

# Evidence-based paradigm shifts in veterinary behavioral medicine

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## Abstract

There is now a large body of research in veterinary behavioral medicine that is clinically relevant and could enrich patients' and practitioners' lives. Too often, however, this research is published in journals that may not be readily available to veterinarians in private practice. Four important topics in the area of veterinary behavioral medicine for which belief has not kept pace with the published data are the unmet need for behavioral medicine in veterinary practice, the veterinary experience as a contributor to fear and distress in dogs and cats, social signaling in dogs and the ongoing "dominance" debate, and punishment as an intervention to change behavior. The present article seeks to provide a critical overview of recent research that is shifting existing paradigms on these topics and should alter the way veterinarians observe and care for patients.

**B**efore veterinary behavioral medicine became a recognized clinical specialty, interventions in this field were often the purview of nonveterinarians who lacked formal training in behavior, neuroscience, behavioral genetics, or learning theory. Unfortunately, many of these interventions were based on myth, belief, or attribution bias, but nevertheless became an ongoing legacy for pet owners and veterinary professionals alike. More recently, veterinary behavior and veterinary behavioral medicine have become focuses of basic research by individuals trained in psychology, anthropology, neuroscience, neurobehavioral genetics, and welfare, which has resulted in a rich, data-driven, evidence-based, clinically relevant body of literature. All too often, however, this research is published in journals that may not be readily available to veterinarians in private practice.

Four important topics in the area of veterinary behavioral medicine for which belief has not kept pace with the published data are the unmet need for behavioral medicine in veterinary practice, the veterinary experience as a contributor to fear and distress in dogs and cats, social signaling in dogs and the ongoing "dominance" debate, and punishment as an intervention to change behavior. The present article seeks to provide a critical overview of recent research that is shifting existing paradigms on these topics and should alter the way veterinarians observe and care for patients.

## ABBREVIATIONS

RMSSD Root mean square of successive differences for neighboring R-R intervals  
SDNN SD of normal-to-normal R-R intervals

## The Unmet Need for Behavioral Medicine in Veterinary Practice

Most colleges of veterinary medicine have historically lacked<sup>1</sup> or still lack<sup>2</sup> full-time programs in veterinary behavioral medicine led by board-certified veterinary specialists who are researchers, clinicians, or both. Accordingly, new veterinary graduates may lack competency in this area and may feel inadequately prepared when asked to assess patients with behavioral problems, treat these patients, or answer clients' questions about their behavioral concerns.<sup>2</sup>

In 2 studies, Roshier et al<sup>3,4</sup> analyzed video recordings of interactions among clients, patients, and veterinarians during routine vaccination examinations at 6 veterinary practices. Clients posed 58 questions pertaining to their pet's behavior during these examinations, but veterinarians responded to only 10. And, none of the 10 questions about which there was some discussion were fully explored or managed during the examination. In exit surveys, the veterinarians stated that they felt handicapped by their lack of training in behavioral medicine, further noting that the discomfort they felt about their lack of knowledge in the field affected the way they communicated with clients in all other settings and often resulted in their shortening conversations. This pattern of shortened conversations, which results in delayed or inadequately addressed client and patient needs, has already been noted for veterinarians. On average, veterinarians interrupt clients after median and mean times of 11 and 15 seconds, respectively.<sup>5</sup> Postures that allow clients to view veterinarians as more trustworthy, with more expertise, such as a direct gaze and body direction,<sup>6</sup> facilitate exchange

and verification of information. But as noted in these studies, veterinarians need thorough training in veterinary behavioral medicine to be useful to clients who have questions about their pets' behaviors.

The lack of proficiency in or comfort with basic behavioral patterns and problems has a poignantly unfortunate outcome. Behavioral problems occur frequently in dogs<sup>7</sup> and represent an important threat to dog welfare. Behavioral problems are a lead cause of both dog abandonment<sup>8</sup> and euthanasia.<sup>9</sup> At least one behavioral reason was recorded for 40% of relinquished dogs in a study<sup>8</sup> that evaluated reasons for relinquishment of companion animals to shelters in the United States, with behavioral reasons accounting for 27% of canine relinquishments for which a single cause was provided. Problematic behavior was responsible for 34.2% of relinquishments to a group of shelters in the United Kingdom,<sup>10</sup> which was similar to the 35% of relinquishments that were for purely behavioral relinquishments in the United States.<sup>11</sup> The most recent data indicate that 20% of shelter dogs in the United States are euthanized<sup>12</sup> and that dogs with behavioral concerns are especially at risk. Of 4,846 relinquished dogs in 3 shelters in Australia, 54% were euthanized because of temperament, aggression, or other behavioral problems.<sup>13</sup>

Currently, behavioral problems pose the single largest threat to the health and longevity of pet dogs.<sup>14</sup> As such, a lack of treatment of behavioral problems poses the single largest threat to general veterinary practices in terms of development and growth of services offered, intellectual and emotional fulfillment of staff, and income. In addition, a lack of adequate and routine care in behavioral medicine threatens the integration of new scientific developments into care as patients age, because the fiscal base to support such care must be developed in the preventive phase. Unfortunately, young animals are most often relinquished rather than treated during this preventive phase.<sup>8-10</sup>

## The Veterinary Experience as a Contributor to Fear and Distress

A lack of general knowledge about veterinary behavioral medicine adversely affects the way basic veterinary care is provided on a routine basis, resulting in unconsidered but serious consequences for patient behavior and well-being. In a practice in Germany, 18 of 135 (13.3%) dogs observed had been dragged or carried into the practice, and 106 of the 135 (78.5%) dogs were fearful on the examination table.<sup>15</sup> Overall, fewer than half the dogs entered the practice calmly. Also, whether dogs exhibited behaviors indicative of distress depended on the dog's previous experience with the practice. Dogs that had had only positive experiences were less fearful than others, and dogs < 2 years old that visited the practice frequently were more fearful than older dogs that visited infrequently. This latter finding suggests that at least for young

dogs, repeated exposure to veterinary practices may actually enhance fear. Similar data exist from Sweden. Dogs that had recently been to a veterinary clinic had higher stress scores than those that had not visited recently.<sup>16</sup> Yet, dogs that stayed in waiting rooms that were not chaotic and dogs that had sufficient time to calm were less stressed than those that were moved quickly into an examination room. Weighing dogs on a scale was much more stressful than sitting in the waiting room.

In another study,<sup>17</sup> 45 dogs were videotaped for 3 minutes each while they remained in the waiting room of a veterinary hospital and then throughout an examination. Two-thirds of all dogs spent > 20% of the time exhibiting at least 1 sign of stress, and 53% of dogs exhibited 4 or more signs of stress. Two behavioral signs of stress, panting and nose licking, were exhibited by more than 50% of all dogs, and 2 of 16 stress-related behaviors, panting and an "ears back" posture, were seen during > 50% of the time videotaped. Dogs rated as highly distressed by the behaviorist researcher were more likely to resist movement from the waiting area to the examination room.

The implications of these studies are clear: we should strive to reduce or remove factors that trigger stress or distress in veterinary clinics, we should provide patients and clients with quiet calm areas where they can await examination, and we should teach dogs how to be voluntarily and calmly weighed and should place scales so that dogs have some control over their participation in the process. For especially anxious dogs or for badly designed scales, weighing dogs at the end, not at the beginning of an appointment, may help minimize a patient's distress.

Similar patterns have been identified in how cats respond to veterinary evaluations. In a study<sup>18</sup> in which 30 healthy cats were evaluated both at home and at a university-based veterinary teaching hospital, there was a significant effect of location on the cats' heart rate, respiratory rate, and blood pressure, with all 3 values substantially higher in the veterinary teaching hospital setting. In a more detailed study<sup>19</sup> that used the same stress scales, 30 minimally restrained cats were evaluated for heart rate, respiratory rate, systolic blood pressure, and heart rate variability. Heart rate variability is a measure of the relative contributions of sympathetic versus parasympathetic tone to heart rate and rhythm, with parasympathetic tone predominating when heart rate variability is high. The SDNN is affected by both sympathetic and parasympathetic tone, and the RMSSD-to-SDNN ratio is a measure of vagosympathetic balance (**Appendix I**). Understanding the relationship between these measures makes them valuable for assessing interventions.

When measured at home, compared with at the veterinary teaching hospital, respiratory rates for cats in the study<sup>19</sup> were, on average, 25 breaths/min lower, heart rates were 28 beats/min lower, and heart rate variability was higher, indicating a relatively greater

parasympathetic effect on heart rate. Interestingly, higher stress scores were found at home, with struggling and vocalizing being the most commonly exhibited behaviors. This finding suggests that behavioral responses may be suppressed in hospital situations that cause sympathetic arousal. More importantly, it suggests that an absence of struggling or vocalizing should not be considered *prima facie* evidence that cats are calm when sympathetic tone is high. Instead, the muting of such behaviors may be a compensatory adaptive response that can easily be misinterpreted by clinicians. This is especially a concern for cats, for which hiding is an adaptive response associated with concomitant decreases in plasma cortisol concentrations.<sup>20</sup> If our goal with veterinary examinations is to detect physiologic patterns indicative of illness, then baseline evaluations must be valid and accurate. These studies suggest that distress may be masking some disease states.

Heart rate variability has also been used to determine how well dogs tolerate undergoing specific examination procedures or even having specific body regions touched. In 2 studies, Kuhne et al<sup>21,22</sup> handled and touched specific body regions in dogs in a timed, standardized manner and evaluated behavioral and cardiac responses for each region touched. The SDNN increased when dogs were petted or held around the head, neck, muzzle, or collar, areas that are commonly touched when restraining dogs for a veterinary examination. In contrast, dogs petted on the chest had an RMSSD-to-SDNN ratio suggesting cardiac flexibility in the absence of behavioral stress. Behavioral signs of distress, including freezing, withdrawal, and actively backing away, were negatively correlated with RMSSD and the RMSSD-to-SDNN ratio, indicating decreased vagal tone and decreased vagosympathetic balance.

New data also suggest that there are welfare implications to veterinary examinations involving fear. For example, a survey<sup>23</sup> to assess welfare of 906 dogs while at veterinary clinics found that most dogs were reported to show welfare concerns, with 221 (24.4%) exhibiting fear, 341 (37.6%) exhibiting excitement, and 33 (3.6%) exhibiting aggression during all phases of the veterinary visit (ie, in the waiting room and examination room, when approached by a veterinarian, and when examined on a table). Nearly 75% of all dogs were uncomfortable on the examination table, and approximately a third attempted to jump from the table. Only 232 of the 906 (25.6%) dogs did not show signs of discomfort when the veterinarian approached them. The amount of attention paid by the veterinarian to the patient positively correlated with the patient's level of compliance and calm behavior, such that stressed and distressed patients did not get the same level of care that calm patients did.

Concerns about the welfare of cats in various veterinary settings were also raised in a study<sup>24</sup> involving 1,111 cats. Clients indicated that their cats' welfare was impaired in a number of veterinary-

related contexts, including while being transported to the clinic (864/1,111 [77.8%]), in the waiting room (813/1,111 [73.2%]), moving to the examination room (880/1,111 [79.2%]), and on the examination table (944/1,111 [85.0%]). Of special concern is the finding that for 650 (58.5%) cats, clients reported that their impaired welfare persisted in the form of stunned, scared, nervous, or aggressive behaviors at home after the visit.

A study<sup>25</sup> involving a series of standardized tests to evaluate dogs' behaviors before, during, and after a veterinary examination found that although participating veterinarians and owners strongly agreed with the researchers regarding aspects of the examination involving pain, the researchers were far more likely to be concerned about aspects of stress than were the participating veterinarians and owners. Furthermore, dogs that were extremely willing to take a treat when just outside the entry area of the veterinary clinic were often unwilling to do so once in the clinic, suggesting that the dogs themselves viewed the experience of entering the clinic as something stressful and undesirable.

Findings for these various studies illustrate how behavioral responses can complicate physical examination of dogs and cats and make interpreting the findings of physical examination difficult. They also highlight why the context in which a behavior occurs matters and suggest ways in which veterinarians can improve patient outcomes and, indeed, their own lives by integrating practices that decrease fear and distress into their daily practice.

## Social Signaling in Dogs and the Ongoing "Dominance" Debate

### Interactions between dogs

Asymmetries in behavioral, demographic, and physical factors may affect social relationships between dogs. And, the twin beliefs that these asymmetries are stable and that they structure all social interactions underlie the assumption that dogs' relationships with each other are defined by a threat-based, social-dominance system. This concept has been incorporated into dog-training philosophies that espouse the idea that dogs must be "dominated" by humans to maintain the type of natural control of dogs that a canine social group would provide. Yet the value of the concept of dominance as an organizing principle is hotly contested, with data indicating that canine social and signaling systems are more complex than previously reported.

Bradshaw et al<sup>26,27</sup> dismiss any notion of dominance as a character trait or personality marker or dimension in dogs, arguing that supporting data are lacking or not in the direction that would support such hypotheses. "Formal dominance" has been postulated to exist in dogs<sup>28,29</sup> and has been defined as resulting from the exchange of status information

through ritualized greeting signals (eg, facial expressions and body postures) that are independent of context and postulated to reduce stress and injury.<sup>30</sup> These ritualized signals of formal dominance have been postulated to go only in 1 direction in dyadic encounters, allowing the construction of a linear rank, which then facilitates hierarchical interactions that minimize risk.

In support of this concept, patterns of interactions for 16 domestic dogs housed as a group have been reported.<sup>29</sup> However, only 3 of the dogs were adults, which may have confounded the results, because social maturity, as reflected by progressive brain myelination and neuronal pruning,<sup>31,32</sup> affects social signaling, decisions, and the character of social interactions with others. Accordingly, data supporting formal dominance among dogs may be an artifact of brain age of the subjects that have been studied. In fact, most of the behaviors associated with what were characterized as unidirectional status signals were given by puppies or subadults, which adults do not treat in the same way as they do other adults. Regardless, most of the relevant signals that met the criteria for analysis were ones traditionally associated with “submissive” behaviors (eg, low posture and rolling onto one’s back) and matched recently published observations on manifestations of canine stress.<sup>33,34</sup> Thus, many of these behaviors may actually indicate the presence of stress, rather than acting to reduce it. Also, when the information conveyed by some of these behaviors is considered, they have been shown to have use as appeasement behaviors,<sup>35</sup> deference behaviors,<sup>36</sup> or calming signals.<sup>37</sup>

The currency of social behavior is signaling, and detailed data on social signaling in normal canine interactions are emerging. Social cognition, the social information attained through observation of interactions, is a major force in the social behavior of dogs. Dogs that watch controlled interactions between a human and a dog “competing” for an object first approach the “winner” only if the human used canine-styled play signals (eg, bowing and lunging play signals), a contextual role for signal interpretation.<sup>38</sup> If these canine-styled play signals were lacking, indicating a switch from play to actual competition over a resource, dogs were slow to approach either the human or the dog. If dogs watched the entire interaction, and so had access to all pertinent information, they did not approach in the same manner as they did if the interaction was clearly a “contest.”<sup>38</sup> Context matters.

Signals like play bows act as behavioral modulators. Play asymmetry (an imbalance between offensive and defensive signals and moves in play) is high in dogs<sup>39</sup> and has been suggested to be associated with social hierarchy (another interpretation of “dominance”).<sup>40</sup> In a study of 203 play sessions between dogs in a park, the number of play bows given and the number of players positively affected the length of play.<sup>41</sup> In addition, play bows and barks were most

common when the soliciting dog could see the other, indicating a role for social cognition.<sup>41</sup> Relaxed open-mouth displays were not associated with biting, and play asymmetry did not differ between dogs grouped as known versus unknown, suggesting that there was no association with or reflection of any existing social hierarchy among the known dogs. Instead, the researchers suggested that rough play and play fighting may have a role in social cohesion.

Likewise, behaviors traditionally thought of as “submissive” signals (eg, rolling over onto one’s back during interactions) instead appear to act as maneuvers to continue a play sequence.<sup>42</sup> Rolling over is a determinant of bout length of play that, in the absence of frank agonistic behavior, serves to avoid nape bites. Rolling over can also be a tactical move to retrieve control of the play bout and determine its subsequent direction. Asymmetries in rollovers depended wholly on the specific play context, and rollovers were associated with shortened bout intervals and pauses (eg, the dog that rolls over determines when play pauses and that dog’s next behavior determines whether play resumes), not with commonly used measures of submission or asymmetry in relationships.<sup>42</sup>

Detailed, frame-by-frame analysis of behaviors that dogs exhibit when approached by another dog indicates that the specific signals sent and the familiarity of the dogs determine the behavioral response.<sup>37</sup> When meeting an unfamiliar dog, dogs significantly more often exhibited nose licking, freezing, paw lifting, and head turning and made themselves smaller than they did when meeting a familiar dog. Licking of another dog’s mouth was most commonly directed toward familiar dogs. These context-dependent signals were never followed by aggressive behavior, but at least one of these behaviors was always given by the receiver of an aggressive behavior. When these behaviors were exhibited after an aggressive interaction, almost 80% of the interactions de-escalated. Aggressive encounters were significantly less likely to remain unchanged or escalate after the recipient of the aggression gave any of these signals, suggesting that the outcomes were modulated by the signaling and behavior of the receiver, even when the dogs were not familiar and had no social history. Such data shift the discussion from a bilateral (dominant vs submissive) social system to one that is more nuanced and driven by information in signals that, themselves, may reflect prior knowledge of those involved.

Together, these data suggest that canine social interactions are inadequately described by a simple dominant-versus-submissive characterization, even within the limited frameworks of formal dominance and competitive ability. Many of the behaviors used as measures of dominance are also well-established behaviors associated with stress in dogs.<sup>34</sup> It is likely that more complex analysis of relationships and factors that facilitate affiliation will lead to a better understanding of canine social behavior and what hap-

pens to social relationships when behavioral abnormalities occur.

More importantly, none of these data support using the concept of dominance to describe relationships between household dogs or between dogs and humans. Yet, misapplication of this concept is at the core of most punishment-based training and drives the idea that we must be able to remove food from dogs.

### **Controlling access to food: a legacy of dominance theory**

One of the commonly used tests for shelter dogs, the SAFER test, uses a fake hand on a pole to remove a food bowl from a dog that is tethered.<sup>43,44</sup> Despite a lack of testing that shows such evaluations to be valid,<sup>45</sup> dogs that fail this test by stiffening, growling, freezing, or biting at the fake hand are usually considered inappropriate candidates for rehoming and are frequently euthanized.<sup>43,44</sup> In 1 study,<sup>43</sup> only 34% of all surveyed shelters made any attempt to modify the associated aggression. However, 96 dogs with a positive response to the fake hand were rehomed and followed up 3 days, 3 weeks, and 3 months after adoption.<sup>43</sup> Only 6 adopters reported any similar behavior within the first 3 weeks, and at 3 months, only 1 incident of growling over a rawhide was reported.<sup>43</sup> Ninety-seven shelter dogs that reportedly showed aggression when food was taken away were adopted and tested in their new homes to calculate numbers of false-positive, false-negative, true-positive, and true-negative results, along with the sensitivity, specificity, and negative and positive predictive values of the test.<sup>44</sup> The sensitivity of the test was only 0.39, and the positive predictive value of the test was 0.55. The test was slightly more predictive of negative behavior, with a specificity of 0.87 and a negative predictive value of 0.78. All adopters responded that rare aggression related to food was not a problem for them and was easily managed.

Use of a fake hand in a behavioral test was originally part of a battery of tests designed to evaluate dogs flagged as potentially dangerous.<sup>46</sup> In a series of 479 tests, sensitivity and positive predictive value of the test were 0.33 and 0.49, respectively, and specificity and negative predictive value of the test were 0.81 and 0.69, respectively.<sup>46</sup> This pattern was similar to that for shelter dogs tested for reactions to food removal.<sup>44</sup> If the criteria for the dangerous dog test were changed so that dogs were tested twice in the same day, there was an effect of desensitization, with improved behavior once the dogs were familiar with the test. If the criteria were further changed so that test results were considered positive only if at least 2 true attacks were exhibited at any time during the test, the sensitivity of the test increased to 0.93.

Although these tests have been adopted in an attempt to minimize risk to potential dog adopters, they raise the question of whether we should actually be able to take food from dogs, at any time and for any

reason. Such unpredictable removal of an essential resource would be likely to provoke anxiety, which may be reflected in the behavior of some shelter dogs that had previously experienced resource scarcity. The studies cited show that dog behavior is more complex than is reflected in control of access to food. These findings also highlight the risk of using unvalidated tests, especially those that may be unfamiliar to dogs. Valid tests must be reliable and repeatable, and such standards are seldom met.<sup>47,48</sup>

### **Interactions between dogs and humans**

Dogs are skilled at social cognition and recognize human signals including pointing, visual direction of attention, gaze and body angle, signals involving movement (eg, knocking), and facial signs. Dogs are able to use a series of human signals to locate hidden food, even if young and inexperienced.<sup>49</sup> However, the types of experiences dogs have with humans affect their ability to recognize and willingness to comply with such signals.

Pet dogs are better than shelter dogs at following pointing signals, attentional state, and direction of attention.<sup>50,51</sup> Shelter dogs and pet dogs, regardless of experience, will gaze at humans when faced with an unsolvable task or novel or puzzling situation, suggesting that dogs have some degree of synchronization with human behavior.<sup>52</sup> When given a choice of asking for food from a human whose face dogs can see or one whose face is covered or otherwise obscured, dogs gaze at the human they can see significantly more often than chance alone would predict.<sup>53</sup>

Dogs are able to use human verbal speech to label toys and are able to store those labels in their memories and make inferences on the basis of them. For example, a dog presented with 4 toys for which it knows the labels and a fifth, novel toy can pick out the novel toy when provided a label that does not match any of the known toys.<sup>54</sup> This series of steps is found in the development of language in human children and may be found in other species also, if we look. The ability to use this type of inferential process may be widespread among dogs learning new behaviors. This finding also raises the possibility that canine vocalizations contain labeling schema.

Dogs produce more facial expressions when humans are actively attending to them, but also when humans are simply oriented toward them, compared with when humans have their backs turned to the dogs.<sup>55</sup> This effect is pronounced for the muscles that raise the inner brow and show the tongue. Vocalizations are also positively affected by human attention. These behaviors occur regardless of whether food is present, indicating something essential about the communication, signaling, and social systems separate from an external reward or arousal.<sup>55</sup>

Caudate activation and increases in dopamine release are associated across species with rewarding stimuli. When receiving a signal indicating a known reward, in contrast to a signal indicating no reward,

dogs have been shown, by means of functional MRI while awake, to experience caudate activation.<sup>56</sup> However, dogs demonstrated relatively greater caudate activation for praise versus a food reward in a manner that paralleled results in a Y-maze choice experiment.<sup>57</sup> This result suggests that information itself is a currency that may have been selected for in the development of social behavior and state in modern dogs. Such behaviors may be affected by the learning environment but may be intrinsic to development of modern dogs. A number of candidate genes are highly differentiated across brain regions of German Shepherd Dogs and indigenous wolves<sup>58</sup> in ways that affect neurochemical receptors to make regional brain neurochemical profiles more similar to those of humans than those of wolves.<sup>59</sup>

These are the types of data that should inform our understanding of how dogs interact with humans. Dogs seek and can use accurate information, so the way we live with them and care for them should reflect this complex neurobiological communication system.

## **Punishment as an Intervention to Change Behavior**

Misapprehensions about the evolutionary history of dogs and about the criteria for evaluating various types of dominance<sup>36</sup> have resulted in the conclusion that human-canine relationships must be structured by “dominance” and force. Contrary to popular belief, efficacy data for aversive, punishment-based interventions are lacking.<sup>60,61</sup> However, studies have demonstrated that adverse behavioral outcomes are associated with punitive training methods among dogs in the general population and dogs seen at specialty behavioral medicine practices.<sup>62-66</sup> The association between aversive training methods and problematic canine behaviors is important for veterinarians to understand, because veterinarians should be a primary resource for information about early training of puppies and kittens and, as discussed earlier, activities in which the veterinary staff members engage may be viewed by patients as punitive.

The incidence of punishment as a disciplinary strategy for undesirable behavior in dogs is high. Hiby et al<sup>67</sup> surveyed 364 dogs owners about how they trained their dog for 7 basic tasks (house-toilet training, chewing household objects, stealing food or objects, sit, come, leave it, and heel) and found that, despite saying that they used praise to train their dog, 304 (83.5%) owners used punishment if their dogs stole food or objects, and 42 (11.5%) used punishment for house-toilet training. In this context, punishment ranged from sending the dog away through yelling to hitting the dog. In a study<sup>62</sup> involving a convenience sample of 192 owners solicited at veterinary clinics that examined possible associations between training methods and 29 relatively common behav-

ioral complaints, owners who used only positive reinforcement reported significantly fewer undesirable behaviors and had significantly fewer dogs that reacted to other dogs or to unfamiliar people. Scores for attention-seeking, fear, and aggression were significantly higher if punishment, negative reinforcement, or both was used. Of course, a survey study such as this cannot establish a cause-and-effect relationship. Therefore, the authors could not conclude whether punishment caused or was a result of the behaviors about which clients complained. Regardless, veterinarians should know that punishment and negative reinforcement have been shown to be associated with worsening and more distressed behaviors in dogs. Such patterns are injurious to canine patients and, potentially, to their owners.

There is some evidence that owner behaviors with respect to punitive interventions may be the cause of undesirable dog behaviors.<sup>64</sup> In that study, 53 dog owners were surveyed about the methods they used to train 7 common tasks and were then videoed in standardized scenarios that involved teaching novel tasks. Dogs trained with punishment were less likely to approach strangers during the video evaluation, and those trained with physical punishment were less playful. Dogs trained with rewards did better with novel training tasks, suggesting that punishment may adversely affect future learning ability or a willingness to engage in situations and behaviors that allow dogs to learn. Such outcomes suggest a risk for a continuous downhill spiral in the dog-human relationship. Veterinarians must be aware of this risk, collect information on training methods as part of the dog’s history, and assimilate that information into the handling of patients and the interventions recommended for them. These results also have implications for how dogs view the process of receiving veterinary care.<sup>25</sup>

Effects of previous interventions on the behavior of dogs evaluated at a specialty behavior clinic have also been studied.<sup>63</sup> The confrontational methods most commonly reported in the clinic survey were “hit or kick dog for undesirable behavior” (43%), “growl at dog” (41%), “physically force the release of an item from a dog’s mouth” (39%), “alpha roll the dog” (31%), “stare at or stare [dog] down” (30%), “dominance down” (29%), and “grab dog by jowls and shake” (26%). These interventions elicited an aggressive response from at least 25% of the dogs on which they were tried. It should be noted that the source of the recommendation to engage in these techniques was usually reported as “self” or “trainer.” Obviously, the study involved dogs sufficiently affected for their owners to seek help from a specialist in behavioral medicine, but the role for veterinarians in providing evidence-based guidance to prevent such problems should be clear. The use of punitive methods themselves has been associated with previous consultation with a nonveterinarian behaviorist or trainer, prior to seeking help from a

behavioral specialist.<sup>66</sup> Such dogs have an increased risk of euthanasia, compared with the risk for dogs that had not been first seen by a nonveterinarian behaviorist or trainer, regardless of the diagnosis. These studies reveal the effects of leaving guidance about behavior to those whose credentials may be absent or inadequate. Behavioral conditions are time-penetrant, and delays in seeking competent, professional care are associated with worse outcomes.

Veterinarians should encourage dog owners to use training practices that are humane and evidence based. Dogs show both lower body postures and signals indicating stress when handlers use negative reinforcement-based methods (eg, the handler removes an aversive stimulus only when the dog exhibits the correct response) to teach the dog to sit or walk calmly on a lead.<sup>68</sup> In contrast, dogs whose handlers use positive reinforcement-based methods (eg, the handler provides a positive consequence for every correctly performed response) show increased attentiveness to the owner. These data indicate that there are effects of training methodology on both the dog-human relationship and the display of stress-related behaviors by dogs. Positive learning outcomes and reduced stress-related behaviors should be focuses of veterinary care.

Austria, Germany, Denmark, Norway, Scotland, Slovenia, Sweden, Switzerland, Wales, and the Canadian province of Quebec now outlaw the use of electric shock-electric stimulation collars and electronic barrier fences for dogs.<sup>61,69</sup> Alterations in the hypothalamic-pituitary-adrenal axis have been documented for dogs that were shocked, compared with those that were not shocked, as part of their training.<sup>70</sup> German Shepherd Dogs that received electric shocks during guard-dog training, but not when later evaluated, showed lower ear posture when free-walking and more stress-related behaviors than did dogs that had never been shocked during their training.<sup>71</sup> These differences were also evident during obedience exercises and exercise with another individual, during which dogs with a history of having been shocked behaved with less certainty toward their handlers than dogs that had never been shocked. A study<sup>72</sup> of naïve laboratory-raised Beagles showed that all dogs experienced an increase in serum cortisol concentration when shocked, compared with baseline concentrations. Also, the less discrete the context, the higher the increase in cortisol concentration was. Again, the source of training advice, primarily through training classes,<sup>62,66</sup> affects whether owners use electric shock collars, despite the finding that owners who use reward-based methods for training a recall are more successful than those who use electric shocks.<sup>62</sup> The data to support punitive interventions, whether they involve negative reinforcement or positive punishment, are lacking, but the data supporting that such measures cause behavioral problems continue to mount.<sup>60,61,69</sup>

These epidemiological data should aid veterinarians in providing anticipatory guidance for early in-

tervention in behavioral complaints and identifying qualified trainers, while understanding that achieving a reasoned approach to the use of humane dog training methods requires understanding factors associated with both dogs and humans, human attitudes toward behaviors, perceived norms related to behavioral control, and human intentions.<sup>69</sup>

## Conclusions

Basic research data on canine and feline behavior can inform veterinary handling of patients and recommendations that could benefit clients, but most veterinarians lack sufficient training in behavioral medicine and frequently lack access to journals where these data are published. The present review covered only a small number of studies related to 4 common topics involving companion animal behavior. Still, although limited in focus, this review does provide some targeted guidance (**Appendix 2**).

There is an essential role for practitioners in the field of behavioral medicine, and there is an essential role for behavioral medicine in routine veterinary examinations. All patients should be assessed for any deviations from normal behaviors during every veterinary examination, and all patients should be assessed for normal behavioral development at maturation landmarks, which means dogs should be assessed at least every 6 months for their first 2 years.<sup>76</sup> Behavioral patterns that are concerning should be reassessed so that interventions can occur as early as possible, when they are more likely to be effective. Although there are profound unmet needs in basic and clinical research on veterinary behavioral medicine, basic research in ancillary fields is providing helpful information, and veterinarians should know that such information exists.

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## Appendix I

Changes in various measures of heart rate variability associated with whether behavioral signs of distress are present or absent in dogs during a routine physical examination.

Behavioral signs of distress	HRV	RMSSD	SDNN	RMSSD-to-SDNN ratio
Absent	Increased	Decreased	Decreased	Increased
Present	Decreased	Increased	Increased	Decreased

Continued on next page.

## Appendix 2

Salient findings of recent studies on the unmet need for behavioral medicine in veterinary practice, the veterinary experience as a contributor to fear and distress in dogs and cats, social signaling in dogs and the ongoing “dominance” debate, and punishment as an intervention to change behavior.

- Most dog and cat owners have unanswered questions about their pets' behaviors. Active listening during veterinary clinic appointments may reveal these questions, even if the veterinarian does not have an immediate answer.
- Not interrupting clients and looking them in the face may help veterinarians and clients communicate better during appointments.
- Most veterinarians believe that they lack adequate training in veterinary behavioral medicine. Thus, veterinarians who feel insecure about their knowledge in this field should not feel alone but should feel the need for additional education.
- If veterinarians can become educated in behavioral medicine, clients will use that skill set.
- Dogs and cats often fear veterinary clinics and exhibit behaviors indicative of that fear (eg, high heart rate, high respiratory rate, alterations in blood pressure and vagal tone, decreases in heart rate variability, low body postures, lip licking, and avoidance). Performing examinations without addressing these fears intensifies them.
- Scales are stressful for cats and dogs; therefore, scales should be made as patient-friendly as possible (eg, by not placing them in a corner and by covering them with a nonskid surface, such as a yoga mat) and patients should be weighed when they are calm (such as after an examination).
- When at a veterinary clinic, cats may appear less fearful than they truly are. Therefore, heart rate, blood pressure, and similar variables should not be measured until cats are behaving normally.
- Being examined on a table heightens fear for some dogs. Examination on the floor, a low bench, or a yoga mat may be preferable. Dogs can learn to use steps to climb to a table with a yoga mat.
- Waiting areas can calm dogs and cats if the waiting areas are quiet and not busy.
- Dogs perceive veterinary clinics as scary places, but clients and veterinary staff members may be unaware of the extent of this fear unless they specifically look for the behavioral signals, postures, and responses associated with fear. Human behavioral adjustments may modulate these fearful behaviors.
- The concept of “dominance” in social interactions of dogs is a focus of debate and research; however, the debate is solely focused on patterns of social organization in large groups of dogs. No professional veterinary or training group supports any role for dominance by humans in interactions with dogs.<sup>73–75</sup>
- Dogs use signals as an indicator of context to determine whether they will interact.
- Play bows extend bouts of play.
- For dogs, rolling over to expose one's belly is not a reflection of dominance but instead shortens play bouts so that the role of directing the play can change.
- The number of dogs involved positively affects the duration of play bouts.
- Dogs exhibit different frequencies of the same behaviors when meeting known versus unknown dogs.
- Many behaviors that have been classified as calming, appeasement, or deferential behaviors significantly decrease agonistic behaviors from an approaching dog.
- Tests that reject shelter dogs for placement on the basis of aggression to having food removed lack validity and are poor indicators of how dogs will behave in new homes.
- Gaze is important in dogs' interactions with humans, and dogs change their gaze depending on whether they perceive that people can see them.
- Dogs can find hidden objects through the use of human signals, indicating that they have social cognition.
- Dogs can categorize objects by name and learn by exclusion, a pillar of human language acquisition.
- Verbal rewards stimulate more caudate activation than do food rewards, suggesting that information matters to dogs.
- Tests of the efficacy of punishment-based training methods to correct behavioral concerns are lacking. Data exist only for the efficacy of medication and behavioral interventions.
- Punishment-based interventions are associated with worsening behavior, including aggression, in dogs in the general population and with worsening behavior and intensification of aggression in dogs examined at referral behavior specialty practices. In the case of the latter, punishment-based interventions increase the risk of rehoming and euthanasia.