

Exploring the Bond

How anticipating relationships between dogs and children can help prevent disasters

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The benefits of having a family dog are substantial. Dogs can provide love, acceptance, and companionship for all members of the family, particularly young children.^{1,2} Children who have pets read more and engage in more social interactions than those without pets.³ Having a good relationship with a pet can also help teach a child to be more humane.⁴ Despite these benefits, an estimated 3 to 4.5 million dog bites occur annually in the United States,⁵ and 50% of these involve children less than 14 years old.^{5,6} Unfortunately, bite prevention efforts often focus on legislation that restricts or condemns dogs,^{7,9} rather than approaches that foster relationships between dogs and children that are based on mutual deference, respect, and communication.^{2,10,11}

Although extensive literature on the medical sequelae of dog bites to humans exists, we do not really know why dogs bite children. Dog bite data in general are incomplete; demographic information about the dogs involved is scant, and broad conclusions are drawn on the basis of generalities about breeds.¹²⁻¹⁴ Unless the dogs involved have a known behavioral diagnosis, we are poorly equipped to draw any conclusions about which dogs will bite and when. Little or no research has been conducted concerning the characteristics of children's and dogs' behaviors associated with most incidents.¹⁵ Information about these behaviors could provide us with critical insight into interactions between children and dogs and help prevent dog bites.

Despite the absence of hard data, considerable advice has been given in the veterinary and medical literature regarding interactions between dogs and children.^{2,10,16-20} These recommendations (**Appendix 1**) assume that the dogs involved are "normal" and interact with "normal," attentive, and supervised children. While the basic advice appears sound, it has not been effective at preventing dog bites. Such didactic recommendations do not consider developmental variables that affect the way children and dogs relate to each other, nor do they consider the compatibility of their temperaments. Addressing these considerations as part of a comprehensive family wellness program could further reduce risk and injury.

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Anticipating interactions between dogs and children is possible only with an understanding of age-specific dog and child behavior. Once the norm of age-specific responses has been defined, factoring in environmental variables such as individual temperament, previous experience, and locale of interaction may enable us to predict what may actually happen between a specific dog and a child. Veterinarians, as the primary caregivers, are familiar with canine development. If they wish to prevent bites to children, they also need to understand child development. In this report, we review the extant literature on age-specific normal behaviors in dogs and children and consider what could happen if the behaviors of the dogs or children involved are problematic, primarily focusing on published data about dogs with behavioral diagnoses. Finally, we describe those issues that any family with children should consider before getting a dog and those that may affect families with dogs that may later add children.

Canine Social Behavior and Development

Canine social systems—Canine social systems are based on deference,^{21,22} which allows dogs within a group to interact in a cooperative and coordinated manner. Humans operate within a similar social framework. A functional convergence between human and canine social systems is supported by the following characteristics: extended family groups that participate in care of the young; a nutritional progression from mother's milk to semisolid food to solid food; sexual maturity preceding social maturity; signaling systems that are redundant and that use nonverbal signals to verify most content^{21,23}; and a rule structure that uses deference rather than combativeness in social interactions and thus allows for fluidity within the system.^{21,23} These similarities in behavior have made domestication and the development of breeds that excel at certain types of tasks possible.²⁴ In social circumstances, canine and human status is conferred on the basis of the individual's ability to act appropriately in various situations and is not taken by force.

Canine signaling—Canine behavior may seem unpredictable and complex to untrained observers.²⁴ Dogs communicate with each other, in part, by use of body language. They also communicate with people this way, but because of similarities in canine and human social behavior, people may interpret canine

signals incorrectly.²¹ For example, when a dog presses its paws on a human's shoulders we anthropocentrically call this a hug; however, in communication between dogs, such behaviors are often challenges. The same behavior can be a challenge in canine-human interactions, or it can be a learned behavior that humans have encouraged and rewarded. Similarly, dogs, even those trained in obedience, may be confused by all but a specific set of verbal and hand signals they've been taught; other verbal or hand signals may interpreted as provocative. This confusion may create only frustration in the relationship between an adult human and a dog, but can result in a bite to a child. Children can be equally confused by a dog that uses a signal for which the child has already formed an association. This is particularly dangerous when a dog that is fearful, confused, or anxious gives mixed signals. For example, children may view a rigid, highly held, wagging tail as a signal that the dog is happy, or a lifted lip as a smile, without realizing that these behaviors can be potential signs of danger. Even children who have lived with dogs cannot always be expected to perceive subtle differences in canine signals or to act appropriately in potentially dangerous situations.

One anthropocentric outlook on dogs and children is that dogs consider children as littermates, and, thus, as rough-and-tumble playmates. Alternatively, dogs may view children as small and erratic variations of adult humans. Children's normal expressions of affection can be loud, shrill, and quite physical, and their movements are often rapid and chaotic. These behaviors share similarities with certain prey behaviors and may confuse dogs or increase their reactivity in any given situation. Some dogs may choose not to interact and may try to remove themselves from the situation, whereas others may respond to what seems like an unpredictable situation by growling or nipping. A behaviorally abnormal dog may deliver a substantial bite because it views the child as a threat, regardless of the child's behavior, whereas a behaviorally normal dog may bite because it cannot escape a child's attentions and is fearful.

Finally, children often do not use appropriate discretion when approaching and handling dogs, and their small stature makes it difficult for them to fend off an attack.^{25,26} Children may unintentionally provoke a dog by petting it while it is eating or startling it while it is sleeping.¹⁶ Children's actions are products of a self-centered world view that does not address or include the specific needs of dogs. These characteristics, coupled with confusion regarding canine signaling, put children in situations where their reactions could make a dog's response more dangerous.

Stages of canine development—A dog's reaction to a child's behavior can be influenced by the dog's developmental stage. Puppies test a variety of behaviors while learning about their interactions with their human family. Puppies learn about social interactions, in part, through object play involving their teeth and paws.²⁷ Dogs do not have opposable thumbs, so they use their mouths and teeth in situations under which humans would use their hands. Mouthy puppy behav-

iors that are not redirected to appropriate chew toys may become problematic and potentially injurious when displayed by adult dogs and may injure children when exhibited within nonagonistic contexts. Children's food, clothing, and body parts can be exciting moving targets for dogs and are easier for dogs to grab than are their adult counterparts. Adult humans may superimpose rules on these situations designed to redirect mouths and teeth; however, children may be less able to redirect puppy behaviors appropriately without using too much force or extraneous movements. Inappropriate efforts at redirection may encourage more aggressive or more forceful behavior from the puppy.

At sexual maturity (onset, 6 to 9 months old), dogs may be more attentive to smells, may increase marking, may roam and begin to fight, and may mount.^{28,29} Most mounting is about social signaling and not about sexual gratification. Such canine signals are easy for children to confuse. They may be amused and inadvertently encourage the behavior or become frightened and treat the dog too harshly. Sexual marking may compound problems with house-training. If children are involved in the house-training process, increased adult supervision is required as dogs become sexually mature. Finally, the urge to roam or fight may render dogs that were previously able to be walked by children less manageable, thus potentially putting the child at risk for injury. Early neutering²⁹ and the use of head collars for walks can minimize potential problems.

At social maturity (onset, 18 to 24 months old; range, 12 to 36 months old), dogs fine-tune their social skills with other dogs and with humans. They may exhibit a different temperament than they did as a puppy.³⁰ Behaviorally normal dogs may become more tentative or more assertive, and dogs with behavioral diagnoses tend to develop or enhance their behavioral problems at social maturity. This change in behavior can have an impact on children who are present during human-canine interactions. A child's behavior that was previously not problematic may become so (eg, pushing the dog down, wrestling with the dog, taking a ball from the dog's mouth).

Older dogs (as determined by breed and general degree of health) are likely to be affected by arthritic joints, diminished eyesight and hearing, and slower responses. Patience and desire to engage in physical play, or the amount of time a dog can tolerate play, wane. Children, who can't take no for an answer and who can't possibly understand the discomforts of old age, may now find themselves around an irritable or potentially fearful dog that reacts in ways that are unprecedented and unanticipated. In extreme cases, older dogs may develop pain aggression or fear aggression secondary to pain.

Child Development

Theories of normal cognitive and psychosocial development established by Piaget³¹ and Erikson³² have been pivotal in helping healthcare providers and parents understand why children behave as they do at different ages. Understanding age-specific changes in a

child's behavior can assist in anticipating problems with interactions between children and dogs that are associated with the child's capacity to understand social dynamics. The following stages of development are modeled on Piaget's and Erikson's theories and consider the effects that a child's gross motor, social, and cognitive capabilities may have on interactions with a dog.

Newborn to 6 months—An infant arriving in a household brings with it new smells (diapers, breast milk, formula) and new sounds (crying, babbling). For everyone in the family, the continuity and predictability of daily life temporarily unravels. The family dog often becomes the last priority. As the baby's motor skills become more purposeful, he or she may reach out and randomly grab some fur, an ear, or a lip. At the end of this developmental stage, most infants will be starting to sit independently, and some will be creeping along the floor or pulling themselves up on their hands and knees, preparing to crawl. In this context, it is understandable that most dog bite injuries in infants are to the face, neck, or head.¹³ Although most dog bites cause relatively minor soft tissue damage in adults,³³ aggressive canine behaviors, whether purposeful or accidental, can have dire consequences for infants.³⁴ The death rate attributable to dog bites in infants is 340 times the rate for a 40-year-old adult.³⁴ A dog's teeth can exert a force of up to 400 lbs/in², and crush injuries are more common than lacerations.³⁵ Dogs that are anxious or exhibit uncertainty in new social contexts will need extra monitoring and assistance as they become accustomed to a new baby.¹⁴

Six to 24 months—Development of gross motor skills proceeds rapidly during these months. Infants master crawling, cruising (using animate and inanimate objects for partial support), and walking. Mobility complements a child's curiosity and facilitates exploration, but it can also place a child at risk. Children who are learning to walk are unsteady on their feet and can be unintentionally knocked down by a dog or its wagging tail. If focused on exploration, toddlers will steamroll right over dogs that are in the way, regardless of the dog's size, shape, or temperament. Dogs themselves are often the object of exploration and may be mouthed on, teathed on, squeezed, and pinched. The dog is subject not only to new behaviors, but also to new behaviors that occur at unpredictable times and with varying and unpredictable intensity. Dogs that need consistent environments (eg, those with anxiety-related conditions, including aggression)²¹ may handle such changes poorly, and dogs that have been able to control their fear or pain in households with a child in the pretoddler stage may now find themselves provoked or threatened by the new behaviors of that same child.

Also around this age, a child's budding desire for autonomy brings tantrums, noise, and commotion that can produce chaos in a household. Predictability vanishes for the dog and, along with it, any rule structure established through interactions with adults. The dog may become confused and uncertain. Whereas many dogs will tolerate some fondling, repeated and unchecked groping and grabbing may cause dogs to

warn of their discomfort by growling or snapping. With a persistent toddler and a less observant parent, several warnings may go unnoticed or unheeded, and a bite may result. If the parent is unaware of the dog's early signaling and the child's persistent response, the bite will appear unprovoked and out of context. In this scenario, the dog's need to be respected is neither considered nor met. Parents who have difficulty setting and maintaining safe boundaries for their child's behavior may find themselves with a fearful and anxious dog who is easily provoked to bite any child.

Two to 5 years—As a toddler moves into the preschool years, gross motor coordination improves markedly. Curiosity becomes more intrusive and experimentation more vigorous. Children are still egocentric, but empathy and the ability to perceive or anticipate the feelings of others begin to emerge. Toddlers and preschoolers do not consider the consequences of their behaviors, nor do they generalize from one incident to another (ie, they do not learn readily from their mistakes). Accordingly, a dog may intensify its aggressive signaling if the child's intrusiveness persists. This is also the age of imagination and fantasy. Dogs may be called on to join tea parties or to play the part of trusty steed. A dog's toys may be taken hostage and used as bait; their food may be played with, tasted, or hidden; and their sleep may be violently or stealthily interrupted. New playmates and friends begin to enter the household with more frequency, bringing new smells, noises, and activity. For dogs that are already uncertain, anxious, or fearful, such activities will worsen these conditions. If these dogs cannot escape to areas where they are not bothered, they may respond aggressively. Oddly, the youngest children in this group, who may be most at risk, are seldom cautioned by adults about inappropriate interactions with dogs.³⁶

Five to 9 years—The school-aged child has the same intense curiosity of the preschooler, but adult supervision markedly decreases. Children of this age need to feel some control over their own lives and begin to challenge authority to learn to whom and for whom they will defer. Early in this developmental stage, the inability to deduce and generalize persists. Yard games become more organized: 3 kids against 1 dog with the object of capturing the dog. Leashes may be made of belts or string and the dog walked (or dragged) around the yard or house. The dog may be punished verbally or physically for any number of perceived infractions, such as breaking a child's toy or digging in the yard. School-aged children want dogs to respond and react to them and may tease the dog by speaking in a high-pitched or singsong voice, dangling a toy overhead, or playing tug of war with the dog's toy. All of these activities may be undertaken by a child who loves his or her dog and whose parents exhibit only appropriate interactive and disciplinary behaviors. When admonished for seemingly mean-hearted behavior, children of this age seem not to have any idea of what they've done and may respond with "We're just playing!"

Statistically, 5- to 9-year-old males have the highest rate of dog bite injury.^{7,11,14,36,37} This finding may be

correlated with certain attributes of this developmental stage: high energy, the child's need to feel control over his or her environment, poor deductive and generalization skills, an inability to grasp the concept of teasing, and decreased parental supervision. Some research exists to support male-biased gender-related differences in aggression,³⁸ and it has been hypothesized that the behaviors characteristic of this developmental stage also affect dog-bite risk.³⁶

Nine to 12 years—Preadolescent children have already entered Piaget's concrete operations phase, in which they are able to organize facts, problem solve, and handle more than 1 aspect of a situation at a time. They think about how others feel, and social groups become increasingly important in their lives. This is the stage during which children may be able to take more responsibility in caring for a dog, such as feeding, grooming, and exercising. It is also the time when purposefully abusive behavior may begin to appear in the form of rough play and excessive teasing. Children in this age group may experiment with the limits of a dog's tolerance to physical stimulation by holding a treat or toy just out of reach, restraining the dog and then calling him to come, or inciting the dog to bark or growl by verbal and physical signaling.

Though more concrete in their approach to the world, children 9 to 12 years old may not be able to translate their theoretical knowledge of an appropriate response in a given situation into action when faced with the same or a similar situation. For example, a child confronted with an unknown dog that is approaching and growling may turn and run rather than stand still and avert his or her eyes as he or she has been taught. The child may be intellectually capable of an appropriate response, but the excitement and anxiety of the situation overrides this knowledge. Intervention programs geared toward school-aged children that educate them about how to interpret a variety of canine signals and how to respond to them^{39,40} present the ideal world; under a real world threat, all learned responses may be forgotten. We must be aware that these programs do not guarantee freedom from dog bites or safe behavior of children around dogs. These programs are not substitutes for anticipatory guidance and should work best when used in conjunction with it.

Growing Up With A Dog

Little information exists on whether growing up with a dog in the household influences a child's behavior toward dogs or the likelihood of that child being bitten. Children 7 to 9 years old who own a dog are 2 times more likely to be bitten by a dog (although not necessarily their own), and one third of all dog bites to children are from dogs owned by the victim's family.⁴¹ Prior experience with dogs may engender a more casual attitude toward dogs in general and may decrease cautious behavior around unfamiliar dogs. A child's behavior during specific developmental periods may also provoke dog bites, regardless of whether such provocation is intentional.^{17,42} Within the 5- to 9-year-old group, children who have lived with dogs may be

at greater risk for bites than those who have not lived with dogs.^{17,41} As mentioned previously, this age coincides with increases in risk-taking and gender-related aggressiveness.

Conversely, one may hypothesize that children who have not lived with dogs and who are not fearful of them may be at risk because of inexperience. No published data exist on the basis of which to evaluate this hypothesis. Children who do not live with dogs and who are fearful of them may model parental feelings and behaviors during interactions with dogs⁴¹ or may react on the basis of inexperience.⁴³ The shrieks and flailing arms and legs of a fearful child will focus a dog's attention on that child and may cause the dog to jump on, knock over, or bite the child. Should the dog's behavioral repertoire include inappropriate play, predatory, or herding behaviors, the child may be at risk for injury.

Individual Dog and Child Behaviors

When evaluating interactions between dogs and children, specific information about each individual is needed. Each dog has its own personality, temperament, and history that will affect the way the dog interacts with its environment. Breed-specific characteristics also influence behavior. Herding dogs (eg, Australian Shepherds, Border Collies, Corgis) may persist in herding a group of children to the point of terrifying them and may use nipping as one of their herding behaviors, whereas Labrador Retrievers may bark relentlessly in search of a game of fetch or may insist on retrieving balls or other toys children are using. Some dogs are more anxious than others, rendering them less able to cope with busy or unpredictable households or with intrusive toddlers and preschoolers.

The temperament, personality, and previous experience of children also contribute to their behavior. Some children are quiet and introverted, whereas others move about and talk continuously. Though it may seem logical that an active child is more apt to provoke a dog and to be bitten more often, it is possible that a quiet and focused child may have more time to intrude on a dog's physical space and to tease, and that his or her warning may be less obvious to the dog or to their caregiver.

Behaviorally normal dogs and children—There is no formula that will predict the outcome of a child-dog interaction. Adults must be able to assess potential risks for injury or inappropriate behavior by the dog and the child. Adults should ensure that potentially dangerous situations are avoided, even if this means restricting the dog's and child's access to each other at certain times (eg, during birthday parties, the dog is confined to a locked bedroom). Any situation that results in stress or anxiety for the dog or the child should prompt adults to take preventive action. Included in potentially stressful events are car rides involving children and dogs, visits of strangers, illness, deaths and births, holiday events and parties, and the approach of a strange dog while walking the family pet. It is better to anticipate problematic situations and minimize their risk than to contribute to a tragedy.

Individuals with problem behaviors—Dogs that have a history of problem behaviors or that have been diagnosed with a behavioral problem require special consideration. Dogs with 1 or more types of aggression have the potential to seriously harm a child without much warning. Even if the dog is being successfully treated for the problem, new situations or unfamiliar children may be provocative. Every family must understand that the simplest and most innocent interaction between any child and a large dog with strong jaws can result in severe injury if the dog or the child errs in communication or judgment.

Children with behavioral problems, such as attention deficit disorder, oppositional defiance disorder, or conduct disorder; children who have been abused or who are abusers⁴⁴⁻⁴⁷; and children who are physically or mentally challenged may be at risk during child-dog interactions, even when the dog is behaviorally normal. If the dog has a behavioral problem, the risk is that much greater. Such complex situations require a substantial time and energy commitment by the parents to ensure that the dog-child relationship is safe and healthy. The dog's quality of life should be a priority as well. Some dogs may be safer, happier, and healthier in households without children.

Anticipatory Guidance

Anticipatory guidance, used so effectively in pediatric health care, could greatly benefit children and dogs if applied to veterinary medicine. In pediatric practices, parents are educated during well-child visits about behavioral, social-emotional, and physical changes they may see in their child during the coming months. Anticipatory guidance empowers parents to provide a safe and supportive environment for the child and the family.

Despite the fact that there are between 52.9 and 58.2 million pet dogs currently residing in US households,⁴⁸ there is little information in the pediatric literature about interactions between children and dogs within or outside of the family unit. Published studies report injury statistics^{13,15,37} and wound care outcomes.¹² Information available on dog behavior suggests prevention of dog bites through improved enforcement of leash laws¹⁷ or by controlling dogs in inhumane ways.^{48,49} Outdated and inaccurate perceptions of canine behavior,¹⁷ including teaching the dog that it is not an alpha wolf and that it has the lowest position in a linear family hierarchy, are reinforced.^{21, 50,51} None of these paradigms address circumstances under which most bites appear to occur.

Until published research provides pediatric practitioners with substantive information on effective dog bite prevention strategies, veterinarians, as the primary caregivers, have an opportunity to make a substantial difference in the lives of dogs and families for whom they provide care. Once they have a basic understanding of the developmental stages of dogs and children, typical behaviors, and communication styles, veterinarians can help parents interpret dog and child behavior at any given developmental stage, predict how their dog and child may interact in a given situation, and form reasonable expectations for their dog's and child's

behaviors. Through anticipatory guidance, veterinarians can empower parents to shape dog-child interactions, thereby enhancing the relationship between dog and family. Veterinarians can counsel parents (and potential parents) about dog-child interactions prior to pet acquisition, during visits designed to assess any problematic behaviors that a dog has that could impact its interactions with an infant, during wellness visits, during physical health concern assessments, and whenever concerns are voiced about the behavior of the dog or child during interactions. Veterinarians should routinely question their clients about their pets' behaviors; if nothing else, their responses will provide a baseline for future comparison.

Ideally, guidance should begin before a family acquires a dog. Assessment of lifestyle, expectations, and degree of commitment to pet care can help the family decide what type of dog, if any, would be a suitable pet (**Appendix 2**). If a dog owner does not have children but is expecting a child in the near future, prenatal counseling by a veterinarian could uncover potential problems their dog may have interacting with a child (**Appendix 3**).

During a dog's wellness visits, general information concerning the ages and stage of development of any children in the household should be elicited so that the veterinarian can address relationships between dog and child developmental stages and behaviors, with special reference to any canine behavioral diagnoses (**Appendix 4**). Particular attention should be given to changes in the dog's behavior since the last visit. Using standard behavioral history forms that include screens for aggressive and anxious behaviors, early warning signs of anxiety or aggression can be detected,²¹ and behavioral problems can be diagnosed and treated.

Although many parents may already be familiar with the various childhood developmental stages, a review by the veterinarian ensures understanding of the various stages and associated behaviors, reinforces information already provided by the pediatrician, and places the information within the context of the dog's health and well-being. More specific advice may be provided in response to questions from the parent or the child or after the veterinarian observes the child's and parent's interactions with the dog. Analysis of child behavior and criticism of parenting style is not the veterinarian's responsibility; however, subtle guidance related to the dog's behavior and the child's role in that behavior is reasonable. Veterinarians and pediatric healthcare providers are ideal partners in promoting health, safety, and well-being for 2- and 4-legged members of the family.

Once incorporated into veterinary practice, anticipatory guidance takes minimal time but provides maximal benefit. It encourages parents to take responsibility for the behaviors of their dogs and children, promotes healthy relationships between dogs and family members, and can be a more effective approach to dog bite prevention. Anticipatory guidance may also decrease the number of recycled and euthanized dogs, because behavior problems are a primary reason for the relinquishment of pets.⁵²⁻⁵⁵

References

1. Katcher A. Physiologic and behavioral responses to companion animals. *Vet Clin North Am Small Anim Pract* 1985;15:403-441.
2. Carithers HA. Mammalian bites of children. *Am J Dis Child* 1958;95:150-156.
3. Siegmund R, Biermann K. Common leisure activities of pets and children. *Anthrozoös* 1988;2:53-57.
4. George H. The role of animals in the emotional and moral development of children. In: Ascione FR, Arkow P, eds. *Child abuse, domestic violence, and animal abuse: linking the circles of compassion for prevention and intervention*. West Lafayette, Ind: Purdue University Press, 1999;380-392.
5. Sacks JJ, Kresnow M, Houston B. Dog bites: how big a problem? *Inj Prev* 1996;2:52-54.
6. Thomas PR, Buntine JA. Man's best friend?: a review of the Austin Hospital's experience with dog bites. *Med J Aust* 1987;147:536-540.
7. Zinte A. No more pet peeves. *Am Baby* 1999;Feb:37-39,66.
8. Klein P. Friendly dog syndrome. *N Y State J Med* 1966;66:2306-2309.
9. Reinhardt T. Thinks veterinarians should unite against dangerous dog breeds (lett). *J Am Vet Med Assoc* 1998;212:489.
10. Harris D, Imperato PJ, Oken B. Dog bites—an unrecognized epidemic. *Bull N Y Acad Med* 1974;50:981-1000.
11. Kizer KW. Epidemiologic and clinical aspects of animal bite injuries. *JACEP* 1979;8:134-141.
12. Gershman KA, Sacks JJ, Wright JC. Which dogs bite? A case-control study of risk factors. *Pediatrics* 1994; 93:913-917.
13. Castelein C, Klouda J, Hirsch H. The bite case scenario—it is not what you think. *WFHS Newsletter* 1996;12-14.
14. Overall KL, Love M. Dog bites to humans: demography, epidemiology, injury, and risk. *J Am Vet Med Assoc* 2001;218:1923-1934.
15. Ndon JA, Jach GJ, Wehrenberg WB. Incidence of dog bites in Milwaukee, Wis. *Wis Med J* 1996;95:237-241.
16. Sokol AB, Houser RG. Dog bites: prevention and treatment. *Clin Pediatr* 1971;10:336-338.
17. Matthews JR, Lattal KA. A behavioral analysis of dog bites to children. *J Dev Behav Pediatr* 1994;15:44-52.
18. Daniels TJ. A study of dog bites on the Navajo reservation. *Public Health Rep* 1986;101:50-59.
19. Parrish HM, Clack FB, Brobst D, et al. Epidemiology of dog bites. *Public Health Rep* 1959;10:891-903.
20. Brobst D, Parrish HM, Clack FB. The animal bite problem. *Vet Med* 1959;54:251-256.
21. Overall KL. *Clinical behavioral medicine for small animals*. St Louis: The CV Mosby Co, 1997.
22. Nolen S. AAHA steers members through changing profession. *J Am Vet Med Assoc* 1999;214:1449-1450.
23. Smith WJ. *The behavior of communicating: an ethological approach*. Cambridge: Harvard University Press, 1977.
24. Clutton-Brock J. Origins of the dog: domestication and early history. In: Serpell J, ed. *The domestic dog: its evolution, behavior, and interactions with people*. Cambridge: Cambridge University Press, 1995;7-20.
25. Brogan TV, Bratton SL, Dowd MD, et al. Severe dog bites in children. *Pediatrics* 1995; 96:947-950.
26. Langley J. The incidence of dog bites in New Zealand. *N Z Med J* 1992;105:33-35.
27. Willson E. The social interaction between mother and offspring during weaning in German shepherd dogs: individual differences between mothers and their effects in offspring. *Appl Anim Behav Sci* 1984/1985;13:101-112.
28. Hopkins SG, Schubert TA, Hart BL. Castration of adult male dogs: effects on roaming, aggression, urine spraying, and mounting. *J Am Vet Med Assoc* 1976;168:1108-1110.
29. Salmieri KR, Bloomberg MS, Scruggs SL, et al. Gonadectomy in immature dogs: effects on skeletal, physical, and behavioral development. *J Am Vet Med Assoc* 1991;198:1193-1203.
30. Willson E. Behavioral test for eight-week-old puppies: heritabilities of tested behavior traits and its correspondence to later behavior. *Appl Anim Behav Sci* 1998;58:151-162.
31. Piaget J. *The origins of intelligence in children*. New York: International Universities Press, 1952.
32. Erickson E. *Childhood and society*. New York: WW Norton, 1963.
33. Nixon J, Pearn J, McGarn F. Dog bite injuries to children: potential rabies threat to Australia. *Med J Aust* 1980;1:175-176.
34. Sacks JL, Sattin RW, Bonzo SE. Dog bite-related fatalities from 1979 through 1988. *JAMA* 1989;262:1489-1492.
35. Parks B, Hawkins L, Horner P. Bites of the hand. *Rocky Mt Med J* 1974;71:85-88.
36. Chin Y, Berkelhamer JE, Herold TE. Dog bites in children less than four years old. *Pediatrics* 1982;69:119-120.
37. Weiss HB, Friedman DI, Coben JH. Incidence of dog bite injuries treated in emergency departments. *J Am Med Assoc* 1998;279:51-53.
38. Fagot LI, Leinbach MD, Hagan, R. Gender labeling and the adoption of sex-typed behaviors. *Dev Psychol* 1986;22:440-443.
39. Spiegel I. The B.A.R.K. dog bite prevention program workbook. Washington, DC: HSUS, 1987.
40. Cornwell MJ. *Animal safety is fun: be a tree, act like a log* (video). Columbus, Ohio: Glencoe Animal Hospital, 1992.
41. Beck AM, Jones BA. Unreported dog bites in children. *Public Health Rep* 1985;100:315-321.
42. Beck AM, Loring H, Lockwood R. The ecology of dog bite injury in St. Louis, Missouri. *Public Health Rep* 1975;90:262-267.
43. Carithers HA. Pets in the home: incidence and significance. *Pediatrics* 1958;21:840-848.
44. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders. IV*. Washington, DC: American Psychiatric Association, 1994.
45. Arkow P. The relationships between animal abuse and other forms of family violence. *Fam Viol Sex Assault Bull* 1996;1:29-34.
46. Kellert SR, Felthous AR. Childhood cruelty towards animals among criminals and non-criminals. *Hum Relations* 1985;38:1113-1129.
47. Ascione F. Children who are cruel to animals: a review of research and implications for developmental psychopathology. *Anthrozoös* 1993;6:226-247.
48. American Veterinary Medical Association. *U.S. pet ownership and demographics source book*. Schaumburg, Ill: Center for Information Management, 1997:1-105.
49. Monks of New Skete. *How to be your dog's best friend*. Boston: Little, Brown & Co, 1986.
50. Rutherford C, Neil DH. *How to raise a puppy you can live with*. Alpine, Colo: Alpine Publications, 1981.
51. Iazzetti I. Anticipatory guidance: having a dog in the family. *J Pediatr Health Care* 1998;12:73-79.
52. Houpt KA, Honig SU, Reisner IL. Breaking the human-companion bond. *J Am Vet Med Assoc* 1996;208:1653-1659.
53. Patronek GJ, Beck AM, Glickman LT. Dynamics of dog and cat populations in a community. *J Am Vet Med Assoc* 1997;210:637-642.
54. Salman MD, New JG Jr, Scarlett JM, et al. Human and animal factors related to the relinquishment of dogs and cats in selected animal shelters in the United States. *J Appl Anim Welfare Sci* 1999; 1:207-226.
55. Scarlett JM, Salman MD, New JG Jr, Kass PH. Reasons for relinquishment of companion animals in U.S. animal shelters: selected health and personal issues. *J Appl Anim Welfare Sci* 1999; 2:41-57.

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Appendix 1

Recommendations for managing interactions of children and dogs*

1. Choose adult dogs as pets, rather than immature ones.
 - Zoonotic parasite transmission is minimized²
 - Known temperament²
 - More predictive behavior; avoid combinations of young dogs (< 1 year) and young children (< 5 years)¹⁸
2. Children cannot be expected to be responsible for pets and show discretion in their handling until they are old enough (unusual at < 6 years).²
3. Teach children to avoid all unfamiliar animals, especially if the animal is sick or injured.^{2,48}
4. Encourage children to be introduced to, and make friends with, neighborhood and playmates' dogs. This means 2 sets of people (the dog's owners and the child's parents) have to approve those interactions.²
5. Teach children not to become physically involved in animal fights. Instead, make sure they know to seek the assistance of an adult.²
6. Teach children responsible pet ownership.
 - Walks
 - Have them accompany adults while they walk the dog on-lead.
 - Make sure they see adults clean up after the dog.
 - When the children are old enough to walk and clean up after the dog, adults should accompany them to reinforce appropriate behaviors.¹⁶
 - Medical care
 - Involve children in the dog's medical care so that they understand the importance of rabies vaccination and avoiding bites.
7. Teach children to respect all dogs, especially if the dog is eating, sleeping, eliminating, or caring for puppies. Do not disturb at these times.^{2,16,48}
8. Teach children never to startle, mistreat, or tease a dog.^{16,17}
9. Teach children never to run from a dog or to stare, shout, or bark at a dog, particularly if fenced, unfamiliar, or in a car.¹⁷
10. Teach children not to reach over fences, or into runs, fences, cars, kennels, or crates. Children should also be taught not to run or ride their bicycles, skateboards, or roller blades back and forth in front of these locations.²
11. Separate dogs and children when particularly tempting food is easily available and when events may be provocative and unpredictable (eg, birthday parties).⁴⁸
12. Monitor children's interactions with dogs, particularly if a new child is involved, or if children or dogs are tired, upset, or ill.⁴⁸

*Superscripted numbers refer to reference citations.

Appendix 2

Topics to be addressed during preacquisition pet counseling*

1. What role is the pet expected to play (eg, companion, working dog, guard dog)? Prospective owners should be aware that most dogs would protect if there were a real threat, without their normal actions being inappropriate or risky.
2. What is the reason for getting the pet?
 - If the parents think that a puppy will teach children responsibility they will be disappointed unless they actively participate in the education process. Children < 12 years old are unlikely to be solely responsible for a dog, and the younger the dog is the more work will be required.
 - Puppies are more work and may be more trouble in households with babies or toddlers.
3. What are the client's specific expectations for the pet?
 - How large a pet are they willing to have? How much will a puppy grow?
 - What activity level do they need or want in the dog? What is their own activity level? These needs should match.
 - Do they have special needs (eg, a dog that hunts, tracks, is "hypoallergenic," or silent).
 - Will the dog's appearance influence the way they interact with the dog? Is the dog a fashion statement? Do they have an idealized vision of the dog that is incompatible with their lifestyle or the amount of time they wish to spend grooming? Do they understand the grooming needs of the chosen breed?
 - What changes are in store for them? Do they understand canine behavioral changes associated with sexual and social maturity? Do they understand how much puppies change physically and behaviorally? If they adopt an older dog, can they meet the dog's changing physical needs?
4. Do the clients understand the costs associated with keeping a dog?
 - Do they understand that quality breeders differ from puppy mills, and that the cost of a show dog differs from that for a pet quality dog? If this dog is rehomed, can they pay for shipping from a rescue group or the adoption fee from a humane shelter?
 - Do the clients understand why it is important to neuter a dog?
 - Do the clients understand that medical and maintenance costs associated with a larger dog will be greater, because medication and supply costs increase in amount as the dog's size increases?
 - Do the clients understand that dogs usually need to be licensed and that dog licenses have a fee associated with them? Do the clients understand the benefits and additional cost of microchipping?
 - Are the clients willing to vaccinate their dog on a recommended schedule?
 - Do they understand that, regardless of the vaccine schedule, that dogs (like people) should have annual physical examinations and that vaccines are inexpensive, but that the bulk of fees paid will be for the veterinarian's skill and time?
 - Are the clients willing to have fecal examinations performed for their dogs 1 to 2 times per year, perhaps more if they live in a city? Are they willing to pay the cost of prevention and treatment for intestinal parasites?
 - If the clients live in heartworm or flea endemic areas, are they willing to have annual heartworm tests and prevent or treat any flea or heartworm problems that develop?
 - Are the clients willing to buy food that meets AAFCO standards and to clean up after their dog when it defecates? The bigger the dog, the more food and feces.
 - Do the clients understand the costs associated with a major illness or its prevention? Are they willing to pay to have their large dog's hips evaluated by radiography? Do they understand, for example, that an intestinal obstruction can require surgery and a hospital stay?
5. What's the client's lifestyle and schedule?
 - Do the clients have allergies?
 - Do the clients have any physical disabilities or are they unwilling or unable to crawl on the ground? If so, working with a small puppy can be difficult.
 - How much time do the clients spend working and recreating? Do they have 2 to 3 hours a day to exhaust and exercise a herding dog puppy? Is an older lap-type dog a better choice?
 - Are the clients willing to provide for the care of their dog in their will as they do for their children? How would the death of that pet affect the family?
6. What breed-specific concerns do the clients have? What breed prejudices do they have?
 - Do they understand variations in grooming needs for different breeds? This is particularly important if the place they fell in love with the breed was a dog show.
 - Do they understand the exercise needs of the breed and the function for which that particular breed was developed (eg, Vizslas are carting dogs and can go long distances and times without resting)?
 - Do the clients understand basic differences in breed behaviors? Do they know what makes a hound a hound and a sighthound a sighthound?
 - Do the clients know what physical or genetic defects are common in that breed or that breeding line?
 - How important is life expectancy to the client, and do they understand the ranges for different breeds?

*Adapted from reference 21.

Appendix 3

Warning signs in dogs that can indicate distress associated with children

- Acute change in a dog's normal behavior (eg, withdrawal, increased circling and patrol behavior, changes in amount or character of vocalization)
- Change in appetite, particularly if dog will only eat in the absence of the child or if the dog suddenly guards its food
- Increased reactivity (eg, barking, growling, patrolling, lunging in new or less provocative circumstances)
- Changes in sleeping or resting activity and locations
- Changes in behavior associated with a behavioral diagnosis and the appearance, or an increase in frequency, of gastrointestinal signs associated with stress (eg, vomiting, regurgitation, diarrhea)
- Signs of separation anxiety only when left with children (eg, vocalization, destruction, elimination, salivation, increase or decrease in motor activity)
- Frank aggression (even without a specific diagnosis) in the presence of children

Appendix 4

Developmental stages in children and their relationship to canine behaviors

Age of Child	Developmental Milestone(s)	Typical Child Behaviors Affecting Dogs	Normal Dog Behaviors	Canine Behavioral Diagnoses that Could Put Children at Risk*
0-6 months	Reflexive behaviors Sitting up and creeping	New noises (crying, screaming, babbling) New smells Grabbing fur or body parts of dog	Sniffing Licking Avoidance (at first)	Predatory aggression Fear aggression
6-24 months	Fine motor skills improve Crawling and cruising Walking and running Curiosity and exploration	Increased noise and chaos Exploration of dog's body with hands, mouth, teeth	Freezing or avoidance Waiting for food	Fear Fear aggression Pain aggression Food-related aggression Possessive aggression
2-5 years	Autonomy and tantrums Gross and fine motor coordination improve Egocentricity Magical thinking and fantasizing Animism and anthropomorphism New friends enter household	Interrupt sleep or rest of dog Fondling dog Chasing games Removal of toy or food Sharing human or dog food New friends enter household	More distant withdrawal Avoidance Offering of toy Soliciting food	Fear aggression Pain aggression Food-related aggression Possessive aggression Protective or territorial aggression Dominance aggression Fear Inappropriate herding behavior
5-9 years	Intense curiosity Experimentation Independence and decreased adult supervision Poor deduction and generalization Desire for control	Teasing dog Reprimanding or punishing dog Bossing dog Roughhousing or tug of war	Curiosity Following Playing with toys Playing roughly Sleeping in specific child's room	Inappropriate play Fear aggression Pain aggression Possessive aggression Territorial or protective aggression Play aggression Dominance aggression Fear Inappropriate herding behavior Inappropriate play Play aggression
9-12 years	Increased peer influence Increased sense of responsibility Concrete operations Problem solving rough Increased deduction and generalization	May take responsibility for feeding, grooming, specific exercising Increased teasing or play Abusive interaction may begin	Accompanying child Aerobic play Sleeping in specific child's room	Dominance aggression Fear aggression Play aggression Protective or territorial aggression

*Diagnostic criteria in reference 21.