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Anthropomorphism and Anthropomorphic Selection—Beyond the "Cute Response"

ABSTRACT

This article explores the origin and evolutionary implications of anthropomorphism in the context of our relationships with animal companions. On the human side, anthropomorphic thinking enables animal companions' social behavior to be construed in human terms, thereby allowing these nonhuman animals to function for their human owners or guardians as providers of nonhuman social support. Absence of social support is known to be detrimental to human health and well being. Therefore, anthropomorphism and its corollary, pet keeping, have obvious biological fitness implications. On the animal side, anthropomorphism constitutes a unique evolutionary selection pressure, analogous to sexual selection, which has molded the appearance, anatomy, and behavior of companion animal species so as to adapt them to their unusual ecological niche as social support providers. Although such species undoubtedly have benefited numerically from the effects of this process, the consequences of anthropomorphism are less benign when viewed from the perspective of individual animals. Indeed, anthropomorphic selection probably is responsible for some of the more severe welfare problems currently found in companion animals.

KEY WORDS: Anthropomorphism, evolution, pets, animal welfare.

Anthropomorphism[2]—here defined as the "attribution of human mental states (thoughts, feelings, motivations and beliefs) to nonhuman animals"—is an

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almost universal trait among companion animal caretakers (pet owners). People throughout the world feed their animal companions on human food, give them human names, celebrate their birthdays, take them to specialist doctors when they become ill, mourn them when they die, and bury them in pet cemeteries with all the ritual trappings of a human burial (Serpell, 1996a). In the United States, people dress their pets in designer-label fashions,[3] enroll them in daycare (Louie, 2000), and provide them with renal transplant surgery (among other high-tech veterinary procedures) at a cost of approximately $6500 per kidney.[4] Surveys have shown that 75 % of pet owners consider their animals akin to children, and nearly half of the women in one survey said that they relied more on their dogs and cats for affection than on their husbands or children (American Animal Hospital Association, 1996).

Most previous discussions of anthropomorphism in the scientific literature have tended to dwell on its validity (or lack thereof) as a technique for describing and interpreting animal behavior (McFarland, 1981; Lockwood, 1985; Kennedy, 1992; Mitchell, Thompson, & Miles, 1997). This article will avoid, as far as possible, the whole question of whether or not anthropomorphism, as I have defined it, is useful or appropriate when studying or interpreting the behavior of animals and concentrate instead on the ways in which it explains, in evolutionary terms, both the benefits and harms of pet ownership.

Genesis

Anthropomorphism appears to have its roots in the human capacity for so-called "reflexive consciousness"—that is, the ability to use self-knowledge, knowledge of what it is like to be a person, to understand and anticipate the behavior of others (Humphrey, 1983). Quite when this ability expanded outward to encompass nonhumans is anybody's guess, although the archaeologist Mithen (1996) claims that anthropomorphism is one of the defining characteristics of anatomically modern humans (*Homo sapiens sapiens*) and that it probably evolved no more than 40,000 years ago. Mithen bases this claim on archaeological evidence of a sudden change in human attitudes toward animals and the natural world coinciding with the Middle/Upper Paleolithic transition. This period was associated with a great variety of other

important cultural and technological advances: the invention of boats, the use of bows and arrows; the first tools made from stone flakes rather than cores, the first appearance of decorative and representational art, and the first unequivocal evidence of ritual burial and other religious practices.

Mithen (1996) attributes these revolutionary changes to a relatively sudden and radical alteration in the functional architecture of the human mind. He argues that the minds of early humans prior to about 40,000 years ago were distinctively modular in structure with different specialized domains of intelligence operating largely independently of each other:

1. A "social intelligence" module designed to deal with the complexities of social interactions, and capable of using self-knowledge or personal "insight" to understand and anticipate the behavior of others;
2. A "natural history intelligence" module adapted to processing information concerning the availability and distribution of biological resources, including the activities and behavior of other species such as predators or prey;
3. A "technical intelligence" module focused on physical aspects of the material world and including techniques for manipulating and constructing objects such as tools and weapons; and
4. A "general intelligence" module concerned with general-purpose problem-solving and decision-making.

According to Mithen (1996), this inherent modularity severely limited the rate of cultural evolution of early humans by preventing the different domains of intelligence from talking to each other. Each had its own specific area of expertise, and there was little or no flow or exchange of knowledge and information between them. Around 40,000 years ago, however, he postulates the evolutionary emergence of what he calls "cognitive fluidity" or the ability of the different modules to begin speaking to each other for the first time, resulting in a cultural explosion of unprecedented magnitude and creativity.

Anthropomorphic thinking, in Mithen's (1996) view, emerged at this time as a direct consequence of a new dialogue between the social and the natural history intelligence modules of the ancestral human brain. This dialogue became possible through the agency of reflexive consciousness, which spread out of its point of origin in social intelligence and into the other domains. This allowed modern humans to apply their sophisticated social skills—their

ability to make inferences about the mental experiences of conspecifics—to their interactions with other animals and the natural world. The effect of this merger was dramatic. Neanderthals and their predecessors no doubt viewed animals and the workings of nature as objects or phenomena of great practical interest; but, if Mithen is correct, they were entirely incapable of using self-knowledge to infer comparable mental states in other species or of interpreting the behavior of other animals in the light of this inference. Modern humans, in contrast, seem to have great difficulty thinking about animals except in anthropomorphic terms. From earliest childhood, it seems, we instinctively view other animals as social subjects (Myers & Saunders, 2002) and imbue them with human-like intelligence, desires, beliefs, and intentions.

Anthropomorphic thinking evolved and spread, Mithen (1996) argues, because it had enormous survival value. The archaeological record shows that the Neanderthals and their forerunners, who probably lacked the capacity for anthropomorphic thinking, were certainly effective hunters but that they were strictly opportunistic in their choice of prey and very limited in their methods of hunting. The evidence from Upper Paleolithic sites, in contrast, indicates that anatomically modern humans were preoccupied with the habits and behavior of animals and engaged in far more complex hunting strategies that required forward planning and the ability to make accurate predictions about the movements and behavior of the species hunted. In other words, it appears that anthropomorphic thinking helped *Homo sapiens* to become a super-predator by providing him with a specialized weapon for penetrating and exposing the minds of his prey.

Anthropomorphism also had other far-reaching consequences. By enabling our ancestors to attribute human thoughts, feelings, motivations, and beliefs to other species, it opened the door to the incorporation of some animals into the human social milieu, first as pets, and ultimately as domestic dependents (Serpell, 1989; Mithen, 1996). According to Mithen, without anthropomorphism, neither pet keeping nor animal domestication would ever have been possible.[5]

Pet keeping, Health, and Quality of Life

Of course, merely stating that anthropomorphism made pet keeping possible does not help to explain why this practice has persisted for at least 14,000

years and possibly far longer. From a purely evolutionary standpoint, pet keeping appears to be an anomalous activity (Archer, 1997). It is easy to explain, for example, why people keep chickens, pigs, or sheep: These animals are worth at least their own weight in eggs, meat, hide, or fiber. But what possibly could be the adaptive value of keeping Siamese Cats or Miniature Schnauzers? Natural selection, we know, favors individuals who behave in ways likely to maximize their own survival and reproductive success and/or that of their own close relatives (Hamilton, 1964). Even the theory of reciprocal altruism, developed by Trivers (1970), requires that we only should help other unrelated individuals when there is a reasonable likelihood of that help being reciprocated at some point in the future (Trivers, 1971). Because pets do not belong even to the same species—much less the same kin group—and are surely incapable of remembering and returning past favors, it is difficult to imagine how pet keeping evolved or why it persists. Pet keeping, moreover, is expensive. About 800,000 people require medical treatment for dog bites each year in the United States (Sacks, Sinclair, Gilchrist, Golab, & Lockwood, 2000); and, according to recent estimates, Americans spend around $11.6 billion a year on prepared pet foods (more than they spend on baby food) and $11 billion a year on pet health care (James, 2000).

A common response to this evolutionary puzzle, and one that keeps being regurgitated in the literature, is the idea that pets are simply social parasites who have perfected the art of releasing and exploiting our innate parental instincts—the so-called "cute response" (Lorenz, 1943; Gould, 1979; Archer, 1997; Budiansky, 2000). Parallels sometimes are drawn with the phenomenon of brood parasitism in birds in which the parasite's nestling seems to exaggerate many of the care-soliciting aspects of the host's own offspring, thus insuring that the nestling is fed assiduously to the detriment of the foster parents and siblings. The superficially infantile appearance of some lapdogs lends support to this idea, but it should be emphasized that a key difference between people and songbirds is that the latter are presumably unaware that they are feeding and caring for a non-conspecific intruder. People may indeed find puppies or Pug Dogs cute, but they certainly are never in any doubt concerning their true provenance (Serpell, 1996a). Another longstanding and denigrating view of pet owners portrays them as akin to users of pornography—that is, individuals who are either unable or unwilling to form "normal" relationships with fellow human beings—and who resort to pets as

counterfeit substitutes for unattainable reality. Accepting this notion, however, would require us to believe that more than half of all American householders (and about a third of European ones) are either severely misanthropic or socially handicapped (Serpell, 1996a).

Fortunately, there also is a third, less disparaging theory of pet ownership according to which people keep animals for companionship for essentially the same reasons that people wear overcoats to keep out the cold: because by doing so, they enhance their own health and quality of life. Research on the putative health benefits of pet ownership still is at a relatively early stage of development, but already it has yielded a variety of interesting findings. Pet owners, for instance, have been shown to possess fewer physiological risk factors (high blood pressure, serum triglycerides, and cholesterol) for cardiovascular disease than non-owners, as well as exhibiting improved survival and longevity following heart attacks (Garrity & Stallones, 1998; Friedmann, Thomas & Eddy, 2000).

Pet guardians appear to be more resistant to the stressful effects of negative life events, resulting in fewer health problems and fewer visits to doctors for treatment (Siegel, 1990). The acquisition of a new pet also has been associated with improvements in owners' mental and physical health and with sustained reductions in their tendency to overreact to stressful situations (Serpell, 1991; Allen, Blascovich, Tomaka, & Kelsey, 1991). Significantly, pet owners who report being very attached to their pets tend to benefit more from pet ownership than those who are less attached, and dog owners tend to do better than cat owners, perhaps because the attachment for dogs, on average, is stronger (Ory & Goldberg, 1983; Freidmann & Thomas, 1995). Interpreting such findings often is difficult, but most authorities now agree that these results are what one would expect if pets were serving as a form of social support (Serpell, 1996a; Garrity & Stallones; Collis & McNicholas, 1998).

Cobb (1976) defined social support as "*information leading the subject to believe that he is cared for and loved, esteemed, and a member of a network of mutual obligation* [italics added]" (p. 300). More recent authors have tended to distinguish between "perceived social support" and "social network" characteristics. The former represents a largely qualitative description of a person's level of satisfaction with the support he or she receives from particular social relationships, while the latter is a quantitative measure incorporating the number,

frequency, and type of a person's overall social interactions (Eriksen, 1994). In practice, both kinds of social support tend to be broken down into different components:

1. *Emotional support*: the sense of being able to turn to others for comfort in times of stress; the feeling of being cared for by others;
2. *Social integration*: the feeling of being an accepted part of an established group or social network;
3. *Esteem support*: the sense of receiving positive, self-affirming feedback from others regarding one's value, competence, abilities or worth;
4. *Practical, instrumental or informational support*: the knowledge that others will provide financial, practical or informational assistance when needed; and
5. *Opportunities for nurturance and protection*: the sense of being needed or depended upon by others (Collis & McNicholas, 1998, p. 115).

However we choose to define it, the importance of social support to human well being has been acknowledged implicitly throughout history; within the last 10 years, an extensive medical literature has emerged confirming a strong, positive link between social support and improved human health and survival. In particular, social support has been shown to protect against cardiovascular disease and strokes, rheumatic fever, diabetes, nephritis, pneumonia, and most forms of cancer, as well as depression and suicide (Eriksen, 1994; Esterling, Kiecolt-Glaser, Bodnar, & Glaser, 1994; House, Landis, & Umberson, 1988; Sherbourne, Meredith, Rogers, & Ware, 1992; Vilhjalmson, 1993). The precise mechanisms underlying these life-saving effects of social support still are the subject of some debate, but most experts seem to agree that the principal benefits arise from the capacity of supportive social relationships to buffer or ameliorate the deleterious health effects of prolonged or chronic life stress (Ader, Cohen, & Felten, 1995). In theory, this salutory effect of social support should apply to any positive social relationship; any relationship in which a person believes that he or she is cared for and loved, esteemed, and a member of a network of mutual obligations. The socially supportive potential of pets, assuming it exists, should therefore hinge on their ability to produce similar effects by behaving in ways that make their owners believe that the animal cares for and loves them, holds them in high esteem, and depends on them for care and protection.

What evidence exists that pets actually may fulfill this role? Surprisingly, very few of the many studies that have investigated the health effects of pet ownership during the last 20 years have considered the behavior of the pet, or the owner's perception of the behavior of the pet, as an important factor in all of this. Rather, pets have been treated as a sort of uniform variable that either is present or absent, as if all pets were equivalent regardless of species, breed, temperament, or behavior. But if pet ownership can be conceptualized usefully as another kind of social relationship, analogous to marriage or friendship, then clearly these relationships should be studied as dyadic interactions in which both participants—human and animal—play important parts (Serpell, 1989b). Only a handful of studies have attempted this, and their findings are revealing.

In one, it was found that people's professed attachments for their pets were strongly influenced by their evaluations of the animal's behavior. Pet owners, it seems, have a good idea of the kinds of behavior they do and do not want from their pets, and they appear to respond to a good match between what they want and what they get from the animal by becoming more attached to the pet (Serpell, 1996b). More recently, researchers in New Zealand investigated whether the degree of behavioral matching or "compatibility" between the pet and owner affected the owner's health. They found that owners who reported a high degree of behavioral compatibility between their pets and themselves were not only more attached to their animals but also experienced better overall mental health, enhanced feelings of well-being, less distress, more positive affect, less anxiety, and fewer physical symptoms of ill-health than did those with less compatible pets (Budge, Spicer, Jones, & St. George, 1998).

To examine the kinds of human-animal interactions involved in these assessments, Bonas, McNicholas, and Collis (2000) at Warwick University in England recently used a survey instrument called the Network of Relationships Inventory as a means of getting people to describe and evaluate the different kinds of social support they derive from both their human and nonhuman relationships. They found that, although human relationships scored higher overall in terms of aggregate social support, pet dogs actually scored higher than humans on a number of specific social or "relational provisions": specifically "reliable alliance," "nurturance," and "companionship."[6] Cats

ranked lower than dogs and higher than other pets, overall, although even cats rivaled humans in terms of their ability to provide "reliable alliance" and "nurturance." Humans only perform substantially better than dogs for "instrumental aid" and "intimacy," both of which depend to a greater extent on either complex cognitive capacities or language.[7] Bonas's subjects also reported far less conflict in their relationships with pets compared with other people. Again, the pet's lack of linguistic ability was probably an important consideration. Because they are unable to talk, pet animals are also unable to judge or criticize their owners, lie to them, or betray their trust.

Bonas et al.'s (2000) study clearly suggests that their subjects had no difficulty describing and evaluating their nonhuman companions using precisely the same relational parameters as those developed and used to describe relationships with humans. By implication, then, these people were interpreting and evaluating the various behavioral signals of social support they received from their pets *as if* they were coming from fellow human beings. In other words, anthropomorphism—the ability, in this case, to attribute human social motivations to nonhumans—ultimately is what enables people to benefit socially, emotionally, and physically from their relationships with companion animals. Most pet owners believe that their animals genuinely "love" or "admire" them, "miss" them when they are away, feel "joy" at their return, and "jealousy" when they show affection for a third party (Serpell, 1996a). One could, of course, argue that these people are simply deluding themselves and that the feelings and emotions they impute to their animals are entirely fictitious. Be that as it may. The fact remains that without such beliefs, relationships with pets would be essentially meaningless. Anthropomorphism rules because any other interpretation of the animal's behavior—any suggestion that the pet might be motivated by other than human feelings and desires—instantly would devalue these relationships and place them on a more superficial and less rewarding footing.

Anthropomorphic Selection—Beyond the "Cute Response"

Although anthropomorphism would appear to be responsible for many of the benefits people derive from the company of pet animals, its effects on the animals are more equivocal. In purely numerical terms, of course, most companion animal species now vastly outnumber their wild ancestors. Due to

habitat loss and persecution by humans, wolves (*Canis lupus*), the presumed ancestors of domestic dogs, now are extinct or endangered throughout much of their former range, while African wild cats (*Felis silvestris libyca*), the progenitors of domestic cats, are much less common now than they used to be. The genetic integrity of many of these isolated populations of wolves and wild cats also is increasingly threatened by interbreeding with their free-roaming, domestic descendents (Mech, 1970; Boitani, Francisci, Ciucci, & Andreoli, 1995; Serpell, 2000). In contrast, domestic dogs and cats now occur on virtually every island and continent (apart from Antarctica) where there are people, and worldwide populations have exploded to the point where it is almost impossible to provide an accurate estimate of their numbers. According to recent figures from the United States alone, there may be as many as 58 million pet dogs in America and nearly 73 million pet cats (Pet Food Institute, 2000), although some would argue that the latter figure should be doubled to accommodate unowned strays. Clearly, if evolutionary success is judged entirely on the basis of numbers, anthropomorphism has been a tremendous boon to these animals.

From an animal welfare perspective, however, the effects of anthropomorphism are far less benign. Anthropomorphic selection[8]—that is, *selection in favor of physical and behavioral traits that facilitate the attribution of human mental states to nonhumans*—imposes unusual and unique pressures on the objects of its attentions, in much the same way that the phenomenon of "female choice" does in sexual selection. The extravagant plumes, crests, combs, wattles, and displays used by the males of many polygamous bird species to intimidate their rivals and impress prospective mates are thought to be runaway products of arbitrary female preferences for grotesque or elaborate physical adornments and behavior (Halliday, 1978). Some of these excrescences may be aesthetically appealing to the human eye; but for the males who carry them, they can become potentially serious handicaps—imposing severe energy costs and both attracting the attention of predators and impairing the bearer's ability to escape from them (Zahavi, 1975). Similarly, many companion animal breeds effectively have become handicapped by selection for traits that appeal to our anthropomorphic perceptions.

Perhaps the most extreme example of this process can be found in the English Bulldog, once a powerful, athletic animal, and now recently described as the

canine equivalent of a train wreck. With its severely brachycephalic head, prognathous upcurved mandible, distorted ears and tail and ungainly movements, the Bulldog more closely resembles a "veterinary rehabilitation project than a proud symbol of athletic strength or national resolve" (Thomson, 1996, p. 220). In addition to the physical deformities, most Bulldogs now must be born by caesarian section, and the breed is crippled by multiple insults to its nasal and respiratory system. At the Veterinary Hospital of the University of Pennsylvania, Bulldogs even are used to study the phenomenon of sleep apnea. The difficulty they have breathing while asleep is so pronounced that most of them die prematurely from heart failure due to chronic oxygen deprivation (Panckeri, Schotland, Pack, & Hendricks, 1996). These malformations mainly are due to a congenital defect known as chondrodystrophy, a developmental anomaly in the formation of bones that produces gross distortions, particularly in the craniofacial and appendicular skeleton. It also is present, though at different levels of expression, in most other brachycephalic breeds, such as Pugs, Boston Terriers, Boxers, Pekingese, and in those with abnormally stunted limbs, including the Dachshund and Basset Hound (Thomson, 1996).

In humans, this condition causes a severe disability, and considerable research efforts are devoted to finding a cure for it. Yet these animals are being deliberately bred to preserve, and even accentuate, the same disabling characteristics. If Bulldogs were the products of genetic engineering by agri-pharmaceutical corporations, there would be protest demonstrations throughout the Western world, and rightly so. But because they have been generated by anthropomorphic selection, their handicaps not only are overlooked but even, in some quarters, applauded.

Of course, not all of what we humans do to exaggerate or enhance the anthropomorphic appearance of companion animals is necessarily harmful, at least from the animal's perspective. It is unlikely, for example, that dogs suffer to any appreciable extent from being dressed up like dolls or from being used by their owners as fashion accessories. One certainly could argue that these animals are diminished symbolically by such uses, in much the same way that human dwarves and midgets are degraded by their use in comic theater (Tuan, 1984). But it is very doubtful whether the animals are aware of the symbolism or that they care. Altering an animal's physical appearance raises

more serious ethical questions, however, when it involves deliberate mutilation. Docking the tails of pets or surgically removing their claws certainly could be interpreted as anthropomorphic interventions. Humans do not possess tails or claws, and it appears that some of us expect our pets to match our own self-image by doing without these natural animal appendages.

Along with anatomy and physical appearance, anthropomorphic selection also has distorted the behavior of pets. Again, some of this is relatively harmless. The proverbial loyalty and fidelity of dogs to their human guardians, for instance, almost certainly is a product of anthropomorphic selection. When these same characteristics are accompanied by abnormally accentuated dependency, however, they result in a crippling pathology. The second most common problem currently seen by animal behavior specialists is the dog who becomes hysterical with anxiety when left alone. These animals shred furniture and carpets, rip holes in doors (often injuring themselves in the process), and defecate and urinate all over the house, so great is their distress at separation (McCrave, 1991). By selecting for animals with exaggerated anthropomorphic (or *paedomorphic*) appeal, it is probable that we inadvertently have created lines of over-dependent dogs who fall apart emotionally when their attachments are threatened. Regrettably, the common response to this problem is either to contain it by incarcerating these animals in cages while their owners are out of the house or to subdue it with psychoactive medication (Podberscek, Hsu, & Serpell, 1999).

Conclusion

The anthropomorphic tendency to attribute human feelings and motivations to nonhuman animals has given rise to a unique set of interspecies relationships that have no precedent elsewhere in the animal kingdom. These human-pet relationships are unique because they are based primarily on the transfer or exchange of social rather than economic or utilitarian provisions between people and animals. For the humans involved in these relationships, anthropomorphism has provided the opportunity to use animals as alternative sources of social support and the means to benefit emotionally and physically from this. For the animals, it has created a novel ecological niche, a set of unusual evolutionary selection pressures, and a variety of corresponding adaptations—some of which are detrimental to the animals' welfare. In this

respect, pet keeping is no different, and certainly no worse, than other ways of using animals for human ends, such as farming or biomedical research. Every novel adaptation to a new environment, whether natural or fabricated, carries with it certain costs, and it would be unrealistic to imagine that things could be otherwise. It is not unrealistic, however, to question the level of cost that animals should have to incur to participate in such relationships. Regardless of how we use animals, there are ethical limits beyond which we should not go, and those limits surely should disallow us from deliberately breeding companion animals who suffer from painful, distressing, or disabling physical or emotional handicaps or from surgically mutilating them in the interests of fashion or convenience.

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Notes

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[2] There are various competing definitions of anthropomorphism in the literature ranging from the attribution of *any* mental state to nonhumans (Kennedy, 1992) to the attribution of exclusively human characteristics (Noske, 1989; Shapiro, 1997). However, as Lehman (1997) points out, these distinctions matter primarily because of the common assumption that anthropomorphism, however it is defined, is necessarily erroneous or mistaken. No such assumption is intended with the present definition, and the actual accuracy or lack of accuracy of people's attributions regarding their pets' mental states is largely irrelevant to the central arguments of this article.

[3] Numerous wholesale and retail websites now exist that specialize in fashion wear for pets, for example: *http://www.michaeljfashions.com/*

[4] Figure derived from the Veterinary Hospital of the University of Pennsylvania, January 2002.

[5] In a recent article, Hirata Yamakoshi, Fujita, Ohashi, & Matsuzawa (2001), describe a case of a wild female chimpanzee apparently capturing and keeping a western tree hyrax as a pet. Such observations clearly pose a fascinating challenge to Mithen's (1996) claim that such behavior is distinctively human.

[6] "Reliable alliance" refers to a person's belief that the relationship will last; "Nurturance" refers to taking care of or protecting others from harm, and

"Companionship" is defined as spending time with others, and doing enjoyable things together.

[7] "Instrumental aid" refers to others providing practical help, and "Intimacy" concerns confiding in others, or sharing private thoughts with them.

[8] It is arguable whether this phenomenon should be labeled anthropomorphic or paedomorphic selection because much of what is selected for in companion animals is characteristic of juvenile or infantile appearance and behavior. Anthropomorphic selection may be the preferable term because the putative goal of selection is to produce animals who are more human-like, even if their human-like features are also child-like or infantile.

References

Ader, R. L., Cohen, N. & Felten, D. (1995). Psychoneuroimmunology: Interactions between the nervous system and the immune system. *The Lancet, 345,* 99-103.

Allen, K. M., Blascovich, J. Tomaka, J., & Kelsey, R. M. (1991). Presence of human friends and pet dogs as moderators of autonomic responses to stress in women. *Journal of Personality and Social Psychology, 61,* 582-589.

American Animal Hospital Association. (1996). *National Pet Owner Survey*. Denver: AAHA.

Archer, J. (1997). Why do people love their pets. *Evolution and Human Behavior, 18,* 237-59.

Boitani, L., Francisci, F., Ciucci, P., & Andreoli, G. (1995). Population biology and ecology of feral dogs in Italy. In J. A. Serpell (Ed.), *The Domestic Dog: Its evolution, behavior, and interactions with people* (pp. 218-244). Cambridge: Cambridge University Press.

Bonas, S., McNicholas, J., & Collis, G. M. (2000). Pets in the network of family relationships: An empirical study. In A. L. Podberscek, E. Paul, & J. A. Serpell (Eds.), *Companion animals and us* (pp. 209-36). Cambridge, Cambridge University Press.

Budge, R. C., Spicer, J., Jones, B., & St. George, R. (1998). Health correlates of compatibility and attachment in human-companion animal relationships. *Society & Animals, 6,* 219-234.

Budiansky, S. (2000). *The truth about dogs: An inquiry into the ancestry, social conventions, mental habits, and moral fiber of* canis familiaris. New York: Viking.

Cobb, S. (1976). Social support as a moderator of life stress. *Psychosomatic medicine, 38,* 300-314.

Collis, G. M., & McNicholas, J. (1998). A theoretical basis for health benefits of pet ownership. In C. C. Wilson & D. C. Turner (Eds.), *Companion Animals in Human Health* (pp. 105-22). Thousand Oaks, CA, Sage.

Eriksen, W. (1994). The role of social support in the pathogenesis of coronary heart disease: A literature review. *Family Practice, 11,* 201-209.

Esterling, B. A., Kiecolt-Glaser, J., Bodnar, J. C., & Glaser, R. (1994). Chronic stress, social support, and persistent alterations in the natural killer cell response to cytokines in older adults. *Health Psychology, 13,* 291-328.

Friedmann, E., & Thomas, S. A. (1995). Pet ownership, social support, and one-year survival after acute myocardial infarction in the cardiac arrhythmia suppression trial (CAST). *American Journal of Cardiology, 76,* 1213-1217.

Friedmann, E., Thomas, S. A., & Eddy, T. J. (2000). Companion animals and human health: Physical and cardiovascular influences. In A. L. Podberscek, E. Paul, & J. A. Serpell (Eds.), *Companion animals and us* (pp. 125-142). Cambridge: Cambridge University Press.

Garrity, T. F., & Stallones, L. (1998). Effects of pet contact on human well-being: Review of recent research. In C. C. Wilson & D. C. Turner (Eds.), *Companion Animals in Human Health* (pp. 3-22). Thousand Oaks, CA, Sage.

Gould, S. J. (1979). Mickey Mouse meets Konrad Lorenz. *Natural History, 88,* 30-36.

Halliday, T. (1978). Sexual selection and mate choice. In J. R. Krebs, & N. B. Davies (Eds.), *Behavioural ecology: An evolutionary approach* (pp. 180-213). Oxford: Blackwell.

Hamilton, W. D. 1964. The genetical evolution of social behavior. *Journal of Theoretical Biology, 7,* 1-32.

Hirata, S., Yamakoshi, G., Fujita, S., Ohashi, G., & Matsuzawa, T. (2001). Capturing and toying with hyraxes (*Dendrohyrax dorsalis*) by wild chimpanzees (*Pan troglodytes*) at Bossou, Guinea. *American Journal of Primatology, 53,* 93-97.

House, J. S., Landis, K. R., & Umberson, D. (1988). Social relationships and health. *Science, 241,* 540-545.

Humphrey, N. (1983). *Consciousness regained.* Oxford: OUP.

James, S. 2000. *Nestle-Ralston Purina deal sign of growing population.* http://www.petsforum.com/petnews/01181c.html

Kennedy, J. S. (1992). *The new anthropomorphism.* Cambridge: Cambridge University Press.

Lehman, H. (1997). Anthropomorphism and scientific evidence for animal mental states. In R. W. Mitchell, N. S. Thompson, & H. L. Miles (Eds.), *Anthropomorphism, anecdotes and animals* (pp. 104-115). Albany: SUNY Press.

Lockwood, R. (1985). Anthropomorphism is not a four-letter word. *Advances in animal welfare science, 1985/86*. Washington, D.C.: Humane Society of the United States.

Lorenz, K. (1943). Die angeborenen Formen möglicher Erfahrung [The innate form of possible experience]. *Zeitschrift für Tierpsychologie*, 5, 235-409.

Louie, E. (2000, November 16). An indoor pet playground, with everything but squirrels to chase. *New York Times*, F, p. 3.

McCrave, E. A. (1991). Diagnostic criteria for separation anxiety in the dog. *Veterinary Clinics of North America*: *Small Animal Practice, 21*, 247-255.

McFarland, D. (Ed.). (1981). *The Oxford companion to animal behaviour*. Oxford: Oxford University Press.

Mech, D. L. (1970). *The wolf: The ecology and behavior of an endangered species*. Garden City, NY: The Natural History Press.

Mitchell, R. W., Thompson, N., & Miles, L. (Eds.). (1997). *Anthropomorphism, anecdotes, and animals: The emperor's new clothes?* Albany: SUNY Press.

Mithen, S. (1996). *The prehistory of the mind: A search for the origins of art, religion and science*. London: Thames & Hudson.

Myers, O. E., & Saunders, C. D. (2002). Animals as links toward developing caring relationships with the natural world. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evoutionary investigations* (pp. 152-178). Cambridge: MIT Press.

Noske, B. (1989). *Humans and other animals: Beyond the boundaries of anthropology*. London: Pluto Press.

Ory, M. G., & Goldberg, E. L. (1983). Pet possession and life satisfaction in elderly women. In A. H. Katcher & A. M. Beck (Eds.), *New Perspectives on Our Lives with Companion Animals* (pp. 303-317). Philadelphia: University of Pennsylvania Press.

Panckeri, K. A., Schotland, H. M., Pack A. I., & Hendricks, J. C. (1996). Modafinil decreases hypersomnolence in the English bulldog, a natural animal model of sleep-disordered breathing. *Sleep, 19*, 626-631.

Patronek, G. J., & Rowan, A. N. (1995). Determining dog and cat numbers and population dynamics. *Anthrozoös, 7*, 199-205.

Pet Food Institute. (2000). *2000 pet incidence trend report.* http://www.petfoodinstitute.org/pet-data.cfm.

Podberscek, A. L., Hsu, Y., & Serpell, J. A. (1999). Evaluation of clomipramine as an adjunct to behavioural therapy in the treatment of separation-related problems in dogs. *The Veterinary Record, 145,* 365-369.

Sacks, J. J., Sinclair, L., Gilchrist, J., Golab, G. C., & Lockwood, R. (2000). Breeds of dogs involved in fatal human attacks in the United States between 1979 and 1998. *Journal of the American Veterinary Medical Association, 217* (6), 836-840.

Salman, M. D., New, J. G., Scarlett, J. M., & Kass, P. H. (1998). Human and animal factors related to the relinquishment of dogs and cats in 12 selected animal shelters in the United States. *Journal of Applied Animal Welfare Science, 1,* 207-226.

Serpell, J. A. (1989a). Pet-keeping and animal domestication: A reappraisal. In J. Clutton-Brock (Ed.), *The Walking larder: Patterns of domestication, pastoralism, and predation* (pp. 10-21). London: Unwin Hyman.

——. (1989b). Humans, animals, and the limits of friendship. In R. Porter, & S. Tomaselli (Eds.), *The dialectics of friendship* (pp. 111-129). London: Routledge.

——. (1991). Beneficial effects of pet ownership on some aspects of human health and behaviour. *Journal of the Royal Society of Medicine, 84,* 717-720.

——. (1996a). *In the company of animals.* Cambridge: Cambridge University Press.

——. (1996b). Evidence for an association between pet behavior and owner attachment levels. *Applied Animal Behavior Science, 47,* 49-60.

——. (2000). Domestication and history of the cat. In D. C. Turner & P. P. G. Bateson (Eds.), *The domestic cat: The biology of its behavior* (pp. 180-192). Cambridge: CUP.

Shapiro, K. J. (1997). A phenomenological approach to the study of nonhuman animals. In R. W. Mitchell, N. S. Thompson, & H. L. Miles (Eds.), *Anthropomorphism, anecdotes and animals* (pp. 277-295). Albany, NY, SUNY Press.

Sherbourne, C. D., Meredith, L. S., Rogers, W., & Ware, J. E. (1992). Social support and stressful life events: Age differences in their effects on health-related quality of life among the chronically ill. *Quality of Life Research, 1,* 235-246.

Siegel, J. M. (1990). Stressful life events and use of physician services among the elderly: The moderating role of pet ownership. *Journal of Personality and Social Psychology, 58,* 1081-1086.

Spencer, L. (1993). Behavioral services in a practice lead to quality relationships. *Journal of the American Veterinary Medical Association, 203,* 940-941.

Thomson, K. S. (1996, May-June). The fall and rise of the English Bulldog. *American Scientist*, 220-223.

Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology, 46,* 35-57.

Tuan, Y.-F. (1984). *Dominance and affection: The making of pets.* New Haven: Yale University Press.

Vilhjalmson, R. (1993). Life stress, social support and clinical depression: A reanalysis of the literature. *Social Science Medicine, 37,* 331-342.

Zahavi, A. (1975). Mate selection-a selection for a handicap. *Journal of Theoretical Biology, 53,* 205-214.