

Sense and nonsense of dominance relationships and hierarchy:

**A closer look on behaviour and social organization structures in domestic
dogs (*Canis lupus familiaris*).**

Author: K.A. Vrolijk (3275094)
1st Supervisor: Dr. C.M. Vinke
2nd Supervisor: Dr. M.J.H.M. Duchateau
Concerns: Master Thesis
Study: Environmental Biology – Behavioural Ecology
Utrecht University, March 2011



Universiteit Utrecht

Index

Abstract 2

Introduction..... 3

Social organizations and social dynamics..... 5

The development and establishment of dominance group structures 6

The use of wolf-pack models..... 12

Humans and dogs 14

Conclusion 17

References..... 19

Abstract

In this paper a closer look is taken on the concept of dominance and hierarchy in domestic dogs with five statements derived from the paper of Bradshaw and colleagues' (2009) as guiding directories for discussion: 1) dominance is based on associative learning, 2) aggression as criteria in dominance relationships, 3) the usability of (captive) pack-theories as found in captive wolf and 4) free ranging dogs for the interpretation of domestic dog behaviour and 5) finally human-dog interactions: how is the domestic dog positioned in the human household?

It is concluded that dominance cannot be purely based on associative learning for two reasons: evidence is available that heredity plays a role as well and it is not in line with the results from and knowledge of nature-nurture research to attribute behaviour purely to associative learning. Furthermore, aggression patterns appear no reliable criteria for dominance relationships; on the contrary submissive behaviours and formal dominance appears a better criteria since these provide unidirectional and linear hierarchies. Similarities between behaviours in wolf and feral dog-packs are found whereby captive wolf pack models appear to be more suitable than situations in which restrictive competitive conditions are present. Unwanted behaviours in household seem to overshadow a variety of causes and the attitude of the domestic dog has changed over time. Domestic dogs appear to be adapted to human in a certain way (e.g. affective if socialized well on humans, more alert on humans and human behaviour in a visual way as compared to wolves), what makes dogs such suitable companions. Nevertheless, it seems doubtful that essential ethological priorities and basic species specific motivations has been adapted by artificial selection in domestication processes, neither should these species specific characteristics be faded away by operant conditioning later in life. Many topics should be carefully studied and discussed in more detail before a repeatedly predictive and proofed model on hierarchy and dominance can be shifted to the past. Thus far, we advocate to be careful and never throw away the child with the bath water.

Keywords

Dominance, Aggression, Hierarchy, Domestic dog, Associative Learning, Behaviour

Introduction

From an evolutionary perspective, living in social groups induces many benefits for an individual and the survival of the species, either on the short or the long term. Benefits of the social structure that are often mentioned in the literature are e.g. 1) anti-predator effects like dilution and confusion effects, meaning that group organized individuals have a smaller chance on being caught by a predator. This phenomenon, for example, can be observed in whirligig beetles (*Gyrinus spp.*)(Watt and Chapman, 1998), leopard geckos (*Eublepharis macularius*) and marmosets (*Callithrix jacchus*)(Schradin, 2000). Other examples are the selfish herd: in guppies (*Poecilia reticulata*) the cohesion is greatest in streams that have the most predators (Seghers, 1974) and vigilance: Arabian babblers (*Turdoides squamiceps*) give alarm calls that warn their group mates of the presence of a predator (Clutton-Brock et al., 1999); 2) more efficient exploitation of food resources: e.g. a lot of animals resting in groups can serve as a information center about patches of food (Ward and Zahavi, 1973), animals living in groups can provide bigger preys, as seen in orb-weaving spiders (*Metepeira incrassata*)(Uetz, 2001) and the efficiency of lions hunting springbok (*Antidorcas marsupialis*)(Stander, 1992) and 3) more efficient territory defense: e.g. in pied wagtails (*Motacilla alba*) a territory holder will accept another bird that helps to defend the territory when within species intruder pressure becomes high (Davies and Houston, 1981). On the other hand, disadvantages of living in social groups can be mentioned as well. Living in a social structure, individuals have to share highly valued and sometimes scarce environmental resources, e.g. food, shelter and mating partners (Pusey, 2008). This may cause highly competitive situations or moments between individual group members which can result into fierce conflicts and may even result into the death of some members (as happened to chimpanzee Luit in Arnhem Zoo, described by Frans de Waal, 1986). Situations that can compromise the social group harmony and may finally compromise the evolutionary benefits of living in groups. In order to prevent serious instability and fierce conflicts, social species are clearly organized in some way, e.g. dominance hierarchies, harem structures, either matriarchal or patriarchal organized. These are called social structures or social organizations. With dominance, a relationship between two animals (A being dominant over B) that is fundamentally asymmetrical is implied (van Hooff, 1987). In order to communicate the social organization and to prevent conflicts, social species have

often highly advanced communication signals, show ritualized patterns and displays, and have clear postures and facial expression as further described in chapter two. The dominance hierarchy is elaborately described in the literature for many animal species such as birds; e.g. in hens (Perrin, 1955); blue footed boobies (Valderrábano-Ibarra et al., 2007), fish (Sloman, 2007), insects; e.g. in bumble bees (Foster et al., 2004) and mammals; e.g. elephants (Wittemyer and Getz, 2007) and domestic horses (Curry et al., 2007).

Recently the usability of the wolf pack-theory on domestic dogs (*Canis lupus familiaris*) was discussed by Bradshaw et al. (2009). The wolf pack-theory is a popular perspective on the social behaviour of dogs in multiple-dog households and sees the dogs' behaviour as reflecting the sociobiological laws of the rigidly structured dominance hierarchy that has been described for wolf packs (van Kerkhove, 2004). Among others, Bradshaw and colleagues discussed topics on the improper use of the word dominance as a description of an individual animal and the importance of aggressive patterns in the establishment of dominance relationships. They finally concluded in their paper that 'the development of stable relationships between individuals can be entirely explained using the principles of associative learning theory'.

The aim of the present literature study is to give a critical overview of the present scientific literature on social organization structures in some mammal species, chimpanzees (*Pan troglodytes*), macaque (*Macaca*) and wolves (*Canis lupus*). Two primate species are selected due to the availability of studies on social dynamics: the changes in composition in social groups (Sjöppa et al., 2008)) and group organization, which form the fundamentals on the many theories of social organization. Wolves are selected because of their ancestral relationship to the domestic dog (Sherman et al., 1996) where this paper finally wants to pinpoint on in order to give some further insight into the arguments (pro or against) of the theories as proposed by Bradshaw and colleagues (2009).

This paper will specifically address five specific discussion points gained from the paper of Bradshaw et al. (2009): 1) dominance based on associative learning: can hierarchies in dogs and other species, like chimpanzees and macaques, be purely based on associative learning, as argued by Bradshaw and colleagues (2009) or are other mechanisms involved? 2) The establishment and maintenance of relationships and hierarchies: is the use of aggression the regular way to establish and maintain dominance relationships? 3) Are the (captive) pack-theories as found in captive wolf and 4) free ranging dogs useful for the interpretation of

domestic dog behaviour? and finally 5) human-dog interactions: What is the position of a dog in a human household? The subsequent themes will be discussed below. We start with a general introduction on social organization and a description of some theoretical models for dominance relationships.

Social organizations and social dynamics

Different models are proposed and described in the literature to show the distribution of dominance relationships within social groupings. Most simple is the linear hierarchy model in which an alpha individual dominates all other members; beta dominates every other individual except alpha, and so on. This model was first described by Schjelderup-Ebbe for hens and referred to as 'pecking order' (Perrin, 1955). This hierarchy is found in other bird species as well, e.g. blue footed boobies (*Sula nebouxi*) (Valderrábano-Ibarra et al., 2007). Another possibility is a sex/age graded hierarchy in which age and sex are defining for the rank order as known in wolves (Packard, 2003). In family based groups, several relationships can exist, which is also found in captive wolf packs (Packard, 2003).

In chimpanzees, the average social group consists of four to six adult males, approximately ten adult females, their infants and juveniles. Typically these groups include nearly no juvenile males (Itani and Suzuki, 1976). The bonds in the group are loose and dispersion rate is high (Itani and Suzuki, 1976). When looking at what type of social organization fits chimpanzee groups, it can be concluded that the sex/age graded hierarchy fits best, since little association between sexes is found, compared to association and aggression within the sexes (de Waal, 1986a). Like chimpanzees, macaques also live in multi male groups with several females. Research in Sulawesi Crested Black Macaque (*Macaca nigra*) showed a linear and transitive dominance hierarchy among the six males in the investigated group (Reed et al., 1997). They described that this type of social organization is similar to those found in multi-male groups in other macaque species rather than the egalitarian social organization of female Sulawesi macaques (Reed et al., 1997). So like chimpanzees, for macaques a sex/age graded hierarchy seems suitable to describe the social organization.

In the wild, wolves the social unit mainly consists of a breeding pair and the collected offspring. Normally all of the offspring disperses in 10-54 months after birth (Mech and

Boitani, 2003). According to Fox (1980) and Zimen (1981) who performed one of the first studies on the social organization on canidae in a captive wolf pack, one male is the leader of the group. They described that it doesn't lead autocratic, but he is the decision maker of the pack. The other wolves respond to him submissively. They explained that this behaviour helps the group cohesion (Fox, 1980; Zimen, 1981), wherein subsequently, a stable relationship can develop. In later studies on wolves, three different models were hypothesized and proposed to describe the social structure, namely 1) the linear, 2) sex/age graded hierarchies and 3) a family relationships model (Packard, 2003). Typically, the sex/age graded hierarchy model assumed older individuals to dominate younger within the sex and generally males dominating females (Packard, 2003). Packard launched these models because of the continuously changing of the environment and individual change; in these circumstances it is hard to imagine that all wolf packs completely fit a pure linear dominance model (in which one alpha dominates all others). Apparently social groups may not stable forever, since there are several factors that can cause changes in a group. A commonly known process is natal philopatry, which means that the offspring remains in the social unit, as described for vertebrates (Ebensperger and Hayes, 2008). Next to natal philopatry other processes may influence group composition, like dispersal, emigration of the formation of new groups by multiple individuals of a previous group (Seppä et al., 2008). Also mortality, for example caused by predation or disease, influences group composition as demonstrated for naked mole-rats (Clarke and Faulkes, 1997).

These changes of composition of social groups are called social dynamics. Social dynamics involves the origination and subsequent variation in size and composition of social groups. In wolves, the average pack remains together for 3-4 years up to max 8 yrs (Mech and Merrill, 1998), which indicate on considerable dynamics in wild wolf populations.

The development and establishment of dominance group structures

In this chapter, a closer look will be taken to dominance hierarchies based on associative learning and aggression as a tool to establish and remain dominance hierarchies, as proposed by Bradshaw and colleagues (2009).

Relationships and hierarchies within a group of animals, on the whole, are based on dominance encounters (de Waal, 1986a). An individual in a group will thereby gain a dominance rank and "knows" its place in the hierarchy. Different factors may play a role in

dominance rank. Next to sex and age, individual temperament and “personality”, either sculptured by both heritability and environment, can also play a role in how *dominant* an individual may behave. So according to the statement of Bradshaw et al. (2009), dominance refers to a relationship between two or more individuals, not to a characteristic of an animal. Also, next to sex and age, derivation can play a role in gaining a specific dominance rank. For example, in macaque dominance rank is partly determined by the rank of the mother. This means that when the mother individual has a high rank, her offspring will gain high rank as well (Bernstein et al., 1979). In a debate about the heritability of dominance in social species it was found that not dominance, but the predisposition of each individual to escalate or reduce conflict in specific social contexts, is heritable (Appleby, 1993; Barrette, 1993). So a humble mood or temperament is associated with a low probability of conflict escalation in a specific interaction, in contrast to a confident mood, which is associated with a high probability of escalation (Packard, 2003).

Changes in ‘personality’ can be found as well, e.g. a result of a fight and as found in captive wolves, assertiveness changes with age, reproductive state, nutritional condition, traumatic experiences and resource contexts (Zimen, 1975). Herewith, one sees genotype and phenotype go hand in hand. This shows that associative learning alone, as proposed by Bradshaw and colleagues (2009), is not likely to cover for all the communicative behaviour patterns shown by animals. To establish relationships and dominance rank, encounters and communication between the individuals are needed developed within the fundamentals of profitable heritable characteristics of the individual personality.

Citing Frans de Waal (1986a), ‘most definitions of dominance are in terms of winning or losing in a conflict, pecking or being pecked, taking or relinquishing possession, approach or retreat and so on. The definitions concern the outcome of competitive encounters rather than the exchange of communication signals between dominants and subordinates and to be context dependent. Their communication, however, is usually more stable over time and more predictable than the outcomes’, as reported for Java monkeys (*Macaca fascicularis*) (Angst, 1975); de Waal (1977) and also for goose families. In goose families (*Anser anser L.*) it was shown that a few days after hatching a stable hierarchy was formed, thereby aggression became extremely rare and rank order was expressed by greeting behaviour (Kalas, 1977). In wolves, Harrington and Asa (2003) described the function of communication between wolves to signals that will enhance the fitness of both sender and receiver. This function

expects aggression to be very low. Communication signals are the tools to establish clear relationships and rank in the so called *formal dominance*. The concept of formal dominance seems to explain the establishment of hierarchies better than the presence and performance of aggression on which Bradshaw et al. (2009) based the absence of any hierarchy in captive wolf packs or domesticated dogs. Theories on formal dominance were first launched by Waal (1986a) in humans, which he popularly described as: 'subordinates will say and do things to make the boss feel important and dominant individuals will occasionally make concessions and show that they care about their subordinates, e. g. by remembering their birthdays'. The formal dominance carry along many communication signals, facial expressions and ritualized body postures that have been developed in all kinds of different social animal species like pigs (Stukenborg et al., 2011), goats (Aschwanden et al., 2009), and sea lions (Fernández-Juricic and Cassini, 2007). Agonistic behavioural patterns serve to communicate with an opponent while preventing any encounter to escalate, as described by Cafazzo and colleagues (2010). It is well known in nonhuman primates that hierarchical organization among members of a social group may limit the costs of aggression by limiting interactions to ritualized dominance displays as opposed to threats and physical contact (Rowell, 1974; Bernstein, 1981; Archer, 1988). In rhesus monkeys facial expression are observed that seems to be unidirectional (teeth-baring): when animal A bared teeth directed to animal B, animal B never directed teeth baring to animal A. De Waal (1986a) found that the hierarchy based on teeth-baring approached perfect linearity, which is not the case for other dominant measures, such as the direction of aggressive encounters.

In the paper of Bradshaw et al. (2009) the concept of formal dominance is not mentioned and only aggressive outcomes of interactions are used as measurements for dominance. Here the question rises why Bradshaw and colleagues did not use the formal dominance and only launch the occurrence of aggression as the utmost measure for dominance? The choice for this measure may be even more surprising considering the fact that aggression, seen from the evolutionary perspective, is exactly the behaviour pattern that should be prevented to guarantee the successful survival of the group/species. This taken together with the findings of de Waal (1986a) argues the question whether aggression is a good and fitting criterion for the establishment of any hierarchy among social animal species.

Many canidae expressions are described to prevent aggression. Rudolf Schenkel (1946) studied expressions in wolves. He found several postures that correspond to several social situations. In wolves, the head is the most expressive center; 'The interaction of the coloring of the face and the function of the facial muscles and, also, the activity of eyes, ears and nose makes the snout, lips, eyes, forehead and ears the bearers of extremely important and variable expression phenomena' (Schenkel, 1946). For example in wolves, threat or defense is characterized by baring of the teeth, accompanied by the corners of the mouth pulled back (Schenkel, 1946). Fox (1969) described the postnatal development of agonistic behaviour patterns in the wolf, coyote and grey fox. In red and Arctic fox these behaviours are first observed at later age. Piloerection and back arching were present in all species, the latter behaviour being especially well developed in the grey fox. The orientation of attack was almost exclusively directed at the cheek in the grey fox, but in other canids the shoulder hackle area, throat and muzzle area were also attacked; prolonged bouts of jaw-muzzle wrestling occurred in the wolf, scruff-wrestling in wolf and coyote and dog, and cheek-wrestling in the grey fox during agonistic play (play-fighting). Orientation of attack was correlated with distinctive body markings in various species. The contribution of social experience in the ontogeny of scruff-oriented attack was demonstrated in hand-raised isolated dogs and visually deprived group-raised dogs. The significance of head-turning, looking away and avoidance of eye contact in wolves and dogs is discussed and showed agonistic behaviours in these canidae present a big overlap. (Fox, 1969)

The same behavioural patterns and postures are also used in more recent researches in domestic dogs, for example by Cafazzo et al. (2010). They described agonistic behaviour (including aggressive, dominance, and submissive behaviour), as observed by an all occurrence sampling method, in free ranging dogs. Aggressive behaviour included threats (threatening posture: pointing, staring at, curling of the lips, baring of the canines, raising the hackles, snarling, growling, and barking), chasing, physical fighting, and biting. Dominance behaviour included upright and stiff body posture with the head and tail held high and the ears pricked, putting the muzzle or a paw on a conspecific's back, and wagging with the tail held high. Submissive behavioural patterns, which are usually displayed in response to a threat, included: avoiding eye contact, holding the head down, flattening ears, holding the tail down or tightly between the hind legs and against the belly, cringing, laying down on the back exposing the ventral side of the chest and sometimes the abdomen,

avoiding, and retreating. Submissive–affiliative behaviour, called by Schenkel (1967) *active submissions*, includes both submissive and affiliative elements: The posture is slightly crouched, the ears are flattened, and the tail is down and wagging; the muzzle of the dog who receives a display of submissive–affiliative behaviour is licked with fast movements. These behaviours are supported by Feddersen-Petersen (2004) in their studies on communication in wolves and domestic dogs. These dominant and submissive behaviour patterns show a big amount of ritualization and phasing, from threats to biting. These behaviours suggest preventing from escalating of an encounter and thus of aggression. This is supported by previous findings in non-human primates (Rowell, 1974; Bernstein, 1981; Archer, 1988).

Referring to the questions of this chapter whether aggression is the regular way to establish and maintain dominance relationships and whether dominance is based on purely associative learning, to following can be concluded: the statement by Bradshaw et al. (2009) that the developments of stable relationships between individuals can be entirely explained using the principles of associative learning, appears implausible in scope of aforementioned reasoning and findings.

All agonistic behaviours are more or less identical in canidae; it is highly doubtful to attribute these similarities to coincidence. Moreover, since the nature and nurture discussion, it generally accepted that factors of heredity and environmental experiences are highly intermingled (Plomin et al., 1997; Meaney, 2001): for all behaviours some sort of blueprint, as in a genetic predisposition, has to be present. This in combination with associative learning forms the basis of the behaviour development of all individuals.

Goodwin and colleagues (1997) researched the effects of heritability processes on the signaling ability, the number of ancestral dominant and submissive behaviour patterns used, of 10 dog breeds selected for their degree of physical dissimilarity to the wolf. The number of ancestral dominant and submissive behavioural patterns used during signaling within single-breed groups ranged from two (Cavalier King Charles spaniel) to 15 (Siberian husky), and this correlated positively with the degree to which the breed physically resembles the wolf, as assessed by a panel of 14 dog behaviour counselors (Goodwin et al., 1997). More evidence for a heritable factor comes from comparative studies on wolves and poodles, performed by Erik Zimen (1971). Here it was found that models of behaviour of adult poodles are comparative to that of behaviour models of young wolves. These findings are

attributed to the fact that domestic dogs like poodles are generally less fearful and less aggressive and tend not to mind invasions of personal space as much as wolves do (Zimen, 1971).

Aforementioned elucidation also calls aggression as the right measurement of dominance, like described by Bradshaw et al. (2009) into question. Submissive behaviours rather than aggression are considered better indicators of a dominance relationship (Rowell 1966; Rowell 1974). This is supported by the findings in a recent study of Cafazzo and colleagues (2010) on free-ranging domestic dogs, where it was found that hierarchy based on aggressive interactions showed a lack of linearity, whereas a similar hierarchy based on submissive behaviours and dominance behaviours was found in absence of resource competition. In the presence of food, submissive behaviour again showed the best parameter of a dominance hierarchy. This was also the case in the presence of receptive females. Hence, in each context submissive behaviour turned out to be the best dominance measure due to the highest linearity and directional consistency index (measuring of unidirectional consistency of behaviour) (Cafazzo et al., 2010). Next to that, it is important to take formal dominance in consideration when looking at the formation of dominance hierarchies. Formal dominance as a communication mechanism includes the expressions and fixed body postures. Seen from evolutionary perspective, these behavioural patterns and postures observed specifically function as prevention of escalation of an encounter. This means that they prevent from aggression to occur. This in turn, prevents from damaging the individuals and waste of energy, which is in the good of the survival of the species. It is illogical, therefore, that the occurrence of aggressive patterns would say something on rank formation in the social organization. At best it might say something in the level of stability or instability in the social organization.

Conclusively it can be said that associative learning plays a role in establishment of relationships but it appears plausible that this is always in connection with the genetic dispositions, the species specific behaviour plasticity and individual personality of an animal. Also, submissive behaviour and postures seem more likely standards, or criteria, for dominance relationships and hierarchies, whereas aggression as a measurement for dominance hierarchies seems discussable from a proximate as well as ultimate perspective.

The use of wolf-pack models

Our domestic dog as kept nowadays is descended from the wolf and therefore it is often assumed that the social relations and communication are similar to that of wolves (Sherman et al., 1996). Bradshaw et al. (2009) discuss the unsuitability of wolf-pack models on domestic dogs because these models are based on captive wolf-packs and might be misleading. The reason to launch this possible unsuitability is that the wolf packs of many of the early studies, used to compose these models, were composed from unrelated animals and therefore aggression might have been more commonly seen than expected if a strict dominance hierarchy was in existence (Zimen, 1975). Another explanation is that the increased aggression might be due to the absence of the possibility for the animals to disperse. So, it is possible that when these packs were composed of related animals or when the packs were smaller the observed aggression would have been less as well. According to Bradshaw and colleagues, therefore, it is questionable whether the arguments on the unsuitability of captive wolf pack-theories are justified, or if captive wolf packs can be used as models for wolf packs under several natural pressures as food-, sexual partner-, and shelter competition. However, it can be possible and plausible that there is a continuum in dominance and aggression in captive wolves. This means that when competition increases, the relevance to gain dominance increases as well. With the acquisition or establishment of dominance in relationships, the chance of increased aggression is also increased. Aggression will only, although rarely, occur when competition over resources is present (Schenkel 1967; Zimen 1975). It is logical that when wolves are kept in a small area, these circumstances appear more often. It is assumable that the same behaviours are recorded when resources become scarce in the wild. This is described for wolf for example during the breeding season and when social and food competition is high (Mech and Boitani, 2003).

In order to provide a better fit to dominance hierarchies in domestic dogs, since much of the aggressive behaviour observed in earlier studies seemed to arise from disputes over territory and access to sexual partners (Bradshaw et al., 2009), they performed an experiment with neutered male dogs. The relationships of the 19 neutered male domestic dogs were observed in a 0.28 ha enclosure. The results of this experiment showed no significant overall hierarchy. So it was concluded that the found pattern of relationships did not fit the wolf pack-model, which should be a pyramidal hierarchy with clear alpha and beta individuals. In this experiment neutered dogs were used, because according to Bradshaw and colleagues

(2009) aggression between dogs is not restricted to sexually entire individuals. They therefore argued that 'wolf pack dominance structures would also have to apply to neutered dogs to explain dog-dog aggression within households' (Bradshaw et al., 2009). Despite these arguments, their choice for neutered animals (breed not mentioned) seems a weak point in their design. Firstly these animals never can serve as a suitable model for a wild dog or wolf population since neutered animals are not present in wild-situations. Secondly, neutering can have effects on (particularly aggressive) behaviour, as previously described e.g. for dogs (Beaver, 1983) and ferrets (Baum, 1976; Schoemaker, 2007).

Thirdly, it is doubtful whether conclusions can be drawn of a group of animals that only exist of male individuals. As described by Packard (2003) wolf packs normally exist of a breeding pair and the dependent offspring, but never of only male individuals. It can be expected that tensions and competition are high in such an unnatural composition and stable relationships will be hard to preserve. In this study 19 adult individuals are used which is also not comparable to a natural situation: normally packs are described of 2 up to an average of 7 to 8 animals per pack (Packard, 2003). Out of this experiment no clear dominance hierarchies could be distinguished, but due to the aforementioned facts it is highly disputable whether these results are representative and useful as well compared to the classic wolf pack studies to explain the social organization in domestic dogs in households. Also questionable in this experiment is the fact that no attention is paid to body postures and facial expressions. In other words formal dominance seems unconsidered.

Nevertheless, recent studies in semi-wild wolves (for example in conservation parks) and studies on semi-wild dogs/free-ranging dogs (India/South Europe) (Cafazzo et al., 2010; Pal, 2008) may give a better insight on dominance hierarchies. Cafazzo et al. (2010) investigated dominance in relation to age, sex and competitive context in free ranging dogs in the suburbs of Rome, Italy. The animals in this study were free ranging domestic dogs which were not socialized to humans and therefore were able to move and bred freely. Results of this study showed older animals dominated younger animals and males dominated females. Also the agonistic rank was positively correlated with the amount of aggression showed by the dogs in each context. Nevertheless, the alpha male was not the most aggressive dog, except in the presence of receptive females (Cafazzo et al., 2010). These relations are similar to those found in wolf pack observations described in Mech and Boitani's 'Wolves' (2003). Whereby is described that wolves show a linear dominance order within each sex and that

this order is largely structured by age. This implicates a sex/age graded hierarchy as proposed for wolves before by Packard (2003) earlier in this paper.

Conclusively, Bradshaw and colleagues (2009) discussed the traditional wolf pack theories and their relevance for explaining domestic dog behaviour. Though the question whether the translation of wolves' social organizations are suitable for our domestic dogs is an interesting one, it appears that it is too early to draw sound conclusions to throw out classic theories on these forms of social organization for several reasons. Moreover, recent studies showed there are certainly some similarities between wolf and feral dog packs. This means that the observations gained from captive wolf packs are not completely useless, as long as they are placed in the right context. These studies also show dominance hierarchies based on submissive behaviour.

Humans and dogs

In this chapter, the last discussion point is addressed considering the fact that many authors use the concept of 'dominance' to describe aggression from dogs toward owners (Bradshaw et al., 2009). But what is the actual position of dogs in our household and how should we communicate with them in order to provide a peaceful living area for both humans and dogs?

For a long time in the history human-animal relationships are known. The social companion humans do interact a lot with is the domestic dog, *Canis lupus familiaris*. The attitude towards dogs has changed over time. In the beginning dogs were used to help herding the sheep, hunting and sled pulling (Udell and Wynne, 2008). In line with different purposes specific characteristics in behaviour and phylogeny in different dogs, artificial breeding by humans eventually resulted in the hundreds of pedigrees that exist today (Udell and Wynne, 2008). Because of the intensive domestication process, the relationship with our animals has changed as well (Topál et al., 2005). To understand the significance of domestication-related changes in the behaviour of our dogs, an experiment was designed by Topál and colleagues (2005). The aim of the study was to investigate the attachment of domestic dogs and wolves to humans. The experiment showed clear domestication influences on attachment behaviour of dogs to people. A significant difference was found between domestic dogs and wolves in which the dogs showed clear attachment behaviour to humans (Topál et al., 2005),

unlike wolves. This was shown by the results of comparisons of greeting behaviour toward the owner and a strange human being. Whereby the dogs showed significantly more greeting behaviour to their owner than to a stranger.

Due to these changes it can be questioned how dogs are positioned in the social human structure: are they part of the *human* pack? And to what extent do they communicate in the *human way* adapted to humans, or do they only communicate in their own communication signs and postures, but how do they interpret humans than?

Bradshaw et al. (2009) described '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' and they argued that the occurrence of aggression from dogs towards owners may also be explained by the means of associative learning. For the latter explanation, they take anxiety as an example for the description of an aggressive behaviour performed on the basics of associative learning, since this behaviour is the most successful for the animal to gain what it wanted: distance from the owner. Again it looks like Bradshaw and colleagues contribute aggression to the performance of dominance in dog behaviour, however, earlier in this paper it has become clear that aggression is not a good criterion for determination of dominance (Rowell, 1974; Bernstein, 1981; de Waal, 1986a; Archer, 1988). Additionally, aggression in animals can have lots of causes different to dominance like territorial aggression, maternal aggression, predatory aggression, and pain aggression may induced by many medical causes e.g. endocrine disorders, infectious diseases, brain tumors, hepatic encephalopathy, hyperkinesia, psychomotor epilepsy, congenital defects, and inherited conditions such as Springer rage and copper storage diseases (Landsberg, 1990; Landsberg et al., 2004). So before aggression shown by the dog is contributed to a behaviour problem, dominance or associative learning related, a clear analysis is needed before any diagnose is proposed.

On the other hand, a closer look can be taken to the situation in many households. The dogs we keep as companion animal literally become part of the family. In some cases, people speak of feelings for their animal that can be compared to feelings for an own child. Thereby they start treating their animal as a human being and attribute human characteristics to them as well, for example being 'guilty' after performing unwanted behaviour (Horowitz, 2009). This is called anthropomorphism. In this situation, even more when actual children

are involved as well; the dog will have no clear insight in its boundaries of acceptable versus unacceptable behaviour. This will cause situations in which the dog is allowed to show a particular behaviour in one situation, but is punished for the behaviour in another situation (for example sitting on the couch with and without visitors in the house). An instable situation and from the animal's perspective, an uncontrollable and unpredictable situation, in which the animal may learn that aggressive acts might be successful to cope with the situation (i.e. operant conditioning as proposed by Bradshaw) or may choose to defend itself: fear aggression which can finally increase by operant conditioning as well.

How should we see our dog in the household 'pack'? In the domestication process from wolf to domestic dog, some characteristics have developed. Miklósi and colleagues (2003) found out that dogs actually look at people, something wolves will not do. Next to looking at people, the domestication process also made dogs able to read and follow hand gestures, where wolves need intensive training to be able to do this (Virányi et al., 2008).

Although dogs seem to have adapted to living with humans it is unlikely that fundamental motivations stayed unchanged. This can be expected since pigs still have the urge to grub, also known as 'oral needs' (foraging with nose through the soil) (Scipioni et al., 2009) and chickens still like to perform dust bathes, even the substrate is not present (Olsson et al., 2002). This raises the expectation that behaviours that attribute to the survival of an individual, and eventually of the species, can not be out selected by artificial breeding managed by humans. For dogs this means that the communication characteristics from the species and relative species stay unchanged. So by the domestication process one was able to 'add' some communication signals to the behaviour of the domestic dog, but the basis behaviour patterns as used in wolves, coyote's, foxes and domestic dogs remained as well.

Conclusively one could say; dogs look with some adaptations in canide-language to humans and we humans look with some adaptations in our human-language and communication to dogs, but with genetic predisposed rank conditions and behavioural plasticity as its boundaries.

Conclusion

In this paper four discussion points gained from the paper from Bradshaw et al. (2009) are discussed. In their article they discuss topics on proper use of the word dominance as a description of an individual animal and the importance of aggressive patterns in the establishment of dominance relationships. Finally they conclude that the development of stable relationships between individuals can be entirely explained using the principles of associative learning theory (Bradshaw et al., 2009). The four discussion points discussed in the present paper are: 1) dominance based on associative learning, 2) the establishment and maintenance of relationships and hierarchies, 3) the usability of wolf pack-theory and 4) studies on feral dogs to explain behaviour of domestic dogs and 5) human-dog interactions.

Referring to the first topic, the main conclusions are that 1) in several studies was formal dominance and submissive behaviours (Rowell, 1974; Bernstein, 1981; de Waal, 1986a; Archer, 1988) may serve as better criteria for dominance hierarchies than aggression, as proposed by Bradshaw and colleagues (2009). 2) Agonistic behavioural patterns with the same sort of expressions can be observed in all canidae, which makes it highly doubtful to attribute these similarities to coincidence and to associative learning, and 3) above all, it is not in line with generally expected nature-nurture facts and findings on heredity and environmental experiences, which are supposed highly intermingled (Meaney, 2001; Plomin et al., 1997). 4) Evidence for heredity in dog behaviour was found by Goodwin and colleagues (1997), who performed a dissimilarity test in domestic dogs compared to wolves, and also by Zimen (1971) who found that behaviour models of poodles are comparative of that from wolves.

5) Following Bradshaw et al. (2009), the models from the wolf pack-theory can be misleading when used on domestic dogs, because the packs these models are based on are not recorded in natural situations, i.e. captive wolf packs. But it is to be expected that more aggression is recorded as well in the wild when resources become scarce, thus more restrictive competitive conditions. Moreover, in a study on free ranging domestic dogs, similarities of relations between animals were found between these dogs and wolves (Cafazzo et al., 2010; Packard, 2003). So it seems models of captive wolf packs can provide a suitable pack-theory, only they represent situations in which competitive conditions are present.

6) At last the position of dogs in human households is discussed. Over time the attitude of dogs as our companion has changed. Where it was first used as a helper it now has become more or less part of the family. This causes a lot of confusions for the animal and brings along so called unwanted behaviour. Therefore, one needs to make clear for the animal what is and isn't aloud with the use of suitable language and communication.

Everything taken together, and spoken with the title of the first discussions on dominance by Bernstein the last word about dominance relationships in dogs and in dogs and humans is not said yet. Be careful; don't throw out the baby with the bathwater.

Acknowledgments

I am sincerely grateful to Dr. C.M. Vinke who read the earlier drafts of this paper and improved its quality and for her kind and generous help. Next I wish to thank Drs. J.A.M. van der Borg for her time and information and also for her help to improve the paper. Also I thank Dr. M.B.H. Schilder for his time to talk with me about the subject of the paper.

References

- Angst, W., 1975. Basic data and concepts in the social organization of *Macaca fascicularis*. In L. Rosenblum (ed.), *Primate Behavior*, Vol 4, p.325-388. Academic Press, New York.
- Archer, J., 1988. *The behavioural biology of aggression*. Cambridge (MA): Cambridge University Press.
- Appleby, M.C., 1993. How animals perceive a hierarchy: Reactions to Freeman et al. *Animal Behavior* 46: 1232-1233.
- Aschwanden, J., Gyax, L., Wechsler, B., Keil, N.M., 2009. Loose housing of small goats groups: Influence of visual cover and elevated levels on fleeing, resting and agonistic behaviour. *Applied Animal Behaviour Science* 119, 171-179.
- Barrette, C., 1993. The 'inheritance of dominance' or of an aptitude to dominate? *Animal Behavior* 46: 591-593.
- Bauer, E.B., Smuts, B.B., 2007. Cooperation and competition during dyadic play in domestic dogs, *Canis familiaris*. *Animal Behaviour* 73, 489-499.
- Baum, J.M., 1976. Effects of testosterone propionate administered perinatally on sexual behavior of female ferrets. *J. Comp. Physiol. Psychol.* 90, 399-410.
- Beaver, B.V., 1983. Clinical classification of canine aggression. *Appl. Anim. Ethol.* 10, 35-43.
- Bernstein, I.S., Bean, C.A., Chikazawa, D., Gordon, T.P., 1979. Mother-daughter dominance reversals in rhesus monkeys (*Macaca mulatta*). *Primates* 20, 301-305.
- Bernstein, I.S., 1981. Dominance: The baby and the bathwater. *Behavioral and Brain Sciences* 4: 419-147.
- van der Borg, J.A.M., Beerda, B., Ooms, M., Silveira de Souza, A., van Hagen, M., Kemp, B., 2010. Evaluation of behaviour testing for human directed aggression in dogs. *Applied Animal Behaviour Science* 128, 78-90.
- Bradshaw, J.W.S., Blackwell, E.J., Casey, R.A., 2009. Dominance in domestic dogs-useful construct of bad habit? *Journal of Veterinary Behaviour* 4, 135-144.
- Cafazzo, S., Valsecchi, P., Bonanni, R., Natobi, E., 2010. Dominance in relation to age, sex, and competitive contexts in a Group of free-ranging domestic dogs. *Behavioral Ecology*.

- Chase, I.D., 1980. Social process and hierarchy formation in small groups: a comparative perspective. *American Sociological Review*, Vol. 45, No. 6, 905-924.
- Clarke F.M., Faulkes C.G., 1997. Dominance and queen succession in captive colonies of the eusocial naked mole-rat, *Heterocephalus glaber*. *Proc Biol Sci.* 264: 993–1000.
- Clutton-Brock T.H., O’Riain, M.J., Brotherton, P.N.M., et al., 1999. Selfish sentinels in cooperative mammals. *Science* 284, 1640-1644.
- Curry, M.R., Eady, P.E., Mills, D.S., 2007. Reflections on mare behaviour: Social and sexual perspectives. *Journal of Veterinary Behavior* 2, 149-157.
- Davies, N.B., Houston, A.L., 1981. Owners and satellites: the economics of territory defence in the pied wagtail, *Motacilla alba*. *Journal of Animal Ecology* 50, 157-180.
- Ebensperger, L.A., Hayes, L.D., 2008. On the dynamics of rodent social groups. *Behavioural Processes* 79, 85-92.
- Feddersen-Petersen, D.U., 2004. Hunde-psychologie. Sozialverhalten und Wesen Emotionen und Individualität. ISBN: 3-440-09780-3.
- Fernández-Juricic, E., Cassini, M.H., 2007. Intra-sexual female agonistic behaviour of the South American sea lion (*Otaria flavescens*) in two colonies with different breeding substrates. *Acta Ethology* 10, 23-28.
- Foster R.L., Ameilia B., Verdirame D., O'Donnell, S., 2004. Reproductive physiology, dominance interactions, and division of labour among bumble bee workers. *Physiological Entomology* 29: 327-334.
- Fox, M.W., 1969. The anatomy of aggression and its ritualization in canidae: a developmental and comparative study. *Behaviour* Vol. 35, 242-258.
- Fox, M.W., Beck, A.M., Blackman, E., 1975. Behavior and ecology of a small group of urban dogs (*Canis Familiaris*). *Applied Animal Ethology* 1, 119-137.
- Fox, M.W., 1980. *The soul of the wolf*. Little, Brown, Boston.
- Goodwin, D., Bradshaw, J.W.S., Wickens, S.M., 1997. Paedomorphosis affects agonistic visual signals of domestic dogs. *Anim. Behav.* 53, 297-304.
- Harrington, F.H., Asa, C.S., 2003. Wolf communication. In: *Wolves, behaviour, ecology and conservation*. (Ed.), Mech, D., Boitani, L.
- van Hooff, J.A.R.A.M., Wensing, J.A.B., 1987. Dominance and its behavioral measures in a captive wolf pack. In: H. Frank (Ed.) *Man and wolf. Advances, issues and problems in captive wolf research*.

- Horowitz, A., 2009. Disambiguating the 'guilty look': Salient prompts to a familiar dog behaviour. *Behavioural Processes* 81, 447-452.
- Itani, J., Suzuki, A., 1967. The social unit of chimpanzees. *Primates* 8, 355-381.
- Kalas, S., 1977. Ontogenie und function der Rangordnung innerhalb einer Geschwister-schar von Grauganssen (*Anser anser L.*). *Z. Tierpsychol.* Vol. 45; 174-198.
- van Kerkhove, W., 2004. A fresh look at the wolf-pack theory of companion-animal dog social behavior. *Journal of Applied Animal Welfare Science* 7(4), 279-285.
- Landsberg G.M., 1990. Diagnosing dominance aggression. *Can. Vet. J.* Volume 31, 45-46.
- Landsberg, G., Hunthausen, W., Ackerman, L., 2004. *Handbook of behavior problems of the dog and cat.* 2nd ed. Elsevier Saunders, Edinburgh, p. 365.
- LeBrun, E.G., 2005. Who is the top dog in ant communities? Resources, parasitoids, and multiple competitive hierarchies. *Oecologia* 142, 643-652.
- Meaney, M.J., 2001. Nature, nurture, and the disunity of knowledge. *Annals of the New York Academy of Sciences* 935, 50–61.
- Mech, L.D. and Boitani, L., 2003. Wolf social ecology. In: *Wolves, behaviour, ecology and conservation.* (Ed.), Mech, D., Boitani, L.
- Mech, L.D., Merrill, S.B., 1998. Daily departure and return patterns of wolves, *Canis lupus*, form a den at 80° latitude. *Can. Field Nat.* 112: 515-517.
- Miklósi, A., Kubinyi, E., Topál, J., Gácsi, M., Virányi, Z., Csányi, V., 2003. A simple reason for a big difference: Wolves do not look back at humans, but dogs do. *Current biology*, Vol. 13, 763-766.
- Olsson, I.A.S., Keeling, L.J., Duncan, I.J.H., 2002. Why do hens sham dustbathe when they have litter? *Applied Animal Behaviour Science* 76, 53-64.
- Packard J.M., 2003. Wolf behaviour: reproductive, social and intelligent. In: *Wolves, behaviour, ecology and conservation.* (Ed.), Mech, D., Boitani, L.
- Pal, S.K., 2008. Maturation and development of social behaviour during early ontogeny in free-ranging dog puppies in West Bengal, India. *Applied Animal Behaviour Science* 111, 95-107.
- Perrin, P.G., 1955. 'Pecking order' 1927-54. *American Speech* Vol. 30 No. 4, 265-268.
- Plomin, R., Fulker, D.W., de Fries, J.C., 1997. Nature, Nurture and Cognitive Development from 1 to 16 years: A Parent-Offspring Adoption Study. *Psychological Science* 8: 442–447.

- Pusey, A.E., 2008. Social Systems. In: *The Behavior of Animals, Mechanisms, Function and Evolution*, pp. 322-323. Blackwell Publishing.
- Reed, C., O'Brien, T.G., Kinnaird, M.F., 1997. Male social behavior and dominance hierarchy in the Sulawesi crested black macaque (*Macaca nigra*). *International Journal of Primatology* Vol. 18, No. 2, 247-260.
- Rowell, T.E., 1966. Hierarchy and organization of a captive baboon group. *Animal Behavior* 22: 430-443.
- Rowell, T.E., 1974. The concept of social dominance. *Behavioral Biology* 11: 131-154.
- Schradin, C., 2000. Confusion effect in a reptilian and a primate predator. *Ethology* 106, 691-700.
- Schenkel, R., 1946. Expression studies on wolves: Captivity Observations. Of the Zoological Garden, Basle and the Zoological Institute of the University of Basle.
- Schenkel, R., 1967. Submission: its features and function in the wolf and dog. *Am. Zoologist* 7, 319-329.
- Schoemaker, N., Hawkins, M.G., 2007. Hyperadrenocorticism in ferrets: clinical updates. In: *Experience Providence*, 79-84.
- Scipioni, R., Martelli, G., Volpelli, L.A., 2009. Assessment of welfare in pigs. *Ital. J. Anim. Sci.* Vol. 8, 117-137.
- Seghers, B.H., 1974. Schooling behaviour in the guppy *Poecilia reticulata*: an evolutionary response to predation. *Evolution* 28, 486-489.
- Seppä, P., Fernández-Escudero, I., Gyllenstrand, N., Pamilo, P., 2008. Colony fission affects kinship in a social insect. *Behav Ecol Sociobiol* 62, 589-597.
- Sherman, C.K., Reisner, I.R., Taliaferro, L.A., Houpt, K.A., 1996. Characteristics, treatment, and outcome of 99 cases of aggression between dogs. *Applied Animal Behaviour Science* 47, 91-108.
- Sloman, K.A., 2007. Effects of trace metals on salmonid fish: the role of social hierarchies. *Applied Animal Behaviour Science* 104, 326-345.
- Stander, P.E., 1992. Cooperative hunting in lions: the role of the individual. *Behavioral Ecology and Sociobiology* 29, 445-454.
- Stukenborg, A., Traulsen, I., Puppe, B., Presuhn, U., Krieter, J., 2011. Agonistic behaviour after mixing in pigs under commercial farm conditions. *Applied Animal Behaviour Science* 129, 28-35.

- Topál, J., Gácsi, M., Miklósi, A., Virányi, Z., Kubinyi, E., Csányi, V., 2005. Attachment to humans: a comparative study on hand-reared wolves and differently socialized dog puppies. *Animal Behaviour* 70, 1367-1375.
- Udell, M.A.R., Wynne, C.D.L., 2008. A review of domestic dogs' (*Canis familiaris*) human-like behaviors: or why behavior analysts should stop worrying and love their dogs. *Journal of the experimental analysis of behavior* 89, 247-261.
- Uetz, G.W., 2001. Understanding the evolution of social behaviour in colonial web-building spiders. In: L.A. Dugatkin (ed.), *Model systems in behavioural ecology*, pp. 110-30. Princeton, NJ: Princeton University Press.
- Valderrábano-Ibarra, C., Brumon, I., Drummond, H., 2007. Development of a linear dominance hierarchy in nestling birds. *Animal Behaviour* 74, 1705-1714.
- Viranyi, Z., Gácsi, M., Kubinyi, E., Topál, J., Belényi, B., Ujfalussy, D., Miklósi, A., 2008. Comprehension of human pointing gestures in young human-reared wolves (*Canis lupus*) and dogs (*Canis familiaris*). *Animal Cognition* 11, 373-387.
- de Waal, F.B.M., 1977. The organization of agonistic relationships within two captive groups of Java monkeys (*Macaca fascicularis*). *Z. tierpsychol.*, 44: 225-282.
- de Waal, F.B.M., 1986. The brutal elimination of a rival among captive male chimpanzees. *Ethology and Sociobiology* 7: 237-251.
- de Waal, F.B.M., 1986a. The integration of dominance and social bonding in primates. *The Quarterly Review of Biology*, Vol. 61, No. 4, 459-479.
- Ward, P., Zahavi, A., 1973. The importance of certain assemblages of birds as "information centres" for food finding. *Ibis* 115, 517-534.
- Watt, P.J., Chapman, R., 1998. Whirligig beetle aggregations: what are the costs and the benefits? *Behavioural Ecology and Sociobiology* 42, 179-184.
- Wittemyer G., Getz, W.M., 2007. Hierarchical dominance structure and social organization in African elephants, *Loxodonta africana*. *Animal Behaviour* 73, 671-681.
- Zimen, E., 1971. *Wölfe und Königspudel. Vergleichende Verhaltensbeobachtungen*. ISBN 3-492-01921-8.
- Zimen, E. 1975. Social dynamics of the wolf pack. Pp. 336-362 in M. W. Fox, ed., *The wild canids: their systematics, behavioural ecology, and evolution*. Van Nostrand Reinhold, New York.
- Zimen, E. 1981. *The wolf: A species in danger*. Delacorte Press, New York.