



Contents lists available at ScienceDirect

## Journal of Veterinary Behavior

journal homepage: [www.journalvetbehavior.com](http://www.journalvetbehavior.com)

## Editorial

## Special issue: The “dominance” debate and improved behavioral measures—Articles from the 2014 CSF/FSF



In addition to our contributed research articles, this first issue of the New Year contains a dedicated “special issue” section of articles solicited from the 2014 Canine Science Forum (CSF) and Feline Science Forum (FSF). Although it was a bit complex to coordinate the topics, the ideas in some of these articles are so novel that it was worth the wait. In the coming year, we hope to target more topics for special issues which we hope will bring to print cutting edge, and sometimes controversial thought in emergent fields.

All questions in science start with one basic comparison: same or different? When we answer that question, we use both qualitative and quantitative parameters. The extent to which we can qualify and quantify measures often depends on how we define them, and singular answers may poorly describe behavior. As is illustrated so well in [Foyer et al. \(2016\)](#), our choice of measures may produce outcomes that are complex to understand. In their study of purpose-bred, military working dogs, the authors examined the results of 4 behavioral subtests, and pre- and post-test salivary cortisol. The comparison groups were dogs chosen to move forward into training and those that were rejected for further training. Acceptance or rejection for further training was based on subjective tests which use Likert scales, refined through benchmarking. The decisions about which dog advanced was made independently of the tests reported here. Here, the behavioral evaluations were objective ethological ones, obtained using video. These results were evaluated within the context of cortisol measures and group (selected or rejected for further training). Surprisingly, dogs selected for full training had higher cortisol levels and higher scores for ambivalent fear, overt fear, and avoidance than did dogs who were not approved for further training. Although, the authors note that the first of the paired cortisol tests may not have represented a truly baseline state, this obscures a bigger picture. We lack fully validated measures of what, specifically, makes any working dog good at any of the tasks required. We know which dogs are chosen, but we do not know which behavior or performance parameters are required for the jobs or which, if any, are superior for the jobs. All we can know now, without an external referent or standard, is how the parameters compare for those dogs accepted and rejected for training, in that population, and which dogs people choose based on their evaluation system. That such evaluations have complex biological underpinnings is clear from this article. When we see patterns like those identified by [Foyer et al. \(2016\)](#) that run counter to what we predicted, we should question whether our more subjective and qualitative measures evaluate the same facets of behavior that our more quantitative and objective measures do, and which differences are most helpful

to us. It's possible that the evaluations and measures that organizations think work for them, do not, in fact, give them the best dogs for their purposes. Without work like that of [Foyer et al.](#) that helps establish external referents, we will never know.

[Pirrone et al. \(2016\)](#) evaluated effects of source and age of adoption on later canine behaviors. Neurodevelopment is complex to evaluate, so [Pirrone et al.](#) used a series of 16 owner-reported behavioral problems, identified using a standardized questionnaire, as potential markers for putative effects of difference in source on neurodevelopment. A statistically significant correlation was found for dogs whose source was a pet store for 4 of the 16 problematic behaviors evaluated. The most concerning pattern involved aggression to humans. Dogs obtained from pet stores (e.g., commercially bred, puppy farm dogs) were reported more often by their owners to exhibit aggression toward humans than were those obtained from private breeders. If this correlation is supported by larger, more controlled studies, the next steps should involve quantification of the experiences of commercially bred puppies versus breeder-bred puppies, assessment of maternal status, and the potential for epigenetic effects. If commercial breeding is stressful and contributes to the development of deleterious behavioral conditions, and studies are mounting suggesting that this is the case, elucidating the mechanisms involved would improve behavioral health of puppies and decrease risks to the public.

In another article emphasizing the measurement of early environmental effects on behavior, [Döring et al. \(2016\)](#) compare the effects of housing, sex, age, and origin or source of the dog on the behaviors of laboratory dogs to novel situations. The 4 housing facilities varied in a number of design and husbandry features, providing the study with a level of complexity that hints at more work to be done. The clever, extensive, and well-designed behavioral evaluation, which is described in sufficient depth that others could replicate it, revealed some surprising and consistent differences across facilities, but in all cases, facility bred dogs were more willing to approach and interact with people and be lured into other activities than were dogs imported into the facility. Again, such findings suggest that a major focus of this field as we move forward must be measuring behavioral development and quantifying factors that alter trajectories.

As noted previously in this *Journal*, culture may affect the presentation of both behavioral problems in dogs and how they are addressed. In a survey of Korean dogs explicitly designed to learn what behavioral concerns people thought they had with their dogs ([Chung et al., 2016](#)), excessive barking, inappropriate elimination, aggression, fearfulness, and separation anxiety were, in order,

the most commonly reported complaints. Some of the patterns reported here may reflect a lack of knowledge about changes in behavior associated with development (e.g., puppies will destroy more than adults, fear often develops with age). This article also found a beneficial effect of exposure to basic training classes at least 1 day a week, again emphasizing that a more in-depth examination of behavioral development is warranted.

Damasceno et al. (2016) explored the effect of a known person on feeding behavior in a cat sanctuary. Behaviors changed in the presence of the human, who simply replaced any eaten dry food. There was no preference for new compared with old dry food, but there was a higher frequency of eating when the experimenter was present. In this study, the experimenter did not interact with the cats, but still had the effect of altering the feeding frequency. Social dynamics are complex, and we tend to study the dramatic events—such as fights—rather than the more passive patterns that may actually provide or maintain the backbone of social organization.

Dieting humans attribute changes in their social and affiliative behaviors to restricted caloric intake. What about cats? Feline obesity is considered a major health problem in the USA, so the pet food industry has developed a series of dietary interventions geared to provide the comfort of feeding with fewer calories. Levine et al. (2016) asked “Do the diets allow the cats to lose weight?” and “Is their mass all that changes?” The authors compared appetitive behaviors before feeding and social behaviors after feeding across 3 treatment groups: a high-fiber diet, a diet formulated to maintain weight in adult cats, and a low-carbohydrate, high-protein diet. After 4 weeks, most cats lost weight, irrespective of diet. At 8 weeks, the high-fiber diet group lost more weight, so were they crankier? No. Across all treatment groups, cats showed enhanced appetitive and social behaviors. There are a number of ways to interpret these data, and those may be affected by whether you like cats. However, denying your cat the opportunity to have a sleeker physique because you are worried about crankiness...is not supported by this study. But your dieting cat may want more attention!

The obesity epidemic in the USA is partially attributed to the way cats are kept in the USA: too little exercise and stimulation, too much food. These practices contribute to more sophisticated welfare concerns. Howell et al. (2016) used a survey tool to investigate welfare in pet cats in one region of Australia, Victoria. Interestingly, nearly half of the people completing the survey reported that their cat spent most of its time outside. This pattern may have relevance for the incidence of reported behavioral concerns: 18% of cats were reported to very or quite often show excessive fear to loud noises, and an additional 28% did so sometimes. Noise reactivity is seldom discussed among the risks for outdoor cats, but these data suggest that we should more fully assay cats' responses to a wide range of stimuli across populations. It's a concern that the behavioral problems that get the most attention are those which are viewed as problems for the people (e.g., not using the litter box). If we are to meet the welfare and humane needs of the species with whom we live, we need to start asking whether the behavioral pattern is or is indicative of a problem for that cat.

If we give them the chance to tell us about their preferences, all species of animals will do so. Indeed, this observation is at the foundation of the concept of the 5 Freedoms as originally expressed in the Brambell report (1965; FAWC, 1993), which has just celebrated its 50th anniversary. Löckener et al. (2016) investigated effects of housing systems on cognitive bias in horses. Box stalls and horseboxes are not part of equid evolutionary history. Is there an effect of the way we keep horses on their well being, as identified by any cognitive bias? If horses are given access to conspecifics and pasture after being maintained in a horsebox, is there any effect on a trained spatial discrimination test? When presented with ambiguous choices, exposure of horses to pasture and conspecifics

for 10 days induced a positive cognitive bias. This outcome is what would be expected if the systems considered in the 5 Freedoms paradigm matter and interact. Simply, the 5 Freedom paradigm and its implications matter.

As Venable et al. (2016) note, there is always a balance to mitigating risk and adversely affecting welfare when horses are managed. If horses are fed pelleted feed, the risk of esophageal obstruction is a concern. Equid grazing behaviors would generally pre-empt such risk, so is there a way to approach a more tempered feeding strategy that would still allow the use of pelleted feed? In their study of grazing muzzles, rate of consumption was slowed significantly.

When we remove the behaviors associated with freedom, what replaces them? Nature truly abhors a vacuum, so if we prohibit access to species typical and desired behaviors something happens, whether the change is internal, and more difficult to assess, or external and available to all who would see. Franchi et al. (2016) ask this question for farmed chinchillas. Fur chewing is a well-known abnormal repetitive behavior, industry wide, so does this behavior affect time budgets, which may have production implications, of affected versus unaffected animals? Interestingly, time budgets were the same when fur chewers were compared with control, nonchewers. What is not surprising to those who do clinical research, but should inform the industry, is that no chinchilla exhibited only fur chewing—bar biting, cage scratching, and back flipping were comorbid abnormal repetitive behaviors which are not reported—and, perhaps unnoticed—by farmers. Unless we actually collect the data, we have no basis for an evaluation of “normal,” and assumptions that we understand the problem, or that there is only one problem, should always be tested.

## 2014 CSF/FSF Special Issue

The CSF, whose abstracts always appear in the *Journal*, was created to bring together researchers from a variety of disciplines who focus on any aspect of behavior or evolution in canids. It has been expanded to include a FSF, and the next meeting of both will be in July 2016 in Padua, Italy (<http://www.csf2016.com/>). At the 2014 CSF meeting in Lincoln, UK, there were foci on the concept of “dominance” in dogs, social behaviors in cats, and modes of measuring behavior. The associated contributed articles suggest that these are all rich intellectual fields.

Harvey et al. (2016) present the results of early testing using a novel evaluation paradigm for dogs intended to become guide dogs. All working dogs require extensive, expensive training. Even with excellent breeding and established selection parameters, not all dogs succeed, and many are not suitable for training, as Foyer et al. (2016) have already discussed. We know little about neurodevelopmental trajectories in dogs. We know that dogs' behaviors can change as they undergo social maturity, something that appears to be true for all social species, and we know that in other species this change is accompanied by neuronal pruning and remodeling. We know even less about neurodevelopmental trajectories for young pups of different ages. If repeated puppy testing can identify tests that flag dogs who are not changing, or dogs who are changing, whether that change is in the desired direction, early testing may flag dogs who are poor investments for training. Given that failure rates for working dog programs are often reported to be in the 50%–75% range, any early identification of dogs that will not be good candidates for training saves resources for what are extremely expensive programs. In an ethological study of 93 dogs evaluated at 5 and 8 months of age, Harvey et al. identified 7 measures within their tests at 5 months, and 5 measures at 8 month that were significantly associated with either qualification or withdrawal. The authors also identified a series of measures that appear unaffected

by the 3-month maturation period. The developed test is sufficiently well designed that it could be used in both pet and working dog populations to define phenotypes that may be amenable to further definition and genetic selection, which is essential for modern breeding programs in an increasingly risky world which relies on the unique canine skill set.

Schöberl et al. (2016) sought to evaluate associations between dog attachment to owners, owner attitudes and relationship to the dog, and the results of a personality assessment for both dogs and humans on the ability to cope with stress during the Ainsworth Strange Situation Procedure for dogs. The assay for stress was serial sampling of salivary cortisol which, as discussed in Lensen et al. (2015), can be nontrivial. Dogs who were more secure in their attachment to their people had lower cortisol levels during the staged attachment and play sessions that are part of the Ainsworth Strange Situation Procedure and showed a greater cortisol response to the threat session, in the absence of their human. Interestingly, the higher the level of human-reported insecurity and reliance on the dog, the higher the dog's cortisol level. Sex of the dog and gender of the human also affected cortisol levels, strongly emphasizing that no behavior occurs in a vacuum and that when behaviors are evaluated, both broad (social environment) and narrow (incident) behavioral contexts need to be considered.

In the third article in this section to focus on assessment paradigms, Szabó et al. (2016) have asked whether we can evaluate true brain aging in dogs in the absence of detailed knowledge of the typical brain and body aging outcomes. Can we separate changes attendant with “demographic aging” or “actuarial senescence”, compared with what is often called “cellular senescence”? In light of the results published by Schütt et al. (2015), who compared a clinical evaluation of aged patients with 2 client-completed questionnaires, interpretation of such studies should be thoughtful and ensure that focus is not placed on spurious correlations.

The putative value of the concept of dominance as an organizing principle continues to be debated. Bradshaw et al. (2016), in their ongoing dialog with Schilder et al. (2014), dismiss any notion of dominance as a character trait and personality marker or dimension. They further tackle the disturbing notion that dogs are domesticated wolves. This unfortunate and broadly unsupported assertion is fraught with myth and has too often led to damaging and abusive training of pet dogs. The ‘dogs as wolves’ argument has also been used to support a bizarre concept of interspecific hierarchy for which data are lacking.

We are all informed in how we approach scientific questions by our training, and psychologists will approach such issues differently from strict traditional ethologists. Both will differ from evolutionary biologists who focus on roles for behavior and signaling in structuring social patterns, within changing demographic, resource, reproductive, and risk (e.g., disease, predation) environments. Evolution is the organizing principle of life, so any behavioral pattern has and can benefit from being considered in a broader context. Certainly, one should ask to what extent we alter any of these resource environments (and access to them, as discussed in the 5 Freedoms) when we confine any animal. This is a relevant question here, since many studies of wolf social behavior are on done on artificially constructed and entrapped groups, which may be better views as studies of potential pathologies than as translational equivalents of wild and free-ranging wolf behaviors.

A large part of the problem in debates about dominance rests on the careless and too often undefined use of the term (Overall, 2008, 2013). The concept of dominance has factored into discussions about sexual selection, resource allocation, social organization, sociobiology, and, as noted by Pawlowski and Scott (1956), Bradshaw et al. (2016), and Schilder et al. (2014), personality traits (see also

Arañori et al., 2016). The additional use of dominance to describe relationships between companion dogs and with respect to the relationships between humans and their dogs is an unfortunate misappropriation of the term within an epistemologically insufficient argument. A brief review may help.

#### *Dominance in sexual selection*

In the sentinel work on sexual selection and elephant seal social behavior that is often cited as a classic dominance system, Le Boeuf and Peterson (1969) note that rather defending the specific breeding sites where females gather in classical “harems,” males of elephant seals establish and defend social hierarchies, with high rank conferring on males access to females due to proximity. Males maintain the rank granting them proximity by fighting for “dominance” over other males, and this social rank is correlated with age, size, strength, health, and breeding success.

Other correlates of rank in elephant seals include the ability to prevent other males from mounting or copulating and, importantly, being able to mount or copulate without interruption (a form of deference) (Le Boeuf, 1974). In situations in which the concept of dominance has been used with respect to status, it is important to realize that ‘status’ is not defined as aggression on the part of the “dominant” animal but rather as the withdrawal of the “subordinate” (Gartlan, 1968; Rowell, 1972, 1974).

That hierarchical status is more than a simple linear round robin is clear even in elephant seals because males who arrive late to breeding grounds cannot simply fight the then-highest ranking male for female access—he must fight everyone, including males with whom he may have had a fight history from previous years, but who are not “dominant” (Le Boeuf, 1974). This pattern suggests a far more complex social structure and evaluation system than the casual, popular sociobiological use of the concept of “dominance”. Because of the time and energy commitments needed to maintain such access, and the tolls on health and strength, the more “dominant” males in this species have relatively short, but effective breeding lives. In this and similar systems, breeding lives are short, in part because the resource environment interacts with the demographic and reproduction environments: time spent in constant vigilance cannot be spent eating, and the high-ranking males, whereas initially older, stronger, and healthier, may go extended periods without food. The very act of what is needed to rise in this hierarchical breeding system ensures that no one maintains access for long. The inevitable consequence of evolution is variation and fluidity.

#### *Dominance in resource allocation and access (competitive ability)*

The concept of dominance was originally developed for use in describing territorial interactions in birds (Hinde, 1956). “Dominance” as it has been used in traditional ethology pertains to an individual's ability, generally under controlled conditions, to maintain or regulate access to some resource (Landau, 1951; Hinde, 1967, 1970; Rowell, 1974; Markham et al., 2015). The concepts of both dominance and linear hierarchies have been grossly misunderstood and misapplied, as discussed below for dyadic events (Gartlan, 1968; Archer, 1988; Rowell, 1974).

#### *Dominance in resource allocation in staged contests (dyadic agonist dominance)*

As a simple description of the regularities of winning or losing staged contests over resources (Archer, 1988), “dominance” should not be confused with status and, in fact, does not need to confer priority of access to resources (Rowell, 1974; Archer, 1988). Even

in physical contests that reveal health, age, size, and correlated ability—attributes commonly associated with sexual selection, “dominance displays” infrequently lead to actual combat. Instead, combat ensues when these attributes and behavioral displays are not effective in eliciting deferential, or even more covert mating behaviors. (Walther, 1977).

Concepts of resource allocation have driven many studies of dominance. For some of these studies, including the classic studies regarding possession of bones in dogs which left the indelible impression that resource fights structured domestic canine social relationships (James, 1949; Pawlowski and Scott, 1956; Scott and Fuller, 1965), the situations in which “dominance” is implicated in hierarchies may be artifacts.

The study of relationships between fewer than 6 animals will automatically produce a numerical rank order hierarchy that is linear (Rowell, 1974; Syme, 1974; Bernstein, 1981; Boyd and Silk, 1983), but the ranks produced are unable to account for the social complexities that are noted. Instead, there is a real role for deferential behaviors which are context dependent and based on knowledge, age, size, and the situation in which individuals are interacting. When examined, the behavior of the relatively “lower status” individuals, not the relatively “higher ranking” one, is what determines the relative hierarchical rank. If there is no assumption of a dominance-based system, one is seldom identified. When free-ranging baboon interactions were classified by behavioral types (e.g., friendly, approach–retreat), and then analyzed according to specific behaviors of the participants, no dominance system was noted (Rowell, 1966, 1967). If what we wish to understand is how animals organize their social interactions and what happens when something goes wrong, a more balanced, interactive, and dynamic approach is needed.

#### *Dominance as a modulator of social interactions*

Rank, itself, is contextually relative. Truly “high-ranking” animals are generally tolerant of “lower ranking” ones (Kaufmann, 1967; Boyd and Silk, 1983; Barrette, 1993), a phenomenon that is actually apparent in the more recent van der Borg et al. (2015) study, if one looks deeper. It is in this context—reducing fighting—that the existence of a hierarchy—a social rule structure—was postulated to be a stress-reducing device (Collias, 1953). However, situations where hierarchies are maintained most rigidly are also ones where measures of stress are high (Rowell, 1966). These situation also often involve captive or artificial social group situations, or groups under resource and/or competing environmental stress (Markham et al., 2015), factors that are too seldom considered in the model. The complex pattern of behaviors elucidated by van der Borg et al. (2015) in situations focusing on behavioral challenges represent only one behavioral context or axis. Affiliative relationships were not represented, nor were those associated with passive interactions, sleeping, and otherwise engaging in tactile communication, despite recent work that familiarity and relationships affect which types of touch may be comfortable for humans (Suvilehto et al., 2015). I'd hypothesize that this finding is likely to be relevant for other social species. No one doubts that competition is one factor in any trade-off driven by the demographic and broadly defined resource and risk environments. But if we neglect consideration of these other, dynamic relationship dimensions we may fail to evaluate any social organization as those affected may see it. It's possible that there is a high value placed on individuals who make decisions that lead to cohesion and decreased risk, averaged across contexts. If so, evaluating one type of interaction will not enlighten you.

The most common types of dominance discussed in studies of domestic dog social behavior, as for many primate studies, are

what *de Waal* (1986) has called “formal dominance” (which, too, has been postulated to minimize the effects of stress) and competitive ability, to separate it from the “dominance” thought to be an outcome of agonistic dyadic processes producing “winners” and “losers,” as described previously. Competitive ability focuses on ability of animals to obtain or to possess resources. Those trained in psychology often add “motivated” to this description of possession, however, motivation at its most basic definition is “desire” which is difficult to quantify and may not be necessary for this debate.

#### *Dominance and domestic dogs*

None of these evolutionary applications of the concept of dominance fit well to describe either the interspecific relationship domestic dogs have with humans, or the relationship among dogs in household. In the latter case, the rules governing the evolution of social behavior (e.g., natural and sexual selection, fitness, inclusive fitness) have largely been suspended or superseded by human decisions. We see the adaptation of canine social skills within human constructed multi-species households. But more importantly, dogs have a relationship with humans unlike that of any other “domestic” animal.

Dogs have been selected over time for true collaborative work with humans, and such selection has historically resulted in dog breeds and their attendant groupings. The molecular data support that dogs separated from wolves more than 15,000 years ago (Vonholdt et al., 2010; Thalmann et al., 2013). Molecular and anthropological data also support that dogs of different morphologies who were likely engaged in different tasks have lived together with humans for at least 15,000 years (Boyko et al., 2009; Castroviejo-Fisher et al., 2011). Stand-alone anthropological evidence supports that dogs have lived intimately with humans for at least 30,000 years (Ovodov et al., 2011; Germonpré et al., 2012). For at least the past 3,000 years, there have been well-defined breed clusters or groups, comprised dogs of different shapes and sizes who engaged in related tasks.

One of the forces associated with speciation may have been a special, collaborative working relationship with humans that ultimately resulted in morphologic variation in dogs as a relatively late development in the human × dog relationship. We accept that humans have changed dogs. We seldom consider the extent to which dogs may have changed humans. Our unique relationship with dogs may be due to convergent evolution of canid and human social systems that was the result of like groups meeting and recognizing the power of collaborative efforts, followed by secondarily derived, homologous changes in brain function (Saetre et al., 2004; Wang et al., 2013) that have allowed modern humans and dogs to truly rely on each other.

Dogs, like humans, have fluid social structures where day-to-day interactions are largely based on deferential behaviors, especially when individuals are known to one another, and on behaviors designed to elicit information about risk in situations where they are not known to each other. Combat is the exceptional choice for resolution of conflict in both canids and humans. When combat is the first choice for conflict resolution, it should be evaluated a potential abnormal, out-of-context behavior (Overall, 2005) or as a flag that there has been some dramatic shift in the larger population dynamic. It is striking that we automatically assume that all social interactions are a range of normal behaviors. Given the attention to stereotypic behaviors and welfare concerns in captive animals, we should expect that pathology may also attach to social behaviors, yet few acknowledge a potential role for it or test for its effects. Agonistic behavior, in contrast to pathologic aggression, is generally accompanied by an elaborate display structure designed

to minimize damage to the individual (see [Walther, 1977](#) for a series of examples). Both canid and human social systems use signals and displays that minimize the probability of outright battle and the damage that could be incurred during fights.

### Dominance and dog-human interactions

The patterns discussed give lie to assertions that humans are at the “top” of the dog × human “hierarchy” and must be “dominant” to their dog. Dogs in households are wholly dependent on the vagaries of their humans, for better or worse. This relationship does not meet the requirements for any hierarchical theory or test. Assertions about the need for humans to be ‘alpha’ to their dogs are derived from an unscientific, and wrong, pop-culture interpretations of the literature. The required interactions for any defense of any hierarchical concept (e.g., behavioral outcomes governed by relative shifts in the resource, demographic, risk, and reproductive environments) are absent.

Given this, there is no justification for the most devastating advice given to people with dogs with behavioral pathology: that they “dominate” their dogs and show the “problem” dogs “who is boss.” Under this rubric, untold numbers of humans have been bitten by both normal dogs and those with behavioral pathology whom they have betrayed, terrified, and given no choice. For dogs who have an anxiety disorder that involves information processing and accurate risk assessment, the behaviors used to “dominate” a dog (e.g., hitting, hanging, subjecting the dog to “dominance downs,” “alpha-rolls,” and other punitive, coercive techniques) convince that troubled, needy, pathologic dog that the human is, in fact, a threat, which results in a worsening of the dog’s anxiety.

Purely pragmatically, if someone believes in the concept of a social system driven and maintained by force, we are complicit in subjecting our patients, our canine companions and each other to a world view that will frighten and harm them. If we continue to operate within the flawed worldview resulting from the adherence to inapplicable and wrong terminology we will damage relationships—between our dogs, and between dogs and ourselves.

The modern, evolving understanding of complex social behaviors requires that we relinquish simplistic and damaging labels. The concept of a “dominant dog” is simply neither valid nor useful in our relationship with our companion dogs, and its application encourages behaviors that can cause morbidity and mortality for dogs and humans.

As so eloquently illustrated in this issue, we can do better, and [Westgarth’s \(2016\)](#) suggestion that we focus on meeting the needs of those dependent on us is an excellent first step.

The discussion of roles for social organization in relationships between cats and humans continues with articles from the CSF/FSF by [Arahorı et al. \(2016\)](#) and [Bradshaw \(2016\)](#).

[Arahorı et al. \(2016\)](#) used a factor analysis to evaluate cats in terms of the personality dimensions “openness,” “friendliness,” “roughness,” and “neuroticism,” and then asked whether personality assessments correlated with oxytocin receptor gene polymorphisms. Oxytocin is widely viewed as a factor in affiliative social behavior and competency when managing stress. The struggle in what to call these dimensions and how to assess them is a perfect foil to the CSF discussion on dominance. One of the polymorphisms was associated with greater “roughness” scores, which represents more forcefulness or assertiveness in behavior. These types of associations can be helpful in understanding underlying mechanisms, and this study suggests that we may wish to look further in genetic variation of underlying broad-stroke patterns.

In his review of feline social systems, [Bradshaw \(2016\)](#) notes just how different cats are from dogs, emphasizing the importance of the historical context in evaluating behavioral data in this under-represented species. The discussion of how the concept of dominance has been applied to cats is worth study because it reflects the weaknesses discussed previously and demonstrates the risks of forcing data into a theory, rather than allowing the data reveal themselves in ways that can test theories, and suggest new ways of understanding theories in them. “Dominance hierarchies” gleaned from resources that are timed and clumped completely ignore the evolution of foraging modes in small cats. Any broader conclusions based on such observations must be suspect.

Although I disagree with the concept that carnivores lack the cognitive capacity to comprehend “dominance” relationships, assessments that reflect the evolutionary biology of the species are important. I think it is far more plausible and logical that species that have and use identifiable patterns in signaling, in a nonrandom manner, to reflect and manage asymmetries in knowledge and relationships, have the capacity, given the evolution of the mammalian brain, to understand social organization and what risks shifts in it pose to them. These conclusions are supported by elegant, emergent imaging work ([Berns et al., 2013, 2015; Cook et al., 2016](#)). The unit of evolution is the individual so one should have the expectation that recognizing, understanding, and participating in management of behavioral asymmetries in a labile environment would be a skill on which selection would act in social animals.

This special issue serves to highlight how new data can change definitions and views. Science is about understanding the world around us. It, too, evolves.

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