ANTHROZOOLOGY: QUANTIFYING THE POSITIVE EFFECTS OF HUMAN-ANIMAL INTERACTIONS AND RELATIONSHIPS

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Introduction

This essay explores research in anthrozoology, which is the study of human-animal interactions. This is a modern interdisciplinary field which was created by an overlap of several other disciplines, including anthropology, ethology, psychology, veterinary medicine, and zoology. A major focus of anthrozoologic research is the quantification of the positive effects of human-animal relationships on either party and the study of the reality of these interactions. Research has revealed that dairy cows in England produce more milk when they are given names rather than numbers (Bertenshaw & Rowlinson, 2009); canine scent detection can identify explosives, drugs, cadavers and termites (Gazit & Terkel, 2003; Adams & Johnson, 1994; Fenton, 1992; Culliney & Grace, 2000), and therapy animals measurably reduce stress responses of patients (Friedmann, Thomas, Cook, Tsai & Picot, 2007). This essay reviews current research regarding animal consciousness, animal empathy, benefits of the human-animal bond, animal-assisted activities, equine therapy, and human-animal communication.

The word *animal* comes from the Latin word *anima*, which means life principle, breath, air, soul, living being. Human and nonhuman animals are both a combination of body and spirit; that is, living biological beings animated by spiritual beings or essences (Smith, 1999). Research in this genre supports a more compassionate, transpersonal, and humanistic view of animal consciousness.

> We need another and a wiser and perhaps a more mystical concept of animals. Remote from universal nature and living by complicated artifice, man in civilization surveys the creature through the glass of his knowledge and sees thereby a feather magnified and the whole image in distortion. We patronize them for their incompleteness, for their tragic fate of having taken form so far below ourselves. And therein we err, and greatly err. For the animal shall not be measured by man. In a world older and more complete than ours they move finished and complete, gifted with extensions of the senses we have lost or never attained, living by voices we shall never hear. They are not brethren, they are not underlings; they are other nations, caught with ourselves in the net of life and time, fellow prisoners of the splendour and travail of the earth. (Beston, 1928, p. 24)

Animal Consciousness

Animal consciousness has been fiercely debated for many years among philosophers, psychologists, and behavioral scientists. Gallup (1970) was one of the early pioneers of research into animal consciousness, with the first study using mirror self-recognition with chimpanzees (*Pan troglodytes*). His research summarized, "Insofar as self-recognition of one's mirror image implies a concept of self, these data would seem to qualify as the first experimental demonstration of a self-concept in a subhuman form" (p. 87).

There is no accepted theory of consciousness, no principled theory to indicate which systems, organic or artificial, are conscious and why. Where does this leave the epistemological questions about animal consciousness? Allen (2009) stated,

> While it may seem natural to think that we must have a theory of what consciousness is before we try to determine whether other animals have it, this may in fact be putting the conceptual cart before the empirical horse. In early states of the scientific investigation of any phenomenon, putative samples must be identified by rough rules of thumb (or working definitions) rather than complete theories. (p. 8)

For much of the 20th century, reductionism was the obsessive focus of nearly all sciences, including biology. This outlook reduced all levels of the world, from the smallest to the largest, to a machine that could be reduced to its parts to help people understand how it works. Reductionism has many triumphs that have enabled bigger, faster, smarter computers and enormous machines that do human bidding. However, this approach utterly fails to recognize the interconnectedness, unity, and interdependence that is nature in all its realms. "When we try to pick out anything by itself we find it hitched to everything else in the Universe" (Muir, 1911, p. 110). The human species is just beginning to recognize that this view of separateness has led to blind exploitation of nature by destroying habitats and by performing experiments on animals with insufficient concern for the effect of these actions. Continuing research of the last two

decades with species as varied as dolphins, parrots, elephants, foxes, dogs, and wolves is gradually changing the view of human uniqueness and allowing the human to view nonhuman, animal behavior through a different lens.

Concepts of Consciousness

Two ordinary senses of consciousness not in dispute with animals are 1) when one is awake versus asleep and 2) the ability to perceive and respond to selected features of their environments. Block (1995) believed that many animals possess access consciousness. Access consciousness is information made available to the brain's systems, such as systems of memory, reasoning, planning, evaluation of alternatives, decision-making, voluntary direction of attention, and rational control of action.

Two remaining senses of consciousness cause controversy when applied to animals: phenomenal consciousness and self-consciousness. Phenomenal consciousness refers to sentience: the qualitative, subjective, experiential, or phenomenological aspects of the conscious experience. Self-consciousness is closely related to theory of mind; that is, whether animals are capable of attributing mental states to others. Dretske (1995) claimed that phenomenal consciousness is inseparable from an animal's capacity to perceive and respond to features of its environment and is therefore very widespread in the animal kingdom.

"Exactly how scientists came to espouse ideas about animal minds that were so at odds with what nonscientists would call common sense is fascinating and instructive" (Pepperberg, 2008, p. 215). Arguments against animal consciousness include the Cartesian argument (the philosophy of René Descartes) that animals do not use language conversationally or reason generally. A common response to this argument is that absence of evidence is not evidence of absence, which has now been well documented by Pepperberg (2008); Gardner, Gardner, and

Van Cantfort (1989); Savage-Rumbaugh and Lewin (1996); and Lyn and Savage-Rumbaugh (2000). For many people, however, the Bible offers the argument that human beings were granted "dominion over the beasts of the field," and their case stops there (Kluger, 2010).

Another argument returns to the theory of mind described above. Carruthers (1998a, 1998b, 2000) maintained that there is little basis for the notion that any nonhuman animals have theory of mind, with the possible exception of chimpanzees. However, Gallup, Anderson, and Shillito (2002) disputed this idea and believed that mirror self-recognition is an indicator of self-awareness and that theory of mind is a byproduct of self-awareness.

Arguments that support animal consciousness begin with similarity arguments, in which reactions of animals to bodily events that humans would perceive as painful clearly elicit a pain response from an animal, as indicated by displays of high-pitched vocalizations, fear responses, nursing of injuries, and learned avoidance responses. Other behavioral evidence includes studies that show other species are susceptible to the same visual illusions as humans, which suggests similar visual experiences (Fujita, Blough, & Blough, 1991). Neurological similarities also suggest commonality of conscious experience. All mammals share the same basic brain anatomy, and visual systems are similar.

Griffin (2010) agreed and asked why scientists assume that the animal experience is exactly like those of humans.

> Cognitive ethology is a large area about which we know very little. But it should certainly include all varieties of mental functioning, conscious or not, and we should remain open to the distinct possibility that the experiences of other species are quite different from any of ours. (p. 26)

If animals can think and feel, what would they say and what would they ask of humans if they could speak our language? According to Bekoff (2010), their manifesto could consist of:

(1) All animals share the Earth and we must coexist.
(2) Animals think and feel.
(3) Animals have and deserve compassion.
(4) Connection breeds caring, alienation breeds disrespect.
(5) Our world is not compassionate to animals.
(6) Acting compassionately helps all beings and our world. (p. 9)

Cambridge Declaration on Consciousness

In July, 2012, the first annual Francis Crick Memorial Conference was held in Cambridge, UK. The conference, titled *Consciousness in Humans and Non-Human Animals*, addressed the notion that humans alone do not possess the neurological faculties that constitute consciousness. The symposium offered presentations of advanced quantitative techniques for measuring and monitoring consciousness, and model organisms spanned the species spectrum "from flies to rodents, humans to birds, elephants to dolphins, and [were] approached from the viewpoint of three branches of biology: anatomy, physiology, and behavior" (Francis Crick Memorial Conference, 2012, p. 1). At the end of the conference, a prominent international group of cognitive neuroscientists, neuropharmacologists, neurophysiologists, neuroanatomists, and computational neuroscientists signed and published The Cambridge Declaration on Consciousness (Low, 2012; see Appendix A). The declaration stated,

> The absence of a neocortex does not appear to preclude an organism from experiencing affective states. Convergent evidence indicates that non-human animals have the neuroanatomical, neurochemical, and neurophysiological substrates of conscious states along with the capacity to exhibit internal behaviors. Consequently, the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Non-human animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates (p. 2).

"Until animals have their own storytellers, humans will always have the most glorious part of the story" (Francis Crick Memorial Conference, 2012, p. 1). Based on this concept, future

symposiums will continue to explore the notion that humans do not alone possess the neurological faculties that constitute consciousness as it is presently understood.

Cognition

Cognition is generally recognized as a collection of mental processes that includes attention, memory, the production and understanding of language, learning, reasoning, problem-solving, and decision-making. Various disciplines study cognition. In psychology and cognitive science, *cognition* usually refers to an information-processing view of an individual's psychological functions. Cognition and logical reasoning in animals has been studied for decades and has produced stunning research results.

Pepperberg (2008) is a cognitive scientist who worked for 30 years with an African Grey parrot (*Psittacus erithacus*) named Alex, as partners and pioneers in animal cognitive research. Behavioral scientists have not believed that birds, which have brains the size of a shelled walnut, possess any potential for language, consciousness, or anything remotely comparable to human intelligence. Alex, however, proved all those assumptions wrong and demonstrated that he could add, sound out words, recognize colors, and understand concepts such as bigger, smaller, more, fewer, and none. He was capable of thought and intention.

When he died unexpectedly on September 6, 2007, it made headline news worldwide. Alex's sudden, unexpected departure left his admirers in awe of his achievements and wondering what else he would have accomplished had he lived. He passed at the height of his powers, leaving observers with a glimpse of another world that has always existed but remains beyond human view: the world of animal minds. Alex's examples suggests how little is really known about animal minds and how much more there is to discover (Pepperberg, 2008). Pepperberg (2009) summarized her research with Alex as:

> Scientifically speaking, the single greatest lesson Alex taught me, taught all of us, is that animal minds are a great deal more like human minds than the vast majority of behavioral scientists believed—or, more importantly, were even prepared to concede might be remotely possible. Clearly, animals know more than we think, and think a great deal more than we know. (p. 77)

The brains of honeybees (*Apis mellifera*) are very small, but their ability to learn and memorize tasks is impressive (Brown & Demas, 1994; Brown, Moore, Brown, & Langheld, 1997; Chittka, Gumbert, & Kunze, 1997; Greggers & Menzel, 1993). Zhang, Bock, Si, Tautz, and Srinivasan (2005) demonstrated that "bees display perceptual and cognitive capacities that are surprisingly rich, complex, and flexible" (p. 5250). This study tested the plasticity and robustness of working memory using a delayed matching-to-sample (DMTS) paradigm. DMTS was introduced by Blough (1959) and is commonly used to study animal memory over relatively short time intervals. Using sugar water as reward, honeybees were trained to match a sample stimulus with one of two or more subsequently presented comparison stimuli. Accurate performance at the end of the retention time frame requires the animal to retain information about the identity of the sample.

Mirror Self-Recognition (MSR)

The ability to recognize oneself in a mirror is a very rare capacity in the animal kingdom. Until 2001, this behavior had only been seen in humans and great apes, specifically common chimpanzee (*Pan troglodytes*), Bonobo (*Pan paniscus,* previously called the pygmy chimpanzee), orangutan (both species Bornean orangutan [*Pongo pygmaeus*] and the Sumatran orangutan [*Pongo abelii*]), and gorilla (*Gorilla*). Interestingly, no monkeys display it (Reiss, 2012a). Of 92 chimpanzees (*Pan troglodytes*) tested by Povinelli, Rulf, Landau, and Bierschwale (1993), 21 demonstrated clear and 9 weak evidence of self-exploration in front of a mirror, with about 75% prevalence in young adults aged 8 to 15 years.

Research has now moved beyond the ape family. In the last decade, dolphins, elephants, and magpies also have been research subjects in mirror self-recognition studies with positive results that suggest convergent cognitive evolution is most likely related to complex sociality and cooperation.

Nonhuman animals in MSR tests typically progress through four stages of behavior when facing a mirror:

(1) Social responses (assuming what they see is another of their own species),

(2) Physical inspection (looking behind the mirror),

(3) Repetitive mirror-testing behavior (the beginning of mirror understanding), and

(4) Self-directed behavior (realization of the mirror image as self; Plotnik, de Waal, & Reiss, 2006; Reiss, 2012b).

Bottlenose dolphins (*Tursiops truncates*) are playful, sociable, fun to be around, and scientists are beginning to recognize the intricate thinking of these big-brained mammals; their intelligence could rival that of humans. Their larger brain weighs more than a human brain and is estimated to have 32 to 34 billion neurons, compared to a human's estimated 86 billion neurons (Reiss, 2012a). The absolute and relative size of the dolphin brain suggests exceptional information-processing power (Herman, 1986). Dolphins appear to have "big brains, processing things in similar ways" (Reiss, 2012b, 4:14 in video).

Reiss and Marino (2001) conducted an MSR test at the New York Aquarium in Brooklyn, NY, with two captive-born male bottlenose dolphins aged 13 and 17 years. The experiment was to test independently whether the two dolphins would use a mirror to view themselves after being marked, sham-marked, or not marked. The mark test was developed and first used by Gallup (1970) during a chimpanzee (*Pan troglodytes*) self-recognition study.

"Collectively [the] findings provide definitive evidence that the two dolphins in this study used the mirror (and other reflective surfaces) to investigate parts of their bodies that were marked" (Reiss & Marino, 2001, p. 5942).

In a more recent and similar MSR test video-taped at the Baltimore Aquarium using a two-way mirror, dolphins could not see the humans but could see themselves in the mirror (Reiss, 2012a). Their video-taped behavior is very similar to that of apes and humans in front of a mirror, and the dolphins clearly showed interest in looking at themselves. They put their eye close to the mirror, opened their mouths, turned upside down, and blew bubbles, all while intently watching their reflection. As in the earlier study, when a dolphin was marked with a black pen on one side of its head but not the other, the dolphin immediately swam directly to the mirror and looked at the mark, as if to determine what had been done to it.

Younger dolphins recognize themselves in a mirror about the same age as human toddlers, at about a year and a half. Young dolphins appear to exhibit behaviors similar to young chimps and human toddlers as they learn to analyze their reflection. Their intelligence could be much like that of humans. Reiss (2012b) stated,

> In the end, [this information] tells us we need to look at these animals in a new light, with a new respect, and really provide much more protection, in terms of conservation and welfare efforts for these animals. And also appreciate we're not at the top anymore, we're not alone, we're surrounded by other intelligences. (4:34 in video)

In an early study of Asian elephants (*Elephas maximus*), two adult elephants failed to find self-recognition in the spontaneous use of mirrored information to locate otherwise hidden food (Povinelli, 1989). However, a more recent study by Plotnik, de Waal, and Reiss (2006) exposed three Asian elephants to visible marks and invisible sham-marks applied to their heads to ascertain whether they would pass the litmus test: spontaneous use of a mirror to see and then touch an otherwise imperceptible mark on its own body. All three subjects reached the third and

fourth stages of MSR progression, and one subject (Happy) passed the mark test on the first day of marking. Happy was marked with both a visible mark and a sham-mark (not visible to the animal), then released into the elephant yard. She walked straight to the mirror, then repeatedly moved away and returned to the mirror. “Out of view of the mirror, she repeatedly touched the visible mark but not the sham-mark. She then returned to the mirror, and while standing directly in front of it, repeatedly touched and further investigated the visible mark with her trunk” (p. 17054).

Dolphins and elephants have complex social structures and show empathetic behavior. If self-recognition is linked to highly developed social behavior, some bird species also may be candidates for self-recognition. The European magpie (*Pica pica*) is a song bird from the crow (*Corvus*) family. They are food-storing corvids that compete with conspecifics for individually cached and memorized hoards. Magpies have a relatively large brain size, are curious, and prone to approach, rather than retreat from, new situations and puzzles. Prior, Schwarz, and Güntürkün (2008) tested five magpie subjects, three of which demonstrated clear spontaneous mark-directed behavior. “Altogether, results show that magpies are capable of understanding that a mirror image belongs to their own body ” (p. 1647). This study was the first evidence of MSR in a nonmammalian species.

Empathy Studies

Empathy is the ability to perceive and feel the emotion of another and comprises a general class of behaviors that exist across species to varying degrees of complexity. The word *empathy* was coined in the early 20th century, to translate the German word *Einfühlung*, which means literally “feeling into” (from the German *em* put into + *pathos* feeling; Pierce, 2007, p. 1). Interanimal empathy has received little attention in behavioral biology “due in part to the

portrayal of the natural world as a field of combat rather than a place of social connectedness" (Preston & de Waal, 2002a, p. 284). Joseph LeDoux, the best funded animal emotional-memory researcher in America, has publicly related how he obtained approval for his initial grant applications only after he removed the term *emotion* from his proposed work and replaced it with learning and memory terms (Panksepp, 2005).

However, over the last two decades, studies have clearly demonstrated empathetic behavior among the Bonobo ape (*Pan paniscus;* de Waal & Lanting, 1997; Savage-Rumbaugh & Lewin, 1996) , elephants (Bates et al., 2008; Douglas-Hamilton, Bhalla, Wittemyer, & Vollrath, 2006; Masson & McCarthy, 1995), dolphins (Holmes & Neil, 2012; Reiss, 2011), and whales (Simmonds, 2006). All of these species have large, complex brains with highly structured societies, as well as social and behavioral complexity in engagements. These animals maintain relationships as long-term bonds between individuals and construct new relationships. Animals that live in social groups benefit from the emotional states of others in the group; the individuals are cooperative and interdependent on all members of their tribe, herd, pod, or organization. The essence of empathy is emotional linkage among conspecifics. Preston and de Waal (2002b) explained,

> On an ultimate level, emotional linkage supports group alarm, vicariousness of emotions, mother-infant responsiveness, and the modeling of competitors and predators; these exist across species and greatly effect [*sic*] reproductive success. Proximately, emotional linkage arises from a direct mapping of another's behavioral state onto a subject's behavior representations, which activate responses in the subject. (p. 1)

It is not just large, nonhuman mammals and cetaceans that exhibit these emotions. More recent studies have shown empathy and prosocial behavior in rats. *Prosocial behavior* refers to actions that are intended to benefit another. Building on observations of emotional contagion in rodents Bartal, Decety, and Mason (2011) tested whether the presence of a (nonpainfully)

restrained cage mate induced a prosocial motivational state in rats, leading them to learn how to open the restrainer door and liberate the cage mate. When liberating a cage mate was pitted against chocolate contained within a second restrainer, rats opened both restrainers and typically shared the chocolate. "Thus, rats behave pro-socially in response to a conspecific's distress, providing strong evidence for biological roots of empathically motivated helping behavior" (p. 1427).

Another study, which this researcher considers of cruel and inhumane design, tested the pain sensitivity of mice produced solely by exposure to their cage mates, but not to strangers, in pain (Langford et al., 2006). The first condition involved the injection of mice with a 0.9% acetic acid, producing painful abdominal constriction (called *writhing*) as a test of behavior with or without the subject's seeing another injected mouse who was or was not a known cage mate. Another modality, thermal pain testing, was used concurrently with the writhing test, as well as blockage of sensory inputs with physical barriers to sight and/or touch. In the end, the study findings were "consistent with the perception-action model of empathy . . . both in the automatic priming of somatic responses in a state similar to that of the attended object and in the modulating effects of familiarity and similarity of experience between subject and object" (p. 1969). Clearly, mice suffer distress when they watch another mouse experience pain.

The seeming empathy of domestic dogs (*Canis familiaris*) is well known to human dog guardians and animal therapy program recipients. There are several reasons that dogs may be particularly empathic toward their human guardians. First, dogs originated from wolves, which are highly social animals that engage in cooperative activities to survive. Second, biological changes during the domestication process may have increased dogs' inherited empathic capacities; and third, breed diversification and selection for increasingly complex cognitive

abilities may have led to increasing forms of empathy and resemblance to human emotional communication (Silva & de Sousa, 2011).

The empathy of dogs may even extend to contagious yawns. Twenty-nine dogs observed a human yawning or making control mouth movements (Joly-Mascheroni, Senju, & Shephert, 2008). Twenty-one dogs yawned when they observed a human yawning, but nonyawning mouth movements did not elicit yawning from any of them. "The presence of contagious yawning in dogs suggest that this phenomenon is not specific to primate species and may indicate that dogs possess the capacity for a rudimentary form of empathy" (p. 446).

A later study by Silva, Bessa, and de Sousa (2012) explored whether the mere sound of a human yawn could be sufficient to elicit yawning in 29 dogs. "Unexpectedly, results showed an interesting interplay between contagion and social effects. Not only were dogs found to catch human yawns, but they were also found to yawn more at familiar than unfamiliar yawns" (p. 721).

A study of the comparisons of human empathy for humans versus human empathy for animals revealed positive results. Angantyr, Eklund, and Hansen (2011) conducted three experiments. The first investigated whether an animal or human target in the same need situation elicited the same or different levels of empathy. The second used the same scenario as in the first experiment, but with two versions: one with a puppy and one with a child as the targets. The third experiment also used the same scenario, with a child, a baby, and a puppy as targets. The results indicated that women feel more empathy than men, and women, but not men, express more empathy for animals than for human adults. "Overall, results indicated that people feel at least as much empathy for animals as for humans" (p. 369).

Benefits of the Human-Animal Bond

Humans appear to be hard-wired to notice nonhuman animals. Mormann et al. (2011) recorded the medial temporal lobe (MTL) of 41 neurosurgical patients undergoing epilepsy monitoring. Prior to the surgery, doctors mapped the participants' brains by inserting electrodes into different areas of their brains. Participants sat on a bed while they viewed approximately 100 images per session on an LCD monitor. Images included animals, people, landmarks, and objects. During 111 experimental sessions, recordings were obtained from the amygdale, hippocampus, and entorhinal cortex. "Neurons in the amygdala responded preferentially to pictures of animals rather than to pictures of other stimulus categories" (p. 1247). The researchers suspected that animals were so important during human evolutionary history that the brain developed a dedicated processing area (Keim, 2011).

Benefits of the human-animal bond encompass many areas of research, such as:

(1) Dairy production resulting in higher milk yields,

(2) Raptors utilized for wildlife damage control,

(3) Household pet ownership,

(4) Canine scent detection,

(5) Canine seizure-alert support,

(6) The effects of animals on human physiological health,

(7) The effects of animals on human psychological health, and

(8) What people think about animal thinking.

Each of these research areas will be explored in more detail.

(1) Dairy production

Dairy production is a critically important commodity worldwide. The positive effects of the human-animal relationship extends to dairy cows (*Bos primigenius)* milk production. Bertenshaw and Rowlinson (2009) studied cattle's fear-response to humans and the effect on their productivity, behavior, and welfare. Reports from 516 stock managers in England indicated that 48% of survey respondents accepted that humans have an impact on cattle temperament, and 9% attribute poor milking temperament with previous negative experiences with humans.

> Higher heifer milk yields (> 200 liters) were found in herds where the stock manager thought it important to know every individual animal. On farms where cows were called by name, milk yield was 258 liters higher than on farms where this was not the case ($p < 0.001$). (p. 59)

(2) Raptors utilized for wildlife damage control

Falconry (or *hawking*) has been a hunting sport for thousands of years. The first written sources in Europe date to the fifth century AD, and the first illustrations of falconry date to around 500 AD (Prummel, 1997). In the United States licensing is federally mandated but managed at the state level, which requires a permit to own a bird of prey, and specifically a falcon. Requirements for a permit are extensive, and include sponsorship from a currently licensed General or Master Falconer; a written test on the care, history, and art of falconry; specific requirements for the raptor housing; and a physical inspection of the facilities. Licensed falconers are a small and tight-knit community, who protect their raptors and support the highly regulated industry. Every bird is federally registered, and "all acquisitions, captures, purchases, gifting, sales, transfers, releases, banding, escapes, losses by death, and all other changes in status and possession of falconry birds must be reported to the United States Fish and Wildlife Service" (Washington State Department of Fish and Wildlife Hunting, 2012, p. 1).

Falconry is now used in a contemporary human-animal relationship which takes advantage of the natural prey response in reaction to avian predators. European starlings (*Sturnus vulgaris*; considered a non-native invasive species), blackbirds (*Euphagus*), American robins (*Turdus migratorius*), and finches (*Leucosticte*) are abundant, with populations estimated between 750 million to 1 billion; the estimated damage to fruit, berry, and grain crops exceeds $150 million annually. Pest bird droppings pose a threat to homes, lawns, golf courses, machinery, industrial facilities, and the exposure of humans to more than 60 dangerous diseases including salmonella, Lyme disease, histoplasmosis, and meningitis. European starlings congregate at dairies and feedlots for food and shelter during frigid conditions. As many as 10,000 starlings have been seen contaminating feed with their droppings. Airports are often surrounded by landfills, wetlands, and other habitats that attract a variety of birds, which pose a threat to aircraft as they land and take off. The bigger the bird, the bigger the threat to aircraft (Tactical Avian Predators, 2012).

A west coast business offers an integrated pest management strategy of ecologically sound pest control that uses falconry, habitat manipulation, and other techniques to eradicate birds, raccoons, skunks, and other animal pests. The company has worked with vineyards, waste management, casinos, recreational lodges, oil refineries, and has protected San Francisco water supplies. Their avian arsenal of raptors includes a Lanner/Saker falcon (*Falco biarmicus/cherrug*), a Saker falcon *(Falco cherrug),* a Peregrine falcon (*Falco Peregrinus*), a Lanner falcon (*Falco biarmicus),* two Harris hawks (*Parabuteo unicinctus*), and a Eurasian eagle owl (*Bubo bubo*) in training (Raptor Adventures, 2012).

(3) Household pet ownership

Perhaps the dedicated brain processing of humans to notice animals comes into play with household pet ownership. In 1988, 56% of United States households lived with a pet; this figure rose to 62% in 2008. This percentage remained steady in 2011-2012 with 62% of households with a pet, which equates to 72.9 million homes. The 2012 total U.S. pet industry expenditures are estimated at $52.87 billion, compared to $50.96 billion (actual) in 2011 and $48.35 billion in 2010. Household pet types are shown in Table 1.

Table 1. *Number of U.S. Households with a Pet (Millions)*

Type	Frequency
Bird	5.7
Cat	38.9
Dog	46.3
Equine	2.4
Freshwater fish	11.9
Saltwater fish	0.7
Reptile	4.6
Small animal	5.0

Source: American Pet Products Association (2012).

Humans and dogs (*Canis familiaris*) share a long and intertwined history. DNA evidence suggests that dogs diverged from wolves beginning as long as 135,000 years ago, but in different places at different times (Vilà et al., 1997). Anthropologists and archaeologists disagree, suggesting that this is an overestimate, as the earliest burial remains of a domestic dog found in Bonn-Oberkassel, Germany, are 14,000 years old. The well-preserved lower jaw and teeth suggest that this animal could be compared to a small sheep dog as a companion of the Cro-Magnon man in the late Paleolithic age (Udell & Wynne, 2008). The exact lineage and location of the first domestic dogs are still under debate, but it is undeniable that they now play an astonishing range of roles in modern society. Dogs rescue people and animals in wilderness, water, collapsed buildings, earthquake rubble, and caves; offer companionship and critical

guidance to the blind, deaf, disabled, and physically challenged; and sniff out drugs, bombs, termites, and multiple diseases, including cancer. Herding, hunting, sledding and other various specializations are critical to human endeavor.

To understand dog behavior becomes vital when one addresses what is perceived as a growing problem of dog attacks and consequent deaths. The American Humane Association (2012) estimated there are 4.7 million dog bites in the United States each year, of which nearly 800,000 require medical care. Half of the dog attacks involve children under 12 years old, and 70% of dog-bite fatalities occur among children under 10 years old. Approximately two-thirds of bites occur on or near the victim's property and most victims know the dog. The insurance industry pays more than $1 billion in dog-bite claims each year.

In response, communities have enacted breed-specific legislation (BSL) that prohibits ownership of certain breeds (e.g. pit bulls, Rottweilers, and others), labeling them *bad dogs*. However, any breed of dog can bite, "and research suggests BSL does little to protect the community from dog-bite incidents. In fact, BSL can have unintended consequences, such as black-market interest and indiscriminate breeding, resulting in overpopulation" (American Humane Association, 2012, p. 1).

Most frightening and tragic are fatal dog attacks. Randall Lockwood, a senior vice-president of the American Society for the Prevention of Cruelty to Animals, is one of the country's leading dog bite experts. He stated,

> A fatal dog attack is not just a dog bite by a big or aggressive dog. It is usually a perfect storm of bad human-canine interactions; the wrong dog, the wrong background, the wrong history in the hands of the wrong person in the wrong environmental situation. I've been involved in many legal cases involving fatal dog attacks, and certainly, it's my impression that these are generally cases where everyone is to blame. Usually there are all kinds of other warning signs. (Gladwell, 2006, p. 43)

Rather than pass breed-specific legislation that bans ownership, communities could instead require training and education of prospective pet owners, perhaps encompassing even a criminal background check to identify known criminals and spouse/animal abusers. Any felony conviction should warrant a closer look at the applicant for a shelter animal. “While some animals are protected by legislation, laws vary widely between counties, states, and even countries. For example, in 2008, Switzerland enacted legislation requiring that prospective dog owners take a 4-hour course in pet care” (Knight & Herzog, 2009, p. 453).

(4) Canine scent detection

Canine scent detection continues to be an extremely promising area of research, as dogs have an amazing capacity to detect scents: “The average dog has around 220 million scent receptors in its nose, as compared to only 5 million for humans” (Coren, 1994, p. 146). Domestic dogs (*Canis familiaris*) have been trained to detect:

- Explosives, land mines, and trip wires. Dogs trained to detect explosives and land mines are now the largest group of working dogs in the world (Gazit & Terkel, 2003; (Phelan & Webb, 2003; Bach & McLean, 2003);
- Accelerants used in fires (Kurz et al., 1994; Tindall & Lothridge, 1995);
- Illegal drugs at border crossings, schools, and workplaces (Adams & Johnson, 1994; Lorenzo et al., 2003; Ritz, 1994; Rouhi, 1997);
- Criminals (by matching the scent of a perpetrator at a crime scene to the scent of a suspect, although this is controversial as a scent identification line-up used as evidence in court; Kalmus, 1955; Schoon, 1996, 1997). Dogs can follow trails of human scent through busy urban centers 48 hours after they were laid with 77.5% average success (Harvey & Harvey, 2003);

- Human cadavers. Detection rates of cadaver dogs ranged from 30% to 81% in field trials (Fenton, 1992; Lasseter, Jacobi, Farley, & Hensel, 2003;) and in another study 57% to 100% recovery rates (Komar, 1999);
- Eastern subterranean termites (*Reticulitermes flavipes Kollar*). U.S. costs of termite damage are estimated to be $2 billion per annum (Culliney & Grace, 2000). Trained dogs were 95.93% accurate in finding more than 40 Eastern subterranean termite workers while incorrectly indicating the presence of termites in containers only 2.69% of the time (Brooks, Oi, & Koehler, 2003);
- Bed bugs (*Cimex lectularis*). Dogs were able to discriminate bed bugs with a 97.5% positive indication rate and 0% false positives. In a controlled experiment in hotel rooms, dogs were 98% accurate in locating live bed bugs (Pfiester, Koehler, & Pereira, 2008);
- Gypsy moths (*Porthetria dispar L.*). Dogs can be trained to detect egg masses that are laid in leaf litter or ground debris. Two dogs evaluated had a combined average detection rate of 75% (Wallner & Ellis, 1976);
- Screwworms (*Cochliomyia hominivorax*). Screwworms are obligate parasites that can kill warm-blooded animals and cause significant economic losses. A dog trained to detect both screwworm pupae and screwworm-infested wounds on animals had an extremely high success rate of 99.7% (Welch, 1990);
- Brown tree snakes (*Boiga irregularis*) for containment and border patrol. Dogs are used in Guam to search outward-bound cargo to prevent accidental introduction of this pest in other countries. Snake-detection dogs have an average location rate of

65% (Engeman, Rodriquez, Linnell & Pitzler, 1998; Engeman, Vice, Rodriguez, Gruver, Santos, & Pitzler, 1998; Engeman, Vice, York, & Gruver, 2002);

- Microorganisms in commercial catfish (order *Siluriformes*) ponds. Some cyanobacteria species produce odorous compounds that accumulate in the flesh of the fish, causing an unpleasant flavor. The cost of affected fish to catfish producers in the U.S. ranges from $15 to $23 million annually. Dogs were shown to identify the two most common problem compounds in pond water samples with 79% to 93% accuracy (Shelby, Schrader, Tucker, Klesius, & Myers, 2004);
- Microbial growth in buildings. Two study dogs were able to locate 75% of hidden microbial growth samples (Kauhanen, Harri, Nevalainen, & Nevalainen, 2002); and
- Cancer. Cancerous cells may produce volatile chemicals, enabling detection by dogs (Sonoda et al., 2011). "It is hypothesized that the canine olfactory ability is determined by polymorphisms in olfactory receptor (OR) genes" (Lesniak et al., 2008, p. 518);
    - A study revealed dogs could detect the odor of melanoma cells at 100% and bladder cancer from urine at 41% (Pickel et al., 2001; Pickel, Manucy, Walker, Hall, & Walker, 2004; Willis et al., 2004);
    - Exhalation samples were used to identify lung cancer with an overall sensitivity of 75% and a specificity of 93% (Ehmann et al., 2012). In another study of lung cancer patients, both overall sensitivity and specificity of canine scent detection compared to biopsy-confirmed conventional diagnosis was 99% (McCulloch, 2006);

- Among breast cancer patients and controls, canine detection sensitivity was 88% and specificity 98% (McCulloch et al., 2006). However, in another study of six dogs, only two performed better than chance in specificity and none were more sensitive than chance (Gordon et al., 2008);
- Colorectal cancer screening of stool samples revealed an overall sensitivity of 97% and a specificity of 99% (Sonoda et al., 2011); and
- Human ovarian carcinomas are suspected to be easily identified by trained dogs. Double-blind tests showed 100% sensitivity and 97.5% specificity (Horvath, Järverud, Järverud, & Horváth, 2008).

Dog scent detection skills also have been used for conservation in the location and monitoring of endangered mammals and birds. Usage of scat (animal droppings)-detection dogs is a noninvasive method and is becoming popular in many countries to support research on threatened species. Information extracted from scat includes species, sex, individual identification, diet, parasitology, reproductive and stress hormones, and is an accessible source of DNA. "By systematically sampling scats over a large geographic area, population characteristics such as sex ratio, relatedness, habitat and home ranges may be estimated" (Browne, Stafford, & Fordham, 2006, p. 99). In North America, scat detection has been used to assess the impacts of human disturbances on black bear (*Ursus americanus*) and grizzly bear (*Ursus arctos horribilis*) populations in Canada (Wasser et al., 2004). Dogs have been trained to locate the scat of endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) in the United States (Smith et al., 2003). Biologists studying the endangered Amur tiger (*Panther tigris altaica*) in Russia use dogs to identify individual animals by scat scenting and matching to the reference collection of known

tigers. Two dogs used in this project have proved to have accuracy rates of 89% and 96% (Kerley, 2003).

The dogs' powerful olfactory cells may even someday restore spinal cord injuries. Scientists have been aware for more than a decade that olfactory ensheathing cells (OEC) might be useful in the treatment of damaged spinal cords because of these cells' unique properties. The cells have the ability to support nerve fiber growth that maintains a pathway between the nose and the brain. Granger, Blamires, Franklin, and Jeffery (2012) conducted a study of 34 domestic dogs that had all suffered accidental severe spinal cord injury. In a randomized, double-blind clinical trial, the dogs were allocated to receive either intraspinal autologous cells derived from olfactory mucosal cultures or injection of cell transport medium alone. "Recipients of olfactory mucosal cell transplants gained significantly better fore-hind coordination than those dogs receiving cell transport medium alone" (p. 3227). A coauthor, Franklin, remarked, "Our findings are extremely exciting because they show for the first time that transplanting these types of cells into a severely damaged spinal cord can bring about significant improvement" (University of Cambridge, 2012, p. 1).

(5) Seizure-alert studies

Another fascinating area of research involves training dogs to recognize specific changes that precede epileptic seizures in humans. Study results are mixed but could offer promising assistance to this life-changing disease. Using specifically trained seizure-alert dogs (SADs), Strong, Brown, Huyton, and Coyle (2002) reported a drop in seizure frequency among 10 patients, with 9 of the 10 showing a 34% or greater reduction, 4 of 10 showing a 50% or greater reduction, and only one showing no improvement. In another study of nontrained dogs, Kirton,

Wirrell, Zhang, and Hamiwka (2004) reported “quality of life was higher in families with a dog that responded to seizures” (p. 2303).

In another study of 63 patients, 29 owned pet dogs of which 9 patients reported their dogs responded to seizures, and 3 also were reported to alert to seizure onset. The study conclusion observed that “success of these dogs depends largely on the handler’s awareness and response to the dog’s alerting behavior” (Dalziel, Uthman, McGorray & Reep, 2003, p. 115). Another more positive study included 22 patients of neurologist-confirmed epilepsy, 87% of which had childhood-onset epilepsy. “All reported seizure-response dog related quality of life improvements (major 82%, moderate 18%) across multiple parameters. Spontaneous alerting behavior developed in 59%” (Kirton, Winter, Wirrell & Snead, 2008, p. 499).

Another complication for epilepsy patients is possible danger from a companion dog that may react aggressively during a seizure. Strong and Brown (2000) reported on 36 cases of pet dogs who suffered significant adverse health effects as a result of their reacting to or anticipating epileptic seizures in their guardians. When a guardian went into a seizure, dogs exhibited escape behavior, a dog was asphyxiated by the lead when attempting to escape from the guardian during a seizure, an assistance dog (not specifically trained as a seizure alert dog) attacked the owner and exhibited aggressive behavior toward the paramedics who responded to the guardian, and dogs bit guardians’ legs and faces during events. “It is important to emphasize the need for specially chosen dogs to be used, and for them to be specially trained” (p. 427).

(6) Effects of animal presence on human physiological health

Multiple studies have explored the physiological effects of companion pet guardianship on human health. However, the assumption that pet guardianship is associated with health benefits must be interpreted cautiously, as the studies generally reveal associations but not

necessarily causal relationships. The impact on pet guardianship seems to be most important for the elderly, disabled, children, the grieving, highly stressed, or socially isolated individuals. An important question is whether pet guardianship causes better health or whether better health encourages pet guardianship. Several surveys reveal that dog guardians exercise more than guardians of other types of pets and nonguardians. A sample of studies of pet guardianship and health outcomes over the last decade is shown in Table 2.

Table 2. *A Sample of Studies of Nonexperimental Studies of Pet Guardianship and Health Outcomes from 1980*

First Author	Year	Participants	Design	Outcomes	Results
Friedmann	1980	92 patients in a coronary care unit; 53 were guardians	Longitudinal cohort	Survival rates	Greater 1-year survival rate for guardians than nonguardians. Guardianship was an independent predictor of survival after controlling for disease severity and social support.
Siegel	1990	938 Medicare enrollees in a HMO; 345 were guardians	Cross-sectional study	Medical contacts	Guardians had fewer medical visits and patient-initiated medical contacts than nonguardians. Psychosocial distress was correlated with number of medical contacts among guardians but not nonguardians.
Anderson	1992	5641 attendees at a screening clinic; 784 were guardians	Cross-sectional survey	Heart disease risk factors and physical exercise behavior	Men: Guardians had lower plasma cholesterol, triglycerides, and systolic BP than nonguardians. Women > 40 years: Guardians had lower systolic BP than nonguardians. Dog guardians exercised more than guardians of other pets and nonguardians.
Jorm	1997	Random sample of 594 Australian adults, age > 70 years; 169 were guardians	Cross-sectional survey	Health service use, blood pressure, cognitive status	No differences between pet guardians and nonguardians on the physical or mental health measures, or in Medicare visits to GPs or specialists.
Parslow	2003	Random sample of 5079 Australian adults age 40-44 and 60-64 years; 2892 were guardians	Cross-sectional survey	Risk factors for heath disease, health status	Pet guardians had higher diastolic blood pressure than nonguardians; there were no differences in systolic BP. Pet owners also had higher body mass index, were more likely to smoke, and undertook milder physical activity than nonguardians.
Headey	2007	Data from national surveys in German (n = 9723) and Australia (n = 1246).	Longitudinal surveys	Health service use	Pet guardians made about 5% fewer annual doctor visits than nonguardians, even after controlling for gender, age, marital status, income, and other variables related to health.

Adapted from Friedmann & Son (2009).

Experimental studies have demonstrated the effect of the presence of and interaction with companion animals on stress indicators. Many of these studies have compared physiological responses or behaviors when a pet or friendly animal (usually a dog) was or was not present, and many studies have indicated that it is not necessary to be a guardian to obtain stress-moderating benefits from the presence of a friendly animal.

Nagengast, Baun, Megel, and Leibowitz (1997) examined whether the presence of a companion animal reduced the physiological arousal and behavioral distress experienced by preschool children during a physical examination. The study included 23 healthy children between the ages of 3 to 6 years during two physical examinations, with and without a dog present. "Statistically significant differences were found with greater reductions in subjects' systolic and mean arterial pressure, heart rate, and behavioral distress when the dog was present" (p. 323).

A Canadian study examined the effect of a companion animal in physical and psychological health in the elderly. Raina, Waltner-Toews, Bonnett, Woodward, and Abernathy (1999) conducted a one-year longitudinal study with standardized telephone interview data collected at baseline and one year later. All participants (baseline $n = 1054$; follow-up $n = 995$) were 65 or older, with a mean age of 73. Physical health was measured as the ability to perform activities of daily living (ADLs). After adjusting for other variables during the year, the ADL level of respondents who were nonguardians deteriorated more on average ($P = .040$) than that of respondents who were guardians. No statistically significant association was seen between guardianship and change in psychological well-being. "However, pet ownership significantly modified the relationship between social support and the change in psychological well being

over a 1-year period" (p. 324). A sample of additional studies of the impact on companion animals on stress indicators is shown in Table 3.

Table 3. *Sample Studies on Impact of Companion Animals on Stress Indicators and Stress Responses Published Since 1990*

First Author	Year	Participants	Design	Animal-Related Situation	Outcomes	Results
Friedmann	1993	213 under-graduate students	Experimental two-group design, repeated measures	Dog present while resting and while reading aloud	Blood pressure (BP), heart rate	Cardiovascular stress responses with dog present were lower for people who had a more positive attitude toward dogs than for those who had a more negative attitude.
DeMello	1999	50 normotensive adults	Experimental three-condition design, repeated measures	Cognitive tasks with friendly dog or goat absent, present with visual interaction, or present with tactual interaction	BP, heart rate	There was greater decrease in BP and heart rate after the cognitive stressor if animal was present than if absent. There was greater reduction with visual versus tactual interaction.
Havener	2001	40 pediatric dental patients	Experimental design, repeated measures	Petting a dog while awaiting dental surgery	Behavior distress and skin temperature	Petting dog was associated with higher skin temp while waiting for surgery among distress patients but not among those who were not distressed.
Kingwell	2001	35 guardians and 37 non-guardians	Experimental two-group design, repeated measures	A friendly but unfamiliar dog was assigned randomly to the first or second half of the study	BP, heart rate, cardiac autonomic function	The presence of the dog did not influence BP or heart rate either at rest or during mild mental stress. Cardiac autonomic profile was best for the guardians with the dog present and without the dog present for non-guardians.
Allen	2001	48 hypertensive patients in high-stress occupations	Experimental pre- and posttest design, repeated measures	One group was assigned to get a pet, the other was not. All participants received angiotensin-converting enzyme inhibitors.	BP, heart rate, and plasma rennin activity	The groups' cardiovascular responses to mental stress did not differ before intervention; 6 months later, the stress responses were lower in those who received pets than in those who did not. In both groups, resting BP was lower 6 months after the intervention but did not differ between groups.

Adapted from Friedmann & Son (2009).

Table 3, Cont'd.

First Author	Year	Participants	Design	Animal-Related Situation	Outcomes	Results
Allen	2002	240 married couples	Experimental 4-group design, repeated measures	Participants assigned randomly to be alone, with pet, or friend (for nonguardians), with spouse, or with spouse and pet or friend. Participants completed mental arithmetic and cold pressor tests.	BP, heart rate	Guardians had lower resting BP and smaller BP increases during cold pressor tests and mental arithmetic than nonguardians. Among guardians, the responses to the stressful tasks were smallest when the pet was present.
Wells	2005	100 volunteers	Experimental, repeated measures	Videotapes of animals were shown to participants	BP, heart rate	BP and heart rate were lower during a moderately stressful activity after viewing videos of birds, primates, and fish than after viewing control videos.
Friedmann	2007	11 community-living older adults	Experimental 2-group crossover	Resting with dog present or absent and talking about daily activities	BP	BP during social stressor was 7 mmHg/2 mmHg lower when the dog was present than when the dog was absent.

Adapted from Friedmann & Son (2009).

(7) Effects of animal presence on human psychological health

A large telephone survey of U.S. households was conducted by random-digit dialing using a two-stage cluster design stratified by U.S. census regions (Stallones, Marx, Garrity, & Johnson, 1990). A response rate of 65.7% yielded a sample of 1,300 respondents between 21 and 64 years of age. The purpose of the study was to examine the relationship of pet guardianship and attachment to pets to self-reported illness behavior and emotional distress in three different stages of life: early adulthood (21 to 34), early middle age (35 to 44), and late middle age (45 to 64). Similar to a number of the physiological studies, the survey concluded that selected populations seem to benefit from pet guardianship, however "the association between ownership and attachment and health may be complex and inconsistent over all age groups" (p. 100).

A detailed study of domestic cats (*Felis catus*) examined 212 couples with cats, 31 couples without cats, 92 living singly with cats, and 52 living singly without cats participated (Turner, Rieger, & Gygax, 2003). The Lexington Attachment to Pets Scale was used to analyze factors such as bad mood, activity, good mood, and seclusion. Interestingly, "only the partner, but not the cat, enhanced positive moods. Cats alleviated negative moods, and this effect was comparable to the effect of a human partner" (p. 213). The study did not advance any theory as to why cats seemed to influence only negative moods (bad mood and seclusion) and not increase the experience of good moods.

A study showing a positive psychological effect of domestic dog (*Canis lupis familiaris)* guardianship examined the questionnaire responses of 62 participants recruited from popular dog-walking sites in the Hampshire countryside (southeast of London, England; Knight & Edwards, 2008). Participants were between 28 and 85 years of age, with an average of 60 years. Gender was unevenly distributed with 76% female. Ten focus groups were utilized in a three-

part process. Researchers identified topics, participants created discussion around these topics, and researchers summarized what was learned. All interviews were transcribed verbatim, resulting in 800 pages of double-spaced transcripts.

Regarding physiological benefits, all participants agreed that dog guardianship was good for their health, describing it as a motivation, and dog-walking was seen as a valuable form of regular physical exercise. The psychological benefits identified by participants included how dogs had "affected and enhanced the participant's quality of life, providing companionship and comfort" (Knight & Edwards, 2008, p. 444) by giving unconditional love. Also identified was the dog as a family member, and participants believed their lives to be much richer for the presence of their dog. "The rewards from living with a dog were emphasized when dogs were described as therapists for their owners" (p. 445). Dogs also provided a sense of security and protection for elderly participants, who perceived that they were safer when walking with a dog as well as in their own homes.

Elderly guardians are severely distressed when they lose a pet, need to have a beloved pet euthanized, or when a transfer to a resident care or hospital necessitates the animal relocated to another home or animal shelter. Morley and Fook (2005) stressed the need not to marginalize or trivialize pet loss in people's lives and address the need to see this as a more general social concern.

> If human/animal bonds are described and valued only in comparison to purely human relationships, then the human/animal relationship is essentially devalued, and we are prevented from appreciating what unique and different attributes such companionship might bring. (p. 134)

As discussed, the prevalence of research on pet guardianship has focused mainly on interactive pets, such as dogs and cats. However, some individuals are unable to participate in this type of relationship due to asthma or allergies to pet hair or fur, the high level of

responsibility associated with an interactive pet (in the case of high travel requirements for employment), a compromised immune system, susceptibility to animal-transmitted diseases, lack of physical capacities, or restrictions of pet guardianship in rental or leasing contracts. In these cases, fish guardianship is an attractive alternative for many people. Langfield and James (2009) utilized a qualitative phenomenological method to explore guardianship of fish as pets. Nine participants responded to questions in semistructured interviews, resulting in the emergence of four themes; their reasons for fish guardianship, fish environment, caring for pet fish, and benefits of owning fish as pets. A number of participants gave their fish names, and different personality traits were noted; however, "one participant cannot eat seafood because she feels like she is eating her pet" (p. 354). Key findings of the study concluded that pet fish guardianship is a meaningful occupation that provides purpose and enjoyment in life, and "pet fish may be an alternative to interactive pets, and one that therapists can recommend to appropriate clients" (p. 355).

(8) What people think about animal thinking

The Best Friends Animal Society (2006) conducted a random-dial telephone survey of 1,000 registered voters. The respondents agreed overwhelmingly that humans have a moral obligation to protect animals and are adamant about passing these values on to their children; 89% said animals should never be abused. More action is needed, however, to support these beliefs. Only 40% of respondents said that they donate to animal welfare organizations, 43% adopt their pets from shelters, and only 7% have ever volunteered at a local shelter. Based on the findings of this national poll, the Kindness Index was derived from a selection of survey questions. "Our ideals drive the index higher, while our actions tend to pull it back down. On a scale of 1 to 10, the (2006) Kindness Index comes out at 5.86. We can certainly do better" (p. 2).

Maust-Mohl, Fraser, and Morrison (2012) interviewed 68 visitors to the New York Hall of Science and Staten Island Zoo, asking qualitative questions regarding their perceptions of animal thinking. The interview comprised eight open-ended questions to access the participant's knowledge of animal cognition (learning and memory, communication, and awareness). Demographic analysis revealed that "participants who had dogs and/or cats, a college education, or watched nature shows were more likely to support the belief that animals can think" (p. 133). Questions regarding animal deception, empathy, and awareness were the most challenging, with the animal awareness question more likely to elicit a negative response (n = 24) or "I don't know" (n = 16) response. Results from these qualitative interviews were used to develop an online consumer survey for American museum visitors to aid in the development of an exhibit on animal minds. The online survey participants (n = 525) were asked to respond to 39 randomized statements about animal cognition and eight demographic questions. In the online survey, the same demographic group agreed with the statements about animal thinking. "The bond between people and their pets or companion animals may facilitate a connection to animals and acceptance of cognitive abilities through their interactions and emotional attachment" (p. 144).

Animal-Assisted Activities and Animal-Assisted Therapy

The use of companion animals in medical settings dates back more than 150 years. Florence Nightingale recognized that animals provide a level of social support in the care of the ill and suggested that "a small pet animal is often an excellent companion for the sick, for long chronic cases especially" (Nightingale, 1969, p. 102). Although media attention is always positively generated for animal-assisted interventions, Kruger and Serpell (2006) suggested that they are "best described as a category of promising complementary practices that are still struggling to demonstrate their efficacy and validity" (p. 21).

Pet Partners (formerly Delta Society) is recognized as one of the country's largest human-services organizations dedicated to improving people's health and well-being through positive interactions with animals (Pet Partners, 2012a). The study of the human-animal relationship has recently been recognized by the National Institute of Child Health and Human Development with a new competitive research grant program to fund studies of the association between pet guardianship and physical and mental health, as well as the use of animals in both physical and psychological therapeutic treatments (National Institute of Child Health and Human Development, 2012).

Animal-assisted activities (AAA) provide opportunities for motivation, education, recreational, and/or therapeutic benefits. These are commonly meet-and-greet activities of pets visiting with people in hospitals, nursing homes, or other public events. The same activity is repeated with many people. Many structured programs exist in hospitals and nursing homes. Another example is the Lutheran Church Charities, which sponsors a K-9 Parish Comfort Dog program that responds to disaster response situations with 60 trained dog teams across six east coast states "utilizing the unique skills of dogs, specifically Golden Retrievers, to open opportunities to touch people. . . . Our dogs are trained service animals prepared to interact with people in ways that provide a bridge for compassionate ministry to take place" (Lutheran Church Charities, 2012, p. 1).

Animal-assisted therapy (AAT) is a more structured, goal-directed intervention that meets specific criteria as an integral component of a treatment process. Progress is measured and sessions are supervised. The supervision may be with a licensed physical therapist, a psychologist, social worker, recreational therapist, or occupational therapist. The therapy may encompass a stroke victim using a small brush to comb a dog, relearning to throw a ball, or

walking a dog for a short distance (with the handler on a double lead and walking alongside the animal). A comparison of the therapy methods is shown in Table 4:

Table 4. *Comparison of AAA and AAT*

AAA	AAT
• Casual meet-and-greet activities that involve companion pets visiting people • No specific treatment goals • Same activity can be used with many people • Detailed notes unnecessary • Visit content is spontaneous • Visit can be as long or short as desired	• Significant part of treatment for many people who are physically, socially, emotionally or cognitively challenged • Stated goals for each session • Individual treatment for each patient • Notes on patient progress taken at each session • Visit scheduled, usually at set intervals • Length of visit is predetermined to best fit medical needs of patient

Adapted from Pet Partners (2012b).

Nimer and Lundahl (2007) conducted a meta-analysis of AAT studies. The researchers reviewed 250 studies, of which 49 met their inclusion criteria. AAT has been applied to a wide variety of clinical issues, including compromised mental function, emotional difficulties, undesirable behaviors, and physical issues across all age groups; children, adolescents, adults, and the elderly. "Overall, AAT was associated with moderate effect sizes in improving outcomes in four areas: Autism-spectrum symptoms, medical difficulties, behavioral problems, and emotional well-being" (p. 225).

In a large study of hospitalized psychiatric patients, 230 patients participated in AAT recreation sessions. The effects were compared between a single AAT session or a single regularly scheduled therapeutic recreation session (without an animal). Before and after participating in the two types of sessions, participants completed the State-Trait Anxiety Inventory, a self-report measure of anxiety. Results indicated that "statistically significant

reductions in anxiety scores were found after the AAT session with patients with psychotic disorders, mood disorders, and other disorders" (Barker & Dawson, 1998, p. 797).

Equine Therapy

Animal-assisted interventions involving domestic horses (*Equus ferus caballus)* generally fall under the jurisdiction of a number of agencies. Among them are the North American Riding for the Handicapped Association (NARHA); its subsection, the Equine Facilitated Mental Health Association (EFMHA); and its affiliate partner, the American Hippotherapy Association (AHA) (Kruger & Serpell, 2006). Equine-faciliated psychotherapy (EFP) and hippotherapy are defined as follows:

- EFP is an experiential psychotherapy that includes domestic equine(s). It may include, but is not limited to, mutually respectful activities, such has handling, grooming, longeing (or lunging), riding, driving, and vaulting. EFP is facilitated by a licensed, credentialed mental health professional working with an appropriately credentialed equine professional (or the mental health professional may be dually credentialed). The therapy structure is an ongoing therapeutic relationship with clearly established treatment goals and objectives developed for the specific client (Kruger & Serpell, 2006).
- Hippotherapy is conducted by an occupational, physical, or speech therapist specially trained to use the movement of the horse to facilitate improvements in the client. Goals may include improving balance, coordination, posture, fine motor control, improving articulation, and increasing cognitive skills (American Hippotherapy Association, 2012).

Equine therapy has been used with positive results with children and adolescents for psychological and behavior issues (Trotter, Chandler, Goodwin-Bond, & Casey, 2008), for children who have experienced intrafamily violence (Schultz, Remick-Barlow, & Robbins,

2006), and equine programs designed specifically with vaulting as psychotherapy with at-risk children (Vidrine, Owen-Smith, & Faulkner, 2002). Equine hippotherapy was used with five children with spastic cerebral palsy. "All five children showed a significant decrease in energy expenditure during walking and a significant increase in scores on walking, running, and jumping" (McGibbon, Andrade, Widener, & Cintas, 1998, p. 754). Reductions in psychological issues have also been reported with adults (Klontz, Bivens, Leinart, & Klontz, 2007).

Communication Between Human and Nonhuman Animals

Domestic dogs (*Canis familiaris)* have an unusual ability to read human communicative gestures and body language compared to nonhuman primates and wolves. One theory about this capacity is that it evolved during domestication, either as a result of direct selection of this ability or as a byproduct of selection against fear and aggression toward humans. A study that tested these theories selectively bred experimental fox kits for 45 years to approach humans fearlessly and nonaggressively (i.e., experimentally domesticated; Hare et al., 2005). These kits became as skillful as dog puppies in using human gestures and were more skilled than a second, control population not bred for tame behavior. "These results suggest that sociocognitive evolution has occurred in the experimental foxes . . . as a correlated by-product of selection on systems mediating fear and aggression . . . and did not require direct selection" (p. 226).

There are several examples in the nonhuman animal world of selected individuals possessing advanced skills to communicate verbally with humans. Alex the Grey parrot (*Psittacus erithacus*) exhibited cognitive capacities comparable to marine animals such as bottlenose dolphins (*Tursiops truncatus),* Bonobo (*Pan Paniscus*) apes, and sometimes 4- to 6-year-old children. "Of particular interest is that his (Alex's) abilities are inferred not from operant tasks common in animal research, but from *vocal* responses to *vocal* questions; that is, he

demonstrates intriguing communicative parallels with young humans, despite his phylogenetic distance" (Pepperberg, 2006, p. 78). Without training and on his own initiative, Alex also appeared to transfer his ability to use "none" to comment on the absence of an attribute (different/same or smaller/bigger) to the absence of a specific quantity, as in zero. A limitation of his vocalizations was difficulties with particular sounds that required lips, such as /p/ and /sp/; these were verbalized as more of a whistle when sonographed.

The bottlenosed dolphin (*Tursiops truncates*) is known for a high level of language competency. Herman's (1986) study proposed that the dolphin's cognitive structures for the interpretation and manipulation of auditory information are highly developed. The study included an exploration of the dolphin's specializations in auditory information processing, language comprehension, sentence understanding (relational sentences, structurally novel sentences, cojoined sentences), and generalization and representation of meaning. "Overall, the positive findings on the ability to process and manipulate auditory materials complexly is in keeping with the expectations based on the extensive auditory and sound production specializations of the dolphin, and concomitant developments in auditory cortex" (p. 241).

Another species that understands the meaning of words, structures complex sentences, can build thoughts and conjugate, all by pointing to icons, is the Bonobo (*Pan Paniscus*) ape. The Great Ape Trust in Des Moines, Iowa, is home to Kanzi, one of seven Bonobos in residence. The Trust takes a novel approach, raising apes from birth with spoken and symbolic language as a constant feature of their days. Kanzi has learned 384 words by formal count, although he seems to understand dozens more. Colorful images on laminated sheets are the symbols by which he communicates. "The sheets include not just easy nouns and verbs like ball and Jello-O and run and tickle but also concept words like from and later and grammatical elements like the -ing and

-ed endings signifying tense" (Kluger, 2010, p. 1). Kanzi uses a favorite melon, honeydew, to negotiate. He points to the glyphs for green, yellow, and watermelon. He named kale "slow lettuce" because it takes longer to chew than regular lettuce. Linguists call the use of symbols *proto-grammar* and note that the ability does not constitute language. Savage-Rumbaugh responded, "The mythology of human uniqueness is coming under challenge. If apes can learn language, which we once thought unique to humans, then it suggests that ability is not innate in just us" (as cited in Raffaele, 2006, p. 1).

Telepathic Interspecies Communication

Telepathic interspecies communication, or telepathic human connection to animals, is a fascinating field in which thousands of human communicators are successfully engaged. Many have professional full-time practices with loyal clients worldwide. The Animal Communicator's Directory (2012) published by the *Species Link Journal* listed more than 150 professional communicators worldwide, with 131 in the United States and 26 in nine other countries such as Canada, Australia, England, Germany, and Switzerland (see Appendix B).

Animal telepathy may seem new, but in fact was first written about by William J. Long in 1919. Long was an American United Church of Christ minister and a well-known naturalist of the early 20th century. He completely accepted animal telepathy as "a natural gift or faculty of the animal mind, which is largely unconscious, and it is from the animal mind that we inherit it—that the animals inherit this power of silent communication over great distances is occasionally manifest even among our half-natural domestic creatures" (Long, 1919, p. 70).

There are very limited published research studies on the topic of telepathic animal communication, but many books and non-peer-reviewed articles are available. One of the few published studies on telepathic animal communication is the doctoral thesis of Vittitoe (2005).

This study examined the "essence of becoming and being an animal communicator through the lived experience of seven women who practice interspecies telepathic communication" (p ii).

Sheldrake (1998) has studied unexplained animal powers since 1988. One of his early studies was a telephone survey in London to determine "how any pet owners had observed seemingly telepathic abilities in their pets" (Sheldrake, Lawlor, & Turney, 1998, p. 57). In this study, 52% of dog owners claimed that their animals knew in advance when a household member was on the way home, compared with 24% of cat owners. Of these animals that had an obvious reaction, 21% of the dogs and 19% of the cats were said to react more than 10 minutes before the person's arrival at home. In addition, 43% of dog owners and 41% of cat owners indicated that their pets responded to their thoughts or silent commands; that the animal knew what their human was thinking. The results of this survey were compared to similar surveys in Northwest England and in California, showing a general pattern of remarkable similarity (Sheldrake et al., 1998).

Another of Sheldrake's studies was with a human guardian and an African Grey parrot (*Psittacus erithacus*) of extraordinary language skills (Sheldrake & Morgana, 2003). At the time of the study, Morgana shared her life with a then 10-year-old African Grey named N'kisi. Starting at five months old, Morgana worked to train N'kisi with two techniques known as sentence frames and cognitive mapping. At five years old, he had a contextual vocabulary of more than 700 words, and by January 2002, Morgana had recorded more than 7,000 original sentences from N'kisi. The parrot has awakened Morgana by commenting on the actions in her dreams.

Video-taped trials were conducted in 2003. Morgana and N'kisi were separated in different rooms, on different floors, while a video camera filmed each of them separately.

Morgana would open an envelope with a photo in it and study it for about 20 seconds. N'kisi was to pick up her thoughts and state out loud appropriate keywords and/or sentences to describe the picture. In the statistical analysis, N'kisi scored significantly more hits than expected by chance, which implies that N'kisi was influenced by Morgana's mental activity while she was studying the photos, even though he could not see her, hear her, or receive other normal sensory clues.

Conclusion

Animal consciousness and cognition research continues to reveal new information regarding animal's theory of mind, self-awareness, and similar visual experiences as humans. The Francis Crick Memorial Conference brought together a prominent international group of leading scientists who agreed and signed the Cambridge Declaration on Consciousness which acknowledged, for the first time, a scientific acceptance that "evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness" (Low, 2012, p. 2). The depth of cognition in an African Grey parrot (*Psittacus erithacus*) has been documented by Pepperberg (2008, 2009), and even the ability of a honeybees (*Apis melllifera*) to learn and memorize tasks is impressive (Brown & Demas, 1994; Brown, Moore, Brown, & Langheld, 1997; Chittka, Gumbert, & Kunze, 1997; Greggers & Menzel, 1993).

Mirror self-recognition (MSR) tests have moved beyond the great apes and shown positive results with dolphins, elephants, and magpies. Other species who live in complex social structures requiring cooperation and adaptability might also be excellent candidates for MSR testing. The essence of empathy is emotional linkage among conspecifics; future research for empathy studies should focus on a broad array of taxa, concerning not only those species with which humans are familiar as companion animals, or those with whom they are closely related (nonhuman primates) but also species that differ in the expression of emotions.

> Even if joy and grief in dogs are not the same as joy and grief in chimpanzees, elephants, or humans, this does not mean that there is no such thing as dog joy, dog grief, chimpanzee joy, or elephant grief. (Bekoff, 2000, p. 868).

Clearly, the benefits of the human-animal bond are extensive, and our modern society would be significantly less safe and healthy without animals in our lives. As this essay has detailed, research has revealed dairy cows produce more milk when they have names; trained raptors can protect our airports and urban water supplies from wildlife pests; and the power of canine scent detection protects us in a myriad of ways, from explosives and landmines to insects and cancer identification. Canines may even improve the health and quality of life of epileptic seizure patients by responding to specific changes that precede a human seizure. The extensive studies of the last 30 years confirm the positive benefits of animal companionship on human physiological and psychological health. Animal-assisted activities and therapy, including equine therapy, are increasingly common and accepted as effective treatments in medical care facilities, a well as treating autism-spectrum symptoms, behavioral and anxiety issues, psychotic disorders and mood disorders.

Communication between human and non-human animals is a promising area of continued research. Clearly certain species such as the African Grey parrot [*Psittacus erithacus*], Bonobo ape [*Pan Paniscus*], and bottlenose dolphin [*Tursiops truncates]* have exceeded previous expectations of their communication abilities. Telepathic interspecies communication as explored by Long (1919) and more recently Sheldrake, Lawlor, and Turney (1998) and Sheldrake and Morgana (2003) is one more component of that continuum now appropriate for structured research.

Animals can keep people connected to their hearts, without which there is no real meaning in life. When people remain connected to their hearts, they will not lose their way in

their mental abstractions and technological innovations that attempt to consume the focus of their lives. When people leave any living beings out of consideration, they cannot be whole. Still deeply connected to nature and their natural place in the universe, animals have much to teach people. “The animals have lifted a veil and made a connection with us in that place where we are all one. The animals are calling us to council” (Eirich, 2012, p. 4).

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APPENDIX A

THE CAMBRIDGE DECLARATION ON CONSCIOUSNESS*

On this day of July 7, 2012, a prominent international group of cognitive neuroscientists, neuropharmacologists, neurophysiologists, neuroanatomists and computational neuroscientists gathered at The University of Cambridge to reassess the neurobiological substrates of conscious experience and related behaviors in human and non-human animals. While comparative research on this topic is naturally hampered by the inability of non-human animals, and often humans, to clearly and readily communicate about their internal states, the following observations can be stated unequivocally:

- The field of Consciousness research is rapidly evolving. Abundant new techniques and strategies for human and non-human animal research have been developed. Consequently, more data is becoming readily available, and this calls for a periodic reevaluation of previously held preconceptions in this field. Studies of non-human animals have shown that homologous brain circuits correlated with conscious experience and perception can be selectively facilitated and disrupted to assess whether they are in fact necessary for those experiences. Moreover, in humans, new non-invasive techniques are readily available to survey the correlates of consciousness.

- The neural substrates of emotions do not appear to be confined to cortical structures. In fact, subcortical neural networks aroused during affective states in humans are also critically important for generating emotional behaviors in animals. Artificial arousal of the same brain regions generates corresponding behavior and feeling states in both humans and non-human animals. Wherever in the brain one evokes instinctual emotional behaviors in non-human animals, many of the ensuing behaviors are consistent with experienced feeling states, including those internal states that are rewarding and punishing. Deep brain stimulation of these systems in humans can also generate similar affective states. Systems associated with affect are concentrated in subcortical regions where neural homologies abound. Young human and nonhuman animals without neocortices retain these brain-mind functions. Furthermore, neural circuits supporting behavioral/electrophysiological states of attentiveness, sleep and decision making appear to have arisen in evolution as early as the invertebrate radiation, being evident in insects and cephalopod mollusks (e.g., octopus).

- Birds appear to offer, in their behavior, neurophysiology, and neuroanatomy a striking case of parallel evolution of consciousness. Evidence of near human-like levels of consciousness has been most dramatically observed in African grey parrots. Mammalian and avian emotional networks and cognitive microcircuitries appear to be far more homologous than previously thought. Moreover, certain species of birds have been found to exhibit neural sleep patterns similar to those of mammals, including REM sleep and, as was demonstrated in zebra finches, neurophysiological patterns, previously thought to require a mammalian neocortex. Magpies in particular have been shown to exhibit striking similarities to humans, great apes, dolphins, and elephants in studies of mirror self-recognition.

- In humans, the effect of certain hallucinogens appears to be associated with a disruption in cortical feedforward and feedback processing. Pharmacological interventions in non-human animals with compounds known to affect conscious behavior in humans can lead to similar perturbations in behavior in non-human animals. In humans, there is evidence to suggest that awareness is correlated with cortical activity, which does not exclude possible contributions by subcortical or early cortical processing, as in visual awareness. Evidence that human and nonhuman animal emotional feelings arise from homologous subcortical brain networks provide compelling evidence for evolutionarily shared primal affective qualia.

We declare the following: "The absence of a neocortex does not appear to preclude an organism from experiencing affective states. Convergent evidence indicates that non-human animals have the neuroanatomical, neurochemical, and neurophysiological substrates of conscious states along with the capacity to exhibit intentional behaviors. Consequently, the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Nonhuman animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates."

***** The Cambridge Declaration on Consciousness was written by Philip Low and edited by Jaak Panksepp, Diana Reiss, David Edelman, Bruno Van Swinderen, Philip Low, and Christof Koch. The Declaration was publicly proclaimed in Cambridge, UK, on July 7, 2012, at the Francis Crick Memorial Conference on Consciousness in Human and non-Human Animals, at Churchill College, University of Cambridge, by Low, Edelman and Koch. The Declaration was signed by the conference participants that very evening, in the presence of Stephen Hawking, in the Balfour Room at the Hotel du Vin in Cambridge, UK. The signing ceremony was memorialized by CBS 60 Minutes.

Appendix B

Species Link Journal: Professional Animal Communicator's Directory

United States	# Listed	International	# Listed
Arizona	9	Canadian Provinces	
California	23	Alberta	2
Colorado	8	British Columbia	5
Connecticut	2	Ontario	2
Florida 6	6	Quebec	2
George	2		
Hawaii	2	Australia	3
Illinois	2	China	1
Iowa	2	England	3
Kentucky	1	Germany	3
Maryland	2	Mexico	1
Massachusetts	4	South Africa	1
Michigan	2	Spain	1
Minnesota	5	Switzerland	2
Montana	2		
Nevada	1		
New Hampshire	2		
New Jersey	3		
New Mexico	1		
New York	13		
North Carolina	5		
Ohio	1		
Oregon	6		
Pennsylvania	5		
Texas	5		
Vermont	4		
Virginia	2		
Washington	7		
Wisconsin	3		
Wyoming	1		
Total	131	Total	26

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