



REVIEW

Dominance in domestic dogs—useful construct or bad habit?

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Abstract The term “dominance” is widely used in the academic and popular literature on the behavior of domestic dogs, especially in the context of aggression. Although dominance is correctly a property of relationships, it has been erroneously used to describe a supposed trait of individual dogs, even though there is little evidence that such a trait exists. When used correctly to describe a relationship between 2 individuals, it tends to be misapplied as a motivation for social interactions, rather than simply a quality of that relationship. Hence, it is commonly suggested that a desire ‘to be dominant’ actually drives behavior, especially aggression, in the domestic dog. By contrast, many recent studies of wolf packs have questioned whether there is any direct correspondence between dominance within a relationship and agonistic behavior, and in contrast to wolves, hierarchical social structures have little relationship with reproductive behavior in feral dog packs. Nor do the exchanges of aggressive and submissive behavior in feral dogs, originally published by S. K. Pal and coworkers, fit the pattern predicted from wolf behavior, especially the submissive behavior observed between members of different packs. In the present study of a freely interacting group of neutered male domestic dogs, pairwise relationships were evident, but no overall hierarchy could be detected. Since there seems to be little empirical basis for wolf-type dominance hierarchies in dogs, the authors have examined alternative constructs. Parker’s Resource Holding Potential (RHP) appears to be less useful when applied to domestic dogs than to other species, although it has the advantage of incorporating the concept of subjective resource value (V) as a factor influencing whether or not conflicts are escalated. The authors propose that associative learning, combined with V, can provide more parsimonious explanations for agonistic behavior in dogs than can the traditional concept of dominance.

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Introduction

The term “dominance” is widely used to both categorize and explain the behavior of domestic dogs. The assumption

that dogs are strongly motivated to establish hierarchical relationships with each other, for example in multidog households and with their human cohabitants, has been widespread in the literature and informs recommended treatment protocols for unwanted aggression toward both other dogs and people (Landsberg et al., 2003). However, the benefit of using the concept of “dominance” in the diagnosis and treatment of dogs that have displayed aggression has recently been called into question (Shepherd, 2002, p. 19; van Kerkhove, 2004; Eaton, 2007), and some

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clinicians have come to avoid referring to it. In this article the authors extend van Kerkhove's argument in 3 areas; the inappropriate use of the term "dominance" as a characteristic of an individual dog, the application of outdated models of wolf pack organization to explain aspects of dog behavior, and the use of "dominance" as a characteristic that determines relationships both between pairs of dogs and between dogs and their owners.

Inappropriate use of the word "dominance" as a description of an individual animal

Confusion still arises through the use of the term "dominant" as a character trait of an individual dog. Although some authors in the clinical behavior literature have warned against the use of the term "dominant" to describe individual dogs (Shepherd, 2002, p. 18), there are also many examples in the dog training literature and the popular media, where "dominance" is described as a characteristic of an individual dog. Kovary (1999) writes: "A dominant dog knows what he wants, and sets out to get it, any way he can. He's got charm, lots of it. When that doesn't work, he's got persistence with a capital 'P.' And when all else fails him, he's got attitude." This kind of statement implies that an individual dog has a "dominance trait" that drives it to achieve a high rank within any intra- or interspecific social group, a perception that may lead to coercive and punishment-based training or other treatment. For example, some authors have recommended the use of the "alpha roll," in which a dog is forcibly turned over onto its back into a "submissive posture," with the aim of "showing the dog who is boss" (Monks of New Skete, 1978). Although there have been occasional attempts in the ethological literature to postulate dominance or submissiveness as traits (Baenninger, 1981), it is now generally accepted that the term "dominance" should be restricted to describing relationships, not individuals (Langbein and Puppe, 2004).

Among ethologists, dominance is normally defined as "an attribute of the pattern of repeated, agonistic interactions between two individuals, characterized by a consistent outcome in favor of the same dyad member and a default yielding response of its opponent rather than escalation. The status of the consistent winner is dominant and that of the loser subordinate" (Drews, 1993). Dominance is therefore primarily a descriptive term for relationships between pairs of individuals. If those individuals live within a group of more than 2, it may (but also may not, as discussed later) be possible to combine dominance relationships to produce a "hierarchy." Although an individual animal can be assigned a dominance rank within such a group (Langbein and Puppe, 2004), there is no reason to assume that a high-ranking individual in one group would also become high ranking if moved to another. Nor is there any good evidence that "dominance" is a lifelong character trait. The hypothesis of the "born alpha" has been tested and rejected for wolves (Packard, 2003, p. 55) and has

been replaced by a more stochastic view, in which temperament changes according to physiological state and social circumstance (Fentress et al., 1987). In addition, puppy testing of domestic dogs does not indicate which individuals will become "dominant" as adults (Diederich and Giffroy, 2006), suggesting that there are multiple factors that contribute to the development of relationships between individuals, rather than a simplistic "dominance trait." As this paper will discuss, these factors include not only individual differences in personality, but also specific learning opportunities and the influence of factors such as endocrine fluctuations. The authors would argue, therefore, that the use of the expression "dominant dog" is meaningless, since "dominance" can apply only to a relationship between individuals. Furthermore, the use of such terminology can lead to the application of training practices that can create anxiety in dogs about interactions with their owners.

Use of "dominance" to describe the quality of a relationship

Even when used to describe relationships, "dominance" has still been employed in a variety of senses in the ethological literature (Drews, 1993). It has been used to characterize both the outcomes of competitions in which animals meet for the first time, or otherwise do not recognize their opponents, and those in which the history of encounters between the individuals in the dyad is remembered and becomes a factor influencing the outcome. Both uses have been applied to dogs, which may be described as being "dominant toward" other dogs met for the first time on walks, or "dominant over" familiar dogs or people in the household. Even when acknowledging a role for history, ethologists have used "dominance" in at least 4 ways: in the functional sense that individuals are "dominant" if they have prior access to key resources; as describing the outcome of repeated aggressive encounters between individuals, such as red deer stags during rut (Clutton-Brock, 1979); as a "pecking order," in which subordinate individuals inhibit their agonistic behavior because of their fear of despotic (dominant) individuals; and in terms of the *absence* of aggression, as when the large majority of disputes are resolved by displays of signals rather than overt aggression, but in which one individual still consistently gives way to another (Drews, 1993).

A further distinction can be made depending on how general and/or lasting the relationship is. Sometimes dominance relationships are only temporary, arising over a particular resource and then disappearing, but in permanent social groups, dominance relationships may either vary between contexts or remain the same across all contexts. In the latter, the assumption is often made that the individuals concerned are competing for "status" that, once achieved, gives them right of access to all resources.

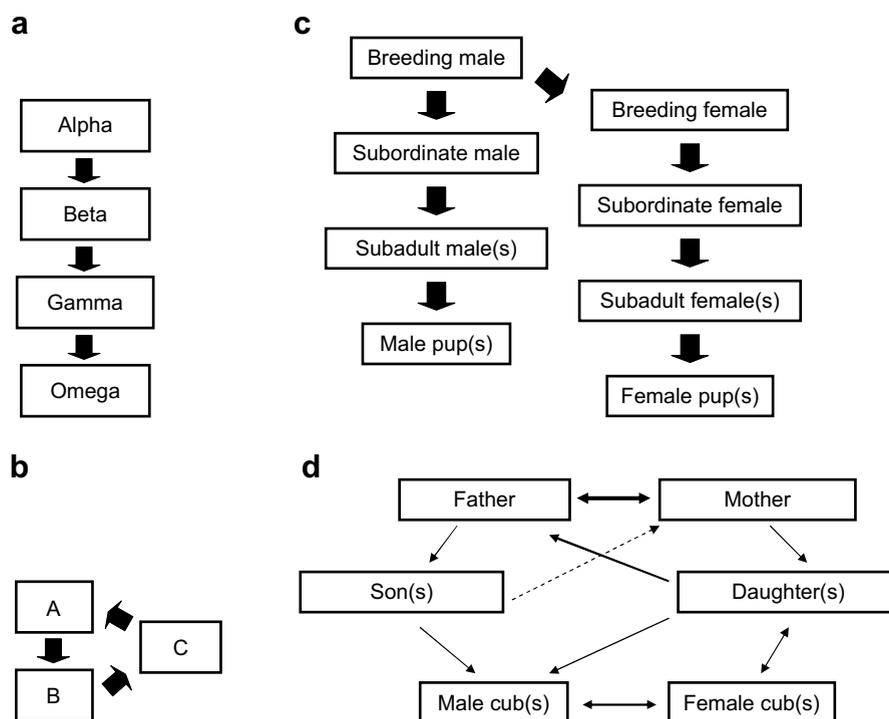


Figure 1 Diagrammatic representations of distributions of dominance relationships within social groupings, where arrows indicate the direction of dominance: (a) linear transitive hierarchy; (b) intransitive (circular) structure; (c) classic captive wolf-pack sex/age graded hierarchy; (d) family-based wolf pack. Figures (c) and (d) are redrawn from Packard (2003).

All of these definitions refer to pairs of animals. When a social group consists of more than 2 individuals, it may (or may not) be possible to organize all the pairwise relationships into a transitive hierarchy in which all relationships can be reduced to a single rank, in which the “alpha” individual is dominant over all others, the “beta” is dominant over all except the alpha, and so on, down to the “omega,” which is subordinate to all others (Figure 1a). However, there is no a priori reason why this should be the case, particularly if differences in strength between animals are small and memories of past encounters play an important role in establishing relationships (van Doorn et al., 2003). Under these conditions especially, nontransitive or circular hierarchies can emerge (e.g., $A > B$, $B > C$, $C > A$: Figure 1b). Wolf packs are traditionally thought of as containing separate male and female age-graded dominance hierarchies (Packard, 2003, p. 53) (Figure 1c).

Some authors have questioned whether hierarchies are simply a construct useful to the observer, or whether the animals themselves are aware of them (Bernstein, 1981, p. 429). However, recent research indicates that most social vertebrates, not just primates (Sapolsky, 2005), may be capable of inferring third-party relationships; dogs appear to have the cognitive abilities to comprehend and interpret them (Rooney and Bradshaw, 2006), as do some fish (Groenick et al., 2007).

When evaluating the usefulness of “dominance” and “hierarchy” to conceptualize the behavior of the domestic dog, it is logical to start with intraspecies social structures,

rather than the more intrinsically asymmetric relationships between dogs and humans. Analogies are often drawn with social groupings in the wolf, the ancestral species, and with groups of feral dogs.

The wolf

Because the domestic dog *Canis lupus familiaris* is descended from the wolf *Canis lupus*, it is often assumed that its capacity to form social relationships is similar to that of the wolf (Sherman et al., 1996; Lindsay, 2000; Feddersen-Petersen, 2007), including a predilection to establish dominance relationships with all individuals, whatever their species, within the social unit. This “wolf pack” theory of companion dog sociality appears to be pervasive within the clinical literature but has been challenged (van Kerkhove, 2004), partly on the grounds that the literature on wolf behavior on which it is based may be misleading. Many of the early studies were of captive packs, often artificially assembled from unrelated individuals, and aggression was sometimes observed more frequently than might be expected if a strict dominance hierarchy was in existence (Zimen, 1975), suggesting that these “packs” would have split into smaller units if they had been able to disperse. The typical social structure was thought to comprise separate male and female hierarchies, each headed by 1 member of the breeding pair (Figure 1c), which suppressed reproduction by other pack members, often by direct aggression. In a large pack both

of the hierarchies were pyramidal, with distinct rank orders apparent only at the top of each, and much more fluid relationships between juveniles.

In the paper the title of which we have adapted for this review, Lockwood (1979), also working with captive packs, tested the validity of applying a hierarchical structure by returning to first principles, recording the behavior of individuals and examining the occurrence of various types of interactions statistically. He found some support for dominance hierarchies, based on proportional exchange of agonistic and submissive signaling, weight, and priority of access to food. However, he found that the *rates* of exchange of both agonistic behavior and appeasement were uncorrelated with dominance, calling into question whether aggression is usefully explained by invoking the dominance concept, even in wolves. Some individuals appeared to wish to disperse, for example, they regularly paced at the edge of the enclosure. The composition of the groups may therefore not have been that which the wolves would have chosen for themselves, possibly causing agonistic behavior motivated more by territoriality (intergroup) than by challenges to dominance rank (intragroup).

Improved techniques for observing the behavior of wild wolf packs have led to a reappraisal of the basis of their sociality. Mech and Boitani (2003, p. 1) state that “the basic social unit of a wolf population is the mated pair,” which are accompanied by their offspring from previous years. Dominance contests in such packs are rare; for example, Mech (1999) observed none in one free-living pack over a 13-year period. The breeding pair appears to be able to maintain its status without aggression. “Submissive” behavior, which Packard (2003) redefines as “appeasing” because it is often spontaneous, rather than being a response to aggression, is commonly performed by the younger pack members toward the breeding pair, and occasionally by the breeding female to the breeding male. In the wild, only larger packs including non-kin, or “disrupted” packs where, for example, one or both of the breeding pair has died, show assertive behavior. Agonistic behavior, when it occurs, appears to be much more labile than would be predicted from a stable hierarchy, changing with factors such as age, reproductive state, nutritional condition, aversive experiences, and the resource under dispute (Packard, 2003).

Thus, recent interpretations of wolf behavior have tended to emphasize cohesive, rather than aggressive, behavior as essential to the stability of naturally occurring packs. Agonistic behavior may be induced by the artificial circumstances experienced by captive packs, in which individuals are often unrelated and cannot voluntarily disperse (Zimen, 1975). The question remains as to which of these circumstances is the better analogy for the situation experienced by the owned domestic dog. King (2004) has logically argued that the captive-wolf analogy may be more appropriate for a multidog household comprising unrelated individuals, but since Lockwood (1979) found no

correspondence between dominance and aggression even in his captive packs, it may still not be straightforward to use dominance as an explanatory concept for dog–dog aggression within a household.

It is also unclear how much the social behavior of the wolf has been affected by domestication. Some authors claim profound changes, particularly in social cognition (Hare and Tomasello, 2005; Miklósi, 2007), that effectively raise a further set of objections to any useful comparability between the wolf pack and a social unit comprising domestic dogs managed by human owners.

Feral dogs

Some of these objections could be addressed if the social behavior and structures of freely associating dogs could be observed. Van Kerkhove (2004), reviewing 5 studies of feral dogs published between 1975 and 1995, concluded that their pack structure is very loose and rarely involves any cooperative behavior, either in raising young or in obtaining food. It is possible that the absence of wolf-type cooperation in these feral dogs, and their overall social instability, may have been a result of repeated interference and displacement by man, rather than an intrinsic incapacity. However, van Kerkhove did not discuss a series of studies of feral dog packs in West Bengal by S. K. Pal and colleagues (Pal et al., 1998, 1999; Pal, 2003, 2005). Within a large population of several hundred individuals at any one time, they were able to identify coherent social groups that consisted largely of close kin, shared communal territories, and were aggressive toward members of neighboring groups (Pal et al., 1998), analogous in this respect to wolf packs. However, the typical sexual and parental behavior that they observed differed substantially from the wolf pack pattern. Females were typically courted by multiple males (up to 8 in Pal et al., 1999), which competed for copulation attempts; although females rejected some of these attempts, copulatory ties with several males on the same day were commonplace (Pal et al., 1999), which would be highly unusual in a wolf pack (Schotté and Ginsburg, 1987; Packard, 2003, pp. 56–59). Aggressive interactions between females, which would be expected if “dominant” females were attempting to monopolize males, as reported in wolf packs (Schotté and Ginsburg, 1987), were extremely rare (Pal et al., 1999), and there was apparently little reproductive suppression of females within social groups; for example, one group contained 2 breeding pairs (Figure 2a) and no nonbreeding adult females (Pal et al., 1998). In wolf packs where more than 2 females produce pups in a season, infanticide by females usually results in the survival of only 1 litter (Packard, 2003, p. 59), whereas infanticide, although not completely unknown among the West Bengal ferals, was rare (Pal et al., 1999) and appears not to have been reported from other feral populations (Boitani et al., 2007).

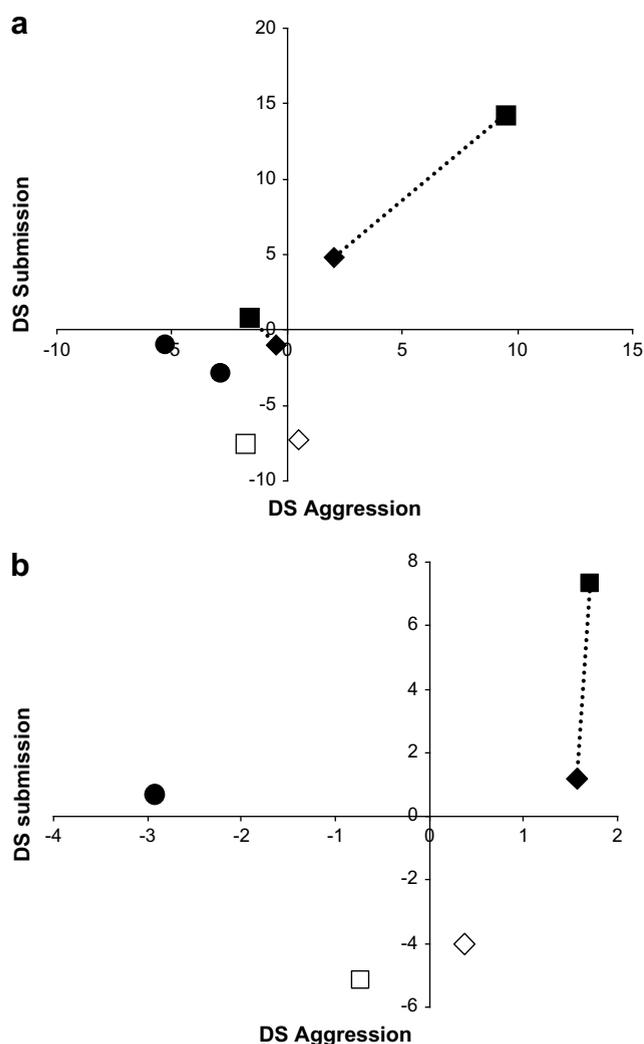


Figure 2 Hierarchies for 2 groups of feral dogs, based on David's scores (DS: Gammell et al., 2003) for aggressive and submissive pairwise encounters (data from Pal et al., 1998, pp. 336–337). Solid squares, breeding males; solid diamonds, breeding females; solid circles, nonbreeding adult males; open squares, juvenile males; open diamonds, juvenile females. Dotted lines link breeding pairs. 2(a), LIG-group; 2(b), HIG-group.

Multiple breeding among feral groups may therefore be possible where ecological conditions allow, possibly because feral dogs lack the behavioral mechanisms whereby breeding pairs of wolves suppress reproduction by other adults within their packs (Harrington et al., 1982). Pair bonding and paternal care were, however, observed in the West Bengal dogs, including feeding of pups by regurgitation by at least 1 male (Pal et al., 1999); previous studies of feral packs had failed to find any paternal care (Boitani et al., 2007).

Therefore, reproduction in feral dog groups, even when their membership is stable, appears not to be controlled by a wolf pack type of “dominance hierarchy.” Moreover, Pal et al. (1998, p. 343) did not observe the ritualized exchanges of behavior that characterize wolf hierarchies:

“[R]itualized displays of dominance or submission were observed on few occasions, and this supports the view that most communication among group members is of a very subtle nature and is based on mutual recognition.” Pal et al. (1998, p. 336) were able to derive hierarchies for 2 of their feral groups based on exchange of “rare aggressive incidents.” Since the groups consisted of 5 and 8 dogs, respectively, there is a possibility that the apparently hierarchical structures could have arisen by chance (Appleby, 1983), and the authors have therefore reanalyzed the data in Pal et al. (1998, pp. 336–337) by deriving David's scores (Gammell et al., 2003) for both aggressive and submissive encounters within the groups (Figure 2). As predicted from the wolf pack model, in both groups 1 breeding pair had the highest David's scores for both aggression performed and submission received. In the LIG group, the second breeding pair occupied an intermediate position in the hierarchy; the rate of exchange of aggression between the same-sex members of these pairs, though asymmetric, was not especially high. The 3 nonbreeding males occupied higher positions than the juveniles based on submission received, but lower positions based on aggression performed (2 in Figure 2a, 1 in Figure 2b), largely because they received relatively high rates of aggression from the “alpha” breeding pair, but they responded with relatively little submission. The juveniles received little aggression but often interacted submissively.

Much of the aggression within groups occurred during the breeding season; males were most aggressive when females were in estrus, and females were most aggressive when they were raising pups (Figure 3) (Pal et al. 1998, pp. 340–342), suggesting that most conflicts arose to protect or enhance reproductive success, as also occurs in wolves when food is not limited (Packard, 2003, p. 58). However, the rates of both aggression and submission altered seasonally, in parallel both between- and within-group, which would not be predicted from the wolf pack model.

It is not clear from this or other studies how members of feral groups maintain group cohesion, but the mechanisms appear to be different from those observed in wolves and again, do not support the “wolf pack” model for dog behavior. Rates of aggression and submission per dyad observed by Pal et al. (1998) were approximately twice as high between groups as within groups, even though within-group encounters were stated to be much more frequent, which is compatible with a group identity based within a shared territory. However, the high rate of submissive behavior between groups (Figure 4) is not predicted from wolf behavior; although few conflicts between wolf packs have been witnessed, it is generally agreed that they are usually highly aggressive and can result in deaths (Packard, 2003, p. 62). By the same argument, it is difficult to reclassify the “submissive” behavior as recorded by Pal from these dogs as “cohesive” pack-bonding behavior, as has been suggested for wolves (Packard, 2003, pp. 56–57), since it is common both between and within groups.

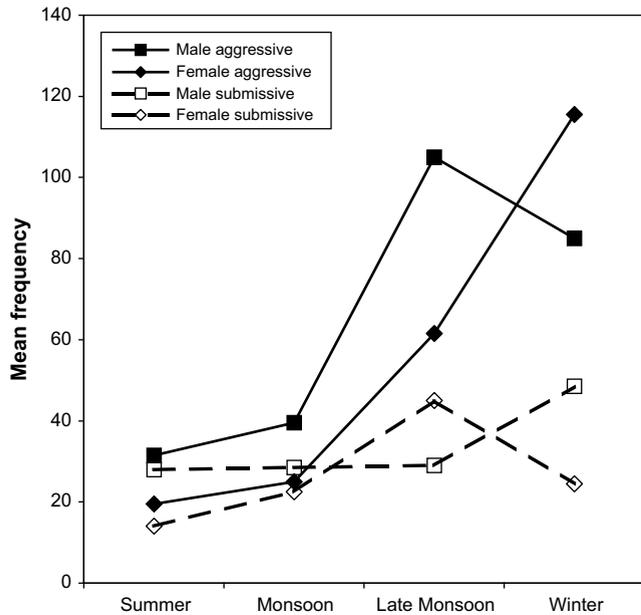


Figure 3 Seasonal changes in frequencies of aggressive and submissive behavior performed by males and females (all age classes) within 2 groups of feral dogs (data from Pal et al., 1998, p. 338). Estrus occurred in late monsoon, pups were nursed by females in winter.

Overall, it appears that domestication has radically altered the social behavior of dogs, so that when they have the opportunity to interact and breed freely, although they do form exclusive kin-based groups, they do not re-adopt a wolf-pack social system within these groups. Mating is competitive, as in many carnivora with less sophisticated sociality than the wolf (Moehlman, 1989), and submissive behavior is used to defuse conflicts, both within and between groups, rather than being reserved for

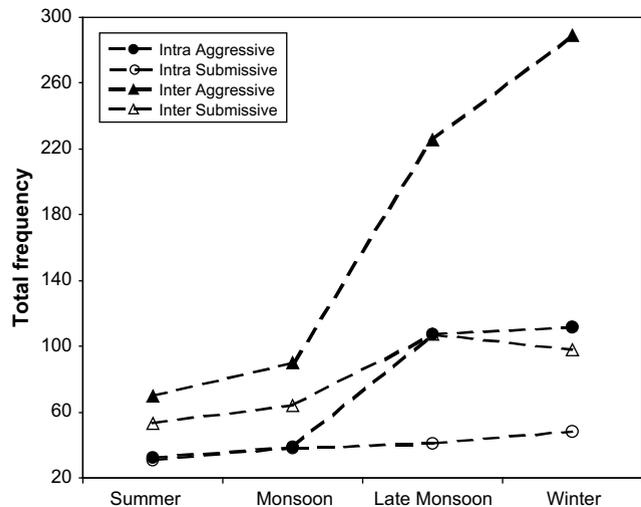


Figure 4 Seasonal changes in frequencies of aggressive and submissive behavior performed between and within 2 groups of feral dogs (data from Pal et al., 1998, p. 338). Estrus occurred in late monsoon, pups were nursed by females in winter.

group cohesion. Pair bonding is retained from the basic canid pattern, as is the capacity to share territories with family members and the occasional outsider (Moehlman, 1989).

Social behavior of neutered dogs

Much of the aggressive behavior observed by Pal and colleagues in feral packs appeared to arise from disputes over territory and access to sexual partners. Since aggression between companion dogs is not restricted to sexually entire individuals, the wolf pack dominance structure would also have to apply to neutered dogs to explain all dog-dog aggression within households. Accordingly, the authors have studied a semipermanent group of 19 neutered male domestic dogs, maintained by a rehoming charity in a 0.28 ha enclosure, to examine whether their agonistic behavior can be interpreted in terms of a hierarchical (“dominance”-based) social structure (Bradshaw, Cooke, Robertson, and Browne, unpublished data). Competitive behavior was characterized by recording the total number of “confident” (e.g., growl, inhibited bite, stand over, mount, stare at, chase, bark at) and “submissive” (e.g., crouch, avoid, displacement lick/yawn, run away) patterns exchanged within each dyad. David’s score for within-group dominance was calculated for each individual separately for confident and submissive behavior; the 2 rankings produced were positively correlated, and therefore the 2 matrices could be combined into 1. The overall David’s score for within-group dominance calculated from this matrix was uncorrelated to the age of the dog, how long it had been in the group, or its weight, although all of the 4 dogs weighing over 30 kg had positive scores.

Even among the 8 dogs which interacted the most, no clear-cut dominance hierarchy could be distinguished (Figure 5). Of the 3 highest ranking individuals, GS rarely interacted with either Ed or Ja, and although these 2 interacted frequently, their “status” relative to one another was unresolved. Among the other members of this group, there were several relationships that do not indicate an overall “hierarchy” (upward arrows, Figure 5). Overall, the pattern of relationships does not fit the predictions of the “wolf pack” model, which should produce a pyramidal hierarchy with clear alpha and beta individuals, or indeed any other conventional hierarchical model. Role theory, as applied to wolves by Lockwood (1979), was at least more descriptive of the observed pattern of interactions, though it did not generate any potential explanation of how the pattern had arisen.

Based on their David’s scores, 3 groups of dogs could be distinguished based on their behavioral “roles” within the group. Three dogs (“Hermits”) interacted so infrequently (total competitive patterns performed ranged between 2 and 5) that David’s scores could not be calculated. Seven dogs with negative scores (“Outsiders”) had no dominant relationships (defined as proportion of confident behavior

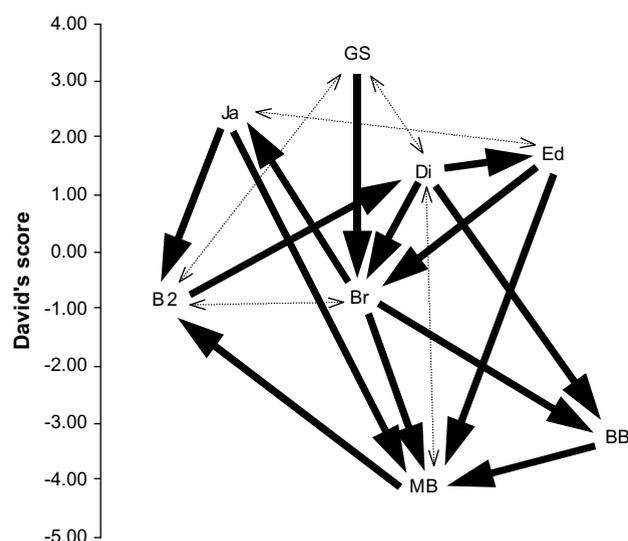


Figure 5 Competitive relationships between the eight Insider dogs (see text for definition) in a semipermanent group of 19 neutered male domestic dogs. Vertical axis: David's dominance score from interactions within this group only. Horizontal spacing is arbitrary. Solid arrows point to the net subordinate within a pair (proportion of confident behavior performed and submissive behavior received < 0.4). Dashed, double-headed arrows indicate an unresolved relationship (proportion of confident behavior performed and submissive behavior received 0.4-0.6). Pairs not joined by arrows exchanged fewer than 5 (weighted) competitive behavior patterns (< 5 confident, < 10 submissive, or any intermediate combination of those proportions).

performed and submissive behavior received > 0.6), except one, which had a single asymmetric relationship based entirely on the exchange of submissive behavior. An eighth was "dominant" over only 1 of these 7, with which it interacted repeatedly, and rarely interacted with any other dog. Each of the remaining 8 dogs ("Insiders"), all with positive David's scores, had "dominant relationships" with between 2 and 5 of the Outsiders, and no subordinate relationships. Each interacted with most of the other 7 Insiders (Figure 5); ratios of exchange could be calculated for approximately two thirds of the dyadic relationships within this group. By contrast, ratios between the Insiders and the Outsiders could be calculated for only about one third of dyads, and within the Outsiders, for only about 1 in 10, since almost all of the apparently competitive interactions occurred within the Insider group.

Overall, the pattern of individual relationships can possibly be interpreted in terms of the behavior of the Insider dogs. These were competitive between themselves, but although they may have had consistently "dominant" or "subordinate" relationships with other individual Insiders, no overall structure had emerged. The remaining dogs were less competitive; a minority (Hermits) employed the strategy of avoiding all contact with others, the majority (Outsiders) interacted mainly with the Insiders but never became "dominant" over any of them. In essence,

relationships appeared to operate at the dyad level, without any overriding structure.

Alternative approaches to interpreting social interactions between dogs

The Resource Holding Potential (RHP) model, invented by Parker (1974) to separate physical fighting ability (RHP) from likelihood of competing in a given set of circumstances, has been proposed by several authors as an alternative framework for explaining relationships between dogs (Wickens, 1993; Shepherd, 2002; Lindsay, 2005). The RHP model is more generally applicable than dominance to disputes between individuals, since it does not require any kind of prior relationship between the competitors; indeed, it has been widely applied to territorial disputes, including first encounters (Barlow et al., 1986). It also has the advantage that it predicts that the outcome of disputes will depend on the subjective value of the resource (V) to each of the individuals, allowing for a "dominance" relationship to be reversed depending on its context. It therefore explains why an otherwise "submissive" member of a group may be permitted access to a resource that it values highly, because it does not pay the usually more "dominant" member to escalate the dispute. In domestic dogs, males especially seem to show context dependence in their relationships with other members of their group (Wickens 1993). Shepherd (2002, p. 19) has proposed a model for aggression in dogs based on resource value.

However, although subjective resource value (V) appears to be useful in explaining the outcome of disputes between dogs, RHP itself may be less valuable. In many disputes between animals of the same species, relative size is a strong predictor of outcome; for example, 2% weight differences are detectable by cichlid fish (Barlow et al., 1986). Domestic dogs appear to pay little attention to relative size, despite the large weight differences between the largest and smallest individuals; for example, size was not a predictor of the outcome of encounters between dogs meeting while being exercised by their owners (Bradshaw and Lea, 1992), nor was size correlated with David's score in the study of neutered male dogs described previously. Therefore, many dogs do not appear to pay much attention to the actual fighting ability of their opponent, presumably allowing differences in motivation (how much the dog values the resource) and perceived motivation (what the behavior of the other dog signifies about the likelihood that it will escalate) to play a much greater role.

In any case, the relationship between dominance and RHP is now thought to be complex and even unpredictable (van Doorn et al., 2003). Modeling indicates that where differences in RHP are small or even trivial, stable dominance hierarchies can emerge based on the history of encounters between animals, if individuals that win one encounter tend to escalate faster in their next disputes, and losers tend not to escalate subsequently, that is, the hierarchy

arises from a few random initial encounters between individuals that cause them to adopt different strategies thereafter. This can be an explanation of why reconstituting the same individuals into groups over and over again can result in completely different dominance hierarchies (Chase et al., 2002), which is counter to the predictions of RHP. Moreover, when RHP effects are small, as they appear to be in dogs, these winner–loser effects can, at least theoretically, give rise to stable nonhierarchical structures, which may either be egalitarian or consist of clear dominance relationships between pairs of individuals but with no overall hierarchy (van Doorn et al., 2003).

Is “dominance” a useful construct in the interpretation of interactions between domestic dogs?

In the clinical literature, aggression between dogs within a social unit has been widely ascribed to competition for social status when signaling has failed to resolve conflicts over resources (Landsberg et al., 2003). Thus, aggression between dogs is often interpreted in terms of dominance rank and the existence of a hierarchy within the members of a multidog household (van Kerkhove, 2004), although some authors acknowledge that the capacity to form hierarchies is likely to vary from breed to breed (Mertens, 2004; Feddersen-Petersen, 2007). However, since the traditional wolf pack competitive dominance structure has been replaced by a more cohesive framework for wolves themselves and very little support has been found for dogs adopting wolflike social structures between members of their own species, it now seems unlikely that interactions between domestic dogs are always, or indeed ever, driven by the aim to “achieve status” within a social group.

However, the concept of RHP, suggested as an alternative model to explain social interactions between dogs (Shepherd, 2002), also appears to oversimplify the factors influencing the development of stable relationships between individuals. Recent models (van Doorn et al., 2003) predict that for social mammals, context and prior experience alone may explain the outcome of encounters, and this type of model appears to fit better with the available data on interactions between domestic dogs. In other words, the development of stable relationships between individuals can be entirely explained using the principles of associative learning theory. When 2 dogs first meet, they will have no prior experience of the likely response of the other in any context. Over repeated encounters, they will learn to recognize the specific cues that might predict a positive or negative response in the other individual, alter their behavior accordingly, and gradually learn how the other dog is likely to respond in a range of different contexts. For example, a puppy coming into a household where an existing dog highly values food, but not toys, would rapidly learn not to approach the adult in the context of food, but may

confidently pull a toy out of the other dog’s mouth. This context-specific learning explains why so-called “dominance hierarchies” between dyads of dogs appear to change from one set of circumstances to another (Mertens, 2002; Shepherd, 2002). Because the outcome of the first encounters between dogs will influence subsequent responses, the circumstances under which these initial interactions occur will have a profound influence on the subsequent development of the relationship. As an example, taking 2 dogs that are contesting possession of a highly valued resource for the first time, if one is in a state of emotional arousal, or if one is in pain, or if reactivity is influenced by recent endocrine changes or motivational states such as hunger, then the outcome of the interaction may be different than if none of these factors were present. Equally, the threshold at which aggression is shown may be influenced by a range of medical factors, or, in some cases, precipitated entirely by pathological disorders. Hence, the contextual and physiological factors present when 2 dogs first encounter each other may profoundly influence the long-term nature of the relationship between those dogs. The complexity of the factors involved in this type of learning means that dogs may develop different “expectations” about the likely response of another individual for each resource in a range of different situations. For example, within a pair of dogs, one may learn that it is likely to be successful in chasing and bringing back a ball that is thrown in the house, but it might expect the other dog to be successful when out for a walk, and not even compete for the ball.

Interpreting the development of social interactions in these terms helps to explain the apparent presence of a hierarchy in stable breeding groups, but the lack of any hierarchy in groups that are more subject to change, or where individuals are introduced in adulthood. Where puppies develop in social contact with the mature members of their “pack,” they are likely to learn consistently that competition with adults is unsuccessful, and that avoidance or appeasement successfully avoids conflict and means that they are tolerated and more likely to access resources. These behaviors are, therefore, likely to persist in the younger animals as they develop into adulthood, maintaining the “dominance relationship” between the older and younger animals, unless environmental circumstances lead to one or another member of the dyad learning an alternative outcome for their interactions. However, where adult animals meet for the first time, they have no expectations of the behavior of the other: they will both, therefore, be initially anxious and vigilant in this encounter (characterized by the tense body posture and sudden movements typically seen when 2 dogs first meet), until they start to be able to predict the responses of the other individual. The outcome of these early adult–adult interactions will be influenced by the specific factors present at the time of the initial encounters. As well as contextual and physiological factors, the previous experiences of each member of the dyad of other dogs will also influence their behavior. Let us

imagine, for example, a neutered male Afghan hound (AH) and a neutered male Jack Russell terrier (JRT). Although the 2 dogs have not met before, each will use information learned previously in similar encounters in deriving their behavioral response to the situation. The AH, for example, may have previously encountered a small, white male dog that responded to it with aggression. Because of the similar cues in this encounter, its anxiety would increase, and it would try to identify any other cues predictive of potential aggression. The JRT may have learned to be anxious about all large dogs that show a tense body posture, because it has learned that this posture predicts aggressive behavior. Because of previous learning experiences in other situations, therefore, the risk of aggression occurring in this encounter is relatively high, whereas if the same 2 dogs had met without any previous negative experiences, the outcome of the interaction would more likely be a friendly one. Using this learning-based model, therefore, explains the complexities of social interaction with no need to invoke the concept of “dominance,” either as a goal or as an element in an overall hierarchical structure.

Interactions between dogs and owners

Many authors also use the concept of “dominance” to describe aggression toward owners, particularly where this behavior occurs over a valued resource (Landsberg et al., 2003, p. 422; Houpt, 2006). However, since other models appear to provide better explanations for the complexity of social relationships between dogs, there is no reason to suppose that “trying to achieve status” is characteristic of dog–human interactions either. In fact, the patterns of interactions between dogs and owners appear to fit better into the model where prior experience and context are the major determinants of subsequent response. Hence, where a dog is anxious about the approach of an owner in a particular context (perhaps because the owner has previously forced the dog into an “alpha roll”), it may show appeasement, avoidance, or aggression to avoid the perceived threat. Since the first 2 are unsuccessful when owners persist in approaching and pulling their pet out from its hiding place, and the latter is successful, even if only momentarily, it is the aggressive response that is reinforced. Over subsequent encounters, if this response is consistently successful, the dog will become more confident in showing this behavior in that specific context. Similar associations can be used to explain how behavior that originates as defensive can metamorphose into the type of offensive behavior that is commonly categorized as “dominant.”

Conclusion

The term “dominance” has been applied in so many contexts, and so widely misused in writings on dog

behavior, that it is opportune to examine whether there are alternative, more parsimonious explanations for why dogs sometimes display aggression. The analogies drawn between the social behavior of dogs and that of their ancestral species, the wolf, appear to refer to a model of wolf sociality that has now been disputed for over 30 years. Moreover, when dogs are able express their social and sexual behavior with minimal interference from man, there is no evidence that they adopt a wolf-type social structure based around a single breeding pair; instead, females mate with multiple males and only subsequently form pair bonds within family groups, similar to the ancestral canid pattern. Neutering appears to disrupt sociality further still, to the point where hierarchies may no longer be discernable. It is therefore doubtful whether the concept of “dominance” can make any useful contribution to explaining dog–dog aggression, and it is therefore even less likely to be applicable to aggression directed at humans, given the added complexities of interspecies communication.

Although RHP has provided an effective alternative to dominance in accounting for the outcome of agonistic interactions in many species, it relies on competing animals being able to make accurate estimates of each others’ fighting abilities, which many domestic dogs seem unable to do. Instead of evoking hypothetical constructs such as “dominance” to explain canine aggression, it is simpler to use the well-established principles of associative learning, and the concept of V borrowed from the RHP model, to explain why individual dogs escalate aggression under some circumstances, and back down under others.

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