeding may have influenced their ingestive behavior.

Role of defense of territory. Invasion of territory by alien or subordinate members of the same species can lead wild and domestic canids to attack. In at least 45 percent of the 2,538 dog bite cases analyzed by Beck and associates (2), the attacks took place on or near the dog owner's property. All of the 11 fatal attacks described by Winkler (10) also took place on the owner's property.

In both cases 2 and 3, the attacks took place on or near the owner's property, and in both cases the dogs had had previous contact with the victim. In case 3, the dogs were very familiar with the victim, but had never been alone with her in the same area. In case 1, the animals were probably on familiar ground (their home range) but were 2.7 km from their main residence. Only case 2 may fit the traditional picture of animals defending a territory from intrusion by strangers.

Role of social interaction with people. Most of the dogs that had engaged in the attacks were described as being friendly toward some people some of the time. The majority of the dogs observed in cases 1 and 3 were extremely variable in their behaviors towards strangers. The animals in all three cases had unusual histories of unsupervised activity and aggressive social interactions with people. The animals involved in case 1 were reportedly kept as guard dogs and were allowed to run at large. Several witnesses reported that the animals had been encouraged to threaten workmen in the area. We do not have details of the social history of the animals in case 2, but they reportedly were allowed to run at large and frequently chased cars and motorcycles. The animals involved in case 3 were always confined to the house or a small fenced yard. They had little contact with people other than the owner. Interestingly, the small female beagle mixed-breed that was reported to have routinely interacted with the victim did not participate in any of the group attacks in the simulated tests. We doubt that this dog was involved in the actual attack.

In all cases there was little or no evidence that the owners had made any effective attempts to inhibit their animals' aggressive behavior toward strangers, and in some instances aggression was apparently encouraged.

Role of environmental stimuli. Canid hunting involves vision, audition, and olfaction, but at close range the main elicitor of attack behavior is the visual stimulus of moving prey. Once vulnerable prey has been identified, group members will coordinate their activities to immobilize it, usually by bites to the hindquarters (13). It is not unusual for wild canids to begin feeding while the prey is still alive, as long as it is incapable of escape.

In cases 1 and 2, the animals apparently were experienced hunters and had probably been hunting shortly before the attacks. The dogs in all the cases may have been aroused by the movements and cries of the victims. In case 1, a motionless boy escaped injury, while the running boy was chased and pulled down. The victim reported that the attack escalated when he screamed or fought against the dogs. When he remained still, the dogs stopped biting. The animals responded in the same way during the test evaluations.

In case 2, foot and paw prints on the ground suggest that the victim had run to a telephone pole and then to a brush pile. He appears to have been

pulled down several times by bites on the buttocks and legs.

We have no knowledge of the behavior of the victim in case 3 before the attack. Since she was afraid of several of the dogs, it is possible that she cried out or moved abruptly upon seeing them loose and may have attempted to escape, and then may have fallen or been pulled down. Many of her wounds could have been received in the process of flailing her arms to defend herself. In our examination of the dogs involved, movement away from them or flailing of the arms elicited chasing, growling, and barking.

Role of the number of dogs. In all cases in this report, the attacks were carried out by packs of at least six dogs. In only 2 of the 11 fatalities surveyed by Winkler, however, did more than one dog participate in the attack (3 dogs in one incident and 7 in another). Pack attacks have a greater probability of resulting in serious injury than attacks by a single dog because of the greater number of wounds that a pack can inflict and the likelihood that social facilitation will prolong or escalate the attack.

Role of the size of the dogs. In general, serious bites are more often attributed to larger dogs (3). In Winkler's survey, only 8 of the 21 animals (38 percent) identified by breed could be classified as large, that is, the size of the adult german shepherd or larger. All of the dogs in case 1 that we examined and at least four of the eight dogs in case 2 were the size of german shepherds or larger. However, all of the animals in case 3 weighed less than 12 kg. Clearly the danger associated with dog attack is a product of the size and the number of dogs and the vulnerability of the victim. Even a single small dog is capable of killing an infant.

Role of estrus. A popular view is that the presence of a female in heat increases the probability of dog attack. The presence of an estrous female leads to the assembly of many male dogs and can thus indirectly increase the danger of attack, which is associated with an increased number of dogs and the aggressive behavior that may occur among them. Competition for females may increase aggression within a pack without an established social hierarchy.

Some clinical cases involving complaints of owners regarding the aggressive behavior of pet dogs have revealed that when female dogs are in heat in the home or vicinity, a male dog may demonstrate increased aggression toward a person that places him-

self or herself between the intact male and the estrous female (unpublished data of V. L. V.). However, estrous females were not present during the simulation tests in case 1 in which the trainer was attacked. Moreover, the trainer was not attacked by the control group, which included an estrous female. We do not know if there were any estrous females in the group of dogs in case 2. Case 3 did involve an estrous female, but we have no way of knowing if the elderly woman who was attacked had interposed herself between this animal and any of the males in that group. The simulation tests were conducted with this group of dogs, which included an estrous female, although a different one than was in estrus at the time of the attack. At no time did any of the investigators in the simulation situation interpose themselves between the estrous female and the other dogs. The threatening behavior began when a person approached the entire group.

In all three cases, there was much concern on the part of the public, the owners, and the police investigators regarding the correct identification of the actual dogs that had engaged in the attacks. Cases 1 and 3 provided a unique opportunity for detailed evaluation of whether specific animals could have been involved in the attacks and what possible contributory factors facilitated the attacks. In both simulations, the pattern of attack was consistent with eyewitness descriptions of the incidents and the nature of the injuries.

In case 1, the boys reported that the dogs that carried out the attack had apparently been hunting shortly before emerging from the woods and were running as they came into the clearing. In the simulated condition, an attack could not be elicited until the dogs had first been excited by chasing a motorcycle. The dogs then redirected their chase toward a running man and attacked him. The animals that led the attack under the controlled conditions were the same dogs as those that the boy reported had persistently attacked him.

In case 3, the male terrier mixed-breed, which was the dog most feared by the victim, was either the first or the second dog to initiate threats and attacks directed at approaching people and at the doll in the simulation tests. The only animal that did not engage in the group threats and attacks directed at the investigators or the doll was the small female beagle mixed-breed that was reported to have had much friendly contact with the victim. The distribution of bites on the doll closely paralleled that of the wounds on the victim.

In both cases 1 and 3, the flailing of arms or legs; rapid, jerky motion; and high-pitched cries increased the intensity of the attack. Moving slowly, or not moving at all, resulted in reduction of the intensity of attack. This observation was corroborated by the victim's report in case 1. It is likely that the attacks in these cases were intensified when the victims attempted to defend themselves or call for help.

The results of our observations give us confidence in the use of behavioral analysis and simulation methods to evaluate possible factors in dog attacks when witnesses or detailed accounts are not available. This is particularly necessary when there is some doubt as to the cause of death, as in cases 2 and 3 where there was initial doubt as to whether people or dogs had caused the deaths.

Addendum—a Fourth Case

Another case came to our attention after this report had been set in type. It is added because of its similarities to the other cases.

On November 10, 1982, a 10-year-old girl was attacked and killed by an unknown number of dogs that were part of a larger group in rural Indiana. The girl was riding a bicycle along a country road between her parent's home and the home of her grandparents when the dogs, which resided between the two homes, attacked her. Her torn jacket was found near the bicycle on the road. Apparently it had been pulled off her as she ran into the woods. The girl's body was found in a supine position, arms outstretched with her head resting against a tree within 50 feet of the road. Her clothes, except for her shoes, had been ripped off by the dogs. It was theorized that she fled from the dogs but was brought down in the woods.

The girl sustained numerous puncture wounds over most of her body and had scratch marks on her back. Her left arm and thoracic wall were partially eaten. The brachial artery system was severed, causing exsanguination and death. Little blood was found on the body or on the ground; it had apparently been consumed by the dogs.

Shortly after the girl left home, a person driving by the scene of the accident reported seeing four dogs on the road near the bicycle, but apparently had not seen the girl and did not stop. Within 45 minutes from the time she was known to have left her home, the dog's owners, who had been away at the time of the attack, discovered the girl's body. No dogs were found around the body. The owner

rounded up all but three of the dogs and confined them in their pen. Sheriff's deputies shot and killed the three loose dogs and brought all the others to the county pound. The shelter manager reported that the dogs had initially been somewhat aggressive and one had snapped at him.

The dogs reportedly had originally been strays that had been provisioned for years by the owners, an elderly childless couple. Many of the dogs had been in residence on their property for several years. Occasionally the dogs were penned, but frequently they were free to roam.

Law enforcement personnel, the medical examiner who was called to the scene of the incident, and the child's parents and grandparents were interviewed. It was learned that the dogs were known to chase cars and other dogs and to bark threateningly at people coming onto the elderly couple's property. In addition, the dogs were known to have killed at least one dog, in the presence of its owner. The dogs chased cars and threatened people more intensely when the owners were away. When at home, the owners suppressed the dogs' threatening behaviors. They had been warned by the county sheriff's department to keep the dogs penned, following a complaint.

The child had been instructed not to make the trip to her grandparents if the dogs were on the road; instead she was to be driven by a parent. It is unknown why she did not follow these instructions on the day of the attack. It is known that she was in a hurry to get to her grandparents' home to use their encyclopedia for a school assignment. Perhaps she was preoccupied and did not see the dogs or decided to make the trip even if she did see them.

The dogs were observed and examined at the county pound on November 27, 1982. There were three puppies under 3 months of age and 11 older dogs. All were mixed-breeds, and most were of very similar appearance and appeared to be related to each other. Most of the adults weighed about 20 kg. A few of them had paw and leg injuries indicative of capture in leg-hold traps. One had a front paw missing. Physical examination indicated that all the dogs were healthy and in good nutritional condition; several had a light layer of adipose tissue under the skin. Many had incisor teeth that were worn to the gums, a condition that results from chewing on hard material such as stones and wire.

When an investigator (V. L. V.) approached and examined individual dogs, they were timid and frightened. In a group some members, although still fearful, would growl at the investigator. Their general behavior was in sharp contrast to that of the

other dog group housed at the same pound; these dogs approached the investigator in a friendly manner, and none exhibited any aggressive behavior. It was not possible to simulate the conditions of the actual attack on the child.

The tragedy is that although these dogs were known to be unfriendly and killers of animals, the real danger to people was not appreciated. The long standing friendships in the community and the rural pattern of permitting dogs to roam free inhibited people from insisting that the dogs be properly managed.

Prevention of Dog Attacks

Perhaps the cases described here can provide some insight into the warning signs of dog attack. Many of the dogs in these cases were lean, and some were underweight. Although there is no indication that hunger played a part in the initiation of the attacks in cases 1 and 2, these dogs did have a history of hunting as a pack unit. We believe that their pack-facilitated hunting behavior and their previous experience working as a coordinated unit played a role in the attack and their subsequent consumption of flesh.

None of the three incidents we have described can be considered to have been intentionally provoked by the victim. However, it is likely that the natural defense reactions (flailing, kicking, and screaming) of the victims escalated the attacks.

Most of the dogs had a history of previous aggressive threats towards people. This history, however, does not necessarily mean that the dogs were not socialized or that their socialization had been inadequate. In fact, many of these dogs, and perhaps all of them, were reported to have interacted in a friendly manner with familiar people under certain circumstances. What was common among all of the dogs in the cases described was that there had been no attempt by responsible adults to inhibit threatening and aggressive behavior directed at some people. Some of the dogs were even reportedly encouraged to act aggressively toward some people.

Often people attempt to solve the problem of aggression in dogs by restraining or isolating them. Although dogs cannot injure anyone while confined, if the animals escape or encounter people with whom they are unfamiliar, they may inflict injuries. Such was apparently the situation in case 3, in which the son of the elderly female victim kept his dogs behind a barrier, and in the addendum case, in which the owner inhibited the dogs' aggressive behavior in his presence and periodically confined the dogs.

The past history of the social interactions of dogs with people in a variety of circumstances is probably an adequate predictor of whether these dogs are inclined to bite someone. But whether an animal could engage in a repeated, unrelenting attack resulting in the death of the victim is more difficult to determine.

All of the animals in the situations we have described were loose or unsupervised at the time of the incident, as they were also in 45 percent of the reported biting incidents reviewed by Beck and associates (2) and in 92 percent of the attacks on letter carriers surveyed by Lockwood and Beck (15). Loose pets are more aggressive closer to their homes and also are more aggressive than unowned strays when they are approached (16). Information obtained from persons presenting their dogs for treatment for aggressive behavior (5-9) indicates that many biting incidents involving both adults and children occur in the home in the presence of other people.

In these situations, in which the owner is often the victim, the incidents are rarely reported officially, and many of the bites are not treated by a physician. In contrast, serious repeated attacks that result in maiming or death usually occur when no one except the victim is present.

Severe dog attacks are a probable product of many factors, including the size, number, and nutritional status of the dogs; their previous aggressive encounters with people; the age, size, health, and behavior of the victim; and the absence of other human beings in the vicinity. A public health program aimed at preventing such incidents could be directed to any one or all of these factors.

The most practical point of intervention is at the level of owner responsibility. Dogs, especially those with a history of threatening any human being, should not be allowed to run free or interact with people unless they are under control. Ideally, companion dogs should not threaten anyone. If owners wish to keep a dog that exhibits uncontrolled aggressive tendencies, they should seek professional help to treat these tendencies. In our (P. L. B. and V. L. V.'s) clinical experience with family dogs that show aggression towards people, obedience training alone has often been unsuccessful in preventing or treating the aggressive tendencies.

A simple education program in dog-bite avoidance directed toward likely victims (for example, children, the elderly, letter carriers, meter readers) could further reduce the incidence of such encounters.

Although such measures would be in the best interest of humane societies, public health and law enforcement officials, and the general public, little progress will be made in such a program until the magnitude and seriousness of dog attacks on the streets and in the home are more widely recognized.

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