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REVIEW

Companion animals and human health: Benefits, challenges, and the road ahead

Marguerite O'Haire

School of Psychology, University of Queensland, Brisbane, Queensland 4072, Australia.

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Abstract Fossil evidence indicates an association between human beings and animals dating back at least half a million years. Today, this relationship remains strong, as evidenced by millions of visits to zoos annually, high rates of pet ownership, and the economic prosperity of the pet industry. A review of the literature indicates that human-animal interactions can remarkably enhance human physical health and psychological well-being. Yet despite reported benefits and public enthusiasm for animal-related activities, human affiliation with animals and nature is rapidly on the decline largely owing to a shift toward industrialized city living. Future research should not only continue to examine the mental and physical health implications of companion animal ownership, but also the ways to most successfully incorporate them into modern lifestyles and communities.

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Introduction

Human relationships with companion animals are not new. Fossil evidence from half a million years ago indicates an association between *Homo erectus* and a canine-like species (Messent and Serpell, 1981). Even before human beings settled into agricultural communities, they kept wild and tamed animals as companions (Savishinsky, 1983). More recently, scientists discovered a 12,000-year-old tomb in modern Israel, in which a person was buried with one arm around a puppy. The scientists who discovered the fossil claim that the arrangement of the burial proves that an affectionate, rather than gastronomic, relationship existed between the person and the animal (Davis and Valla, 1978).

Today, this relationship remains strong. Millions of people each year travel and pay money to spend the day viewing

animals at the zoo. In the United States and Canada, more children and adults visit zoos than all major professional sporting events combined (Wilson, 1993). In Australia and the United States, approximately 63% of households own domesticated pets (Australian Bureau of Statistics, 1995; American Pet Products Manufacturers Association, 2008). The pet care industry alone contributes an annual average of AU \$4.62 billion to the Australian economy and US \$43.4 billion to the US economy (Australian Companion Animal Council Inc., 2006; American Pet Products Manufacturers Association, 2008).

Pet owners spend enormous amounts of money, time, and energy on creatures that seem to give nothing of utilitarian value in return. Owners allow companion animals to live in their homes for free, pay for their food and medical bills, and often purchase many toys and accessories for them. At first glance, the return for human beings seems nonexistent. Many pet owners, however, report that their companion animals give a great deal in return in the form of affectionate attachments known as the human-animal bond (Beck and Katcher, 1996). The perceived mutual affection between companion animals and their human counterparts is

Address for reprints and correspondence: Marguerite O'Haire, School of Psychology, University of Queensland, Brisbane, Queensland 4072, Australia.

E-mail: marguerite.ohaire@uqconnect.edu.au

supported by the loving and pleasant feelings often experienced during interactions (Archer, 1997). These feelings have spurred a unique field of research called human-animal interactions. An emerging literature in the area has revealed that interacting with companion animals can remarkably enhance human health and well-being. Although exciting scientific advances have been made, the future of the field will require attention to the unique nature and challenges of human-animal interactions and their research.

In order to explore the benefits and challenges associated with human-animal interactions, in a future article we will begin by presenting the initial studies that garnered public interest, then explore two of the most commonly cited theoretical frameworks, highlight empirically supported applications among the general public and in therapeutic interventions, discuss the difficulties facing human-animal interactions and their study, and finally, present ideas for future research.

Initial research

In 1980, a group of medical researchers conducted a longitudinal study of patients with coronary heart disease (Friedmann et al., 1980). Their data indicated that one year after being discharged from a coronary care unit, pet owners were more likely to be alive than nonowners. In other words, people who owned a pet had one-third the mortality rate of those who did not own a pet. Because coronary heart disease is a stress-related disease, researchers have suggested that the protective effect of pet ownership is due to its effect on psychological risk factors (Patronek and Glickman, 1993). Thus, by reducing stress and improving mental health, companion animals may make their owners more likely to survive (Friedmann, 1995). The study by Friedmann et al. (1980) was one of the first to impress upon the general public that companion animals can and do have a great effect on our health, even on something as serious as heart disease (Beck and Katcher, 1996). Over 7 million people around the world die from coronary heart disease each year (Mackay and Menash, 2004). Evidence of the power of pets to influence this deadly disease through improved mental health jump-started a surge of research dedicated to studying the benefits of companion animals for human health.

Almost a decade later, in response to growing data indicating the positive effects of companion animals on human health, the US National Institutes of Health held a technology workshop on the health benefits of pets (National Institutes of Health, 1988). The final presentation of the workshop concluded with a declaration that no future study of human health should be considered comprehensive if the animals with whom people share their lives are not included (Beck and Glickman, 1987).

In 1994, Australian researchers conducted the National People and Pets Survey, which was the first national study to investigate the relationship between pet ownership and

human health (Headey, 1999). The results indicated that dog and cat owners had better mental and physical health than nonowners. They made fewer annual doctor visits and were less likely to be on medication for heart problems or sleeping difficulties. Headey (1999) thus deduced that pet ownership probably reduces national health expenditure. To calculate savings, it was assumed that all recurrent health expenditures (excluding capital expenditures) could be divided proportionately to the number of doctor visits made by each person. For example, people who visit the doctor more often are responsible for proportionately more hospital costs, pharmaceutical costs, salary costs, and so on. Therefore, because the national sample survey data indicated that pet owners made fewer doctor visits, it was estimated that during the fiscal year of 1994-1995, A \$988 million were saved due to pet ownership (Headey, 1999). A subsequent longitudinal study based on the fiscal year of 1999-2000 estimated that AU \$3.86 billion was saved because of pet ownership (Headey et al., 2002). It should be noted that these savings do not include potentially increased costs related to pet ownership, such as injuries caused by dogs (particularly bites), garbage expenditure, and the normal costs of pet keeping (e.g., food and veterinary expenses). Additionally, expenditure savings by both individuals and governments will vary based on the type of health care system in use, whether public or private. The reported savings, therefore, serve as an indication of the potential health benefits of pets, rather than a fiscal argument for pet ownership. The researchers concluded that small differences in health system use between pet owners and nonowners may equal huge savings in public health expenditure (Headey, 1999; Headey and Grabka, 2007).

Two hypothesized mechanisms

Following these and other instrumental publications on the health and financial benefits of pet ownership, researchers began to look at the underlying mechanisms of human-animal interactions. Many theories have been proposed, yet there is currently no unified, empirically supported theoretical framework to describe how companion animals benefit the mental and physical health of human beings (Kruger and Serpell, 2006). Two of the most commonly cited theories include the biophilia hypothesis and the social support hypothesis.

Biophilia hypothesis

The biophilia hypothesis proposes that human beings have an innate propensity to attend to and be attracted by other animals and living things (Wilson, 1984). Evolutionarily, attention to animals would enhance an individual's chances of survival because animal behavior acts as an environmental sentinel indicating safety or danger (Wilson, 1984, 1993).

Today, living creatures continue to provide a pleasant external focus for attention, which has a calming and relaxing effect on viewers (Gullone, 2000). However, with the increasingly urban lifestyles of modern industrialized societies, many people find fewer and fewer opportunities to interact with animals and nature (Maller et al., 2005). Having a companion animal in the home may provide a link to human evolutionary history that enhances psychological well-being (Gunter, 1999).

Looking at animals, for example, can reduce anxiety in times of stress (Friedmann, 1995). When in the presence of a pet dog, people show reductions in cardiovascular, behavioral, and psychological indicators of anxiety (Friedmann et al., 1983; Wilson, 1991). Friedman et al. (1983) examined the effect of the presence of a friendly dog on children's blood pressure while resting and during the mildly stressful task of reading aloud. The study used a within-participants design, whereby each participant experienced resting and reading, both with and without the dog present. Order of conditions was counterbalanced across participants. Results indicated that children's blood pressure during both resting and reading was lower in the presence of the dog. The authors concluded that the presence of an animal can reduce anxiety in mildly stressful situations. Wilson (1991) conducted a similar study, in which anxiety levels of undergraduate students were measured during three conditions: reading aloud, reading quietly, and interacting with a friendly dog. A within-participants, repeated-measures design was used, in which blood pressure was measured at 2-minute intervals over a 10-minute baseline period, followed by the three experimental conditions. Order of conditions was again counterbalanced across participants. Results indicated that blood pressure was lower while the subjects were reading quietly and interacting with the dog than while reading aloud. The researchers concluded that interacting with an animal has an anti-anxiety effect similar to relaxation activities such as reading quietly. A limitation to the study was the confounding factor of talking, which occurred during both reading aloud and interacting with the animal, but not during reading quietly. Future research may expand on this study by incorporating a control condition that also facilitates talking.

Another example of the anxiety-reducing effects of looking at animals can be seen in the calming effects of watching a fish tank. Many doctors' office waiting rooms house aquariums because of their effectiveness in lowering heart rate and blood pressure during stressful situations, such as waiting to undergo surgery (Katcher et al., 1984; Beck and Katcher, 1996). Katcher et al. (1983) compared blood pressure as a physiological indicator of stress in participants while they were watching a small aquarium containing tropical fish, watching a blank wall, or during the mildly stressful task of reading aloud. Results indicated that watching the fish lowered blood pressure and produced a state of relaxation. For participants with hypertension, watching the fish tank lowered blood pressure to levels within the normal range. The authors conclude that viewing animals, regardless of

whether they are familiar or bonded, can reduce anxiety and tension. DeSchrive and Riddick (1990) conducted a similar study on the psychophysiological effect of viewing aquariums with an elderly population. The investigators compared pulse rate and muscle tension while participants watched a fish aquarium, fish videotape, or placebo videotape. Results indicated that participants who viewed either the fish aquarium or fish videotape had a lower pulse rate and lower muscle tension than participants who viewed the placebo videotape. The authors suggest that viewing animals and nature, whether live or videotaped, has a relaxing effect on viewers. Further research across different age groups and cultural backgrounds will be useful in elucidating the effect of viewing aquariums.

Even unconsciously, the presence of an animal can change a person's perception of a scene. Researchers have tested this phenomenon by using a modification of the Thematic Apperception Test (Murray, 1943). The original test provides pictures of people in provocative, yet ambiguous, scenes and asks participants to describe the scenes. The Animal Thematic Apperception Test (ATAT) expands upon this framework by having two sets of pictures, identical except for the presence or absence of an animal (Lockwood, 1983; Friedmann and Lockwood, 1991). Lockwood (1983) presented participants with pictures from the ATAT and asked them to describe the people in the scenes. People in scenes with animals were consistently described as friendlier, happier, and less threatening than the same people in scenes without animals. Friedmann and Lockwood (1991) replicated this methodology with a larger, more diverse sample and found similar results. The researchers concluded that a person's perception of a situation influences his or her stress response (Lockwood, 1983; Friedmann and Lockwood, 1991). The ATAT reveals that when an animal is present, people perceive situations as less stressful and are able to react more calmly, which may enhance their psychological well-being (Friedmann, 1995).

Social support hypothesis

Another commonly cited theory regarding the benefits of human-animal interactions is the social support hypothesis. Lack of social support is a huge risk factor for subsequent physical and psychological problems (Uchino et al., 1996). The social support hypothesis proposes that companion animals are a social support in and of themselves and also that they act as facilitators of social interactions between other human beings (Beck and Katcher, 2003; Kruger and Serpell, 2006; McNicholas and Collis, 2006).

As social supports in and of themselves, companion animals reduce loneliness and contribute to a general sense of well-being in their owners (Sable, 1995). Reasons cited for their success as social supports include their constant availability, nonjudgmental support, and unconditional love (Friedmann et al., 1980; Kruger et al., 2004). As

such, people form strong attachments to their pets. Many people consider their pet to be a member of the family and say that the loss of a pet would mean as much to them as the loss of a family member or friend (Cain, 1983; Beck and Katcher, 1996).

Examples of the benefits of companion animals as social support include statements by cancer patients, who say that the presence of a companion animal lessens their fears, despair, loneliness, and isolation and enables them to adapt to their extremely difficult situations (Muschel, 1984). Social support from companion animals can also be crucial for the elderly, who often lose human social support because of friends and family moving away or passing away (Bustad and Hines, 1983; Beck and Katcher, 2003). Siegel (1990) examined the use of physician services among people over the age of 65 over a 1-year period. After controlling for demographic characteristics and health status, results indicated that pet owners made fewer visits to physicians and were therefore buffered from the effect of stressful life events on physician service use. After controlling for health status, the researchers deduced that pet ownership primarily influences social and psychological processes, rather than directly influencing physical health. They conclude that the stress buffering effect of pets may be a result of their ability to provide social support to their owners. In a similar study, Norris et al. (1999) collected questionnaire data from retired persons regarding their life satisfaction and perceived health. Pet owners reported higher life satisfaction and perceived health than non-owners. The authors cite the non-evaluative social support provided by animals as one of the reasons for positive life perceptions among their owners. One limitation of both studies is the correlational nature of the data, in that the type of people who choose to own pets may have greater health and life satisfaction than those who choose not to own pets. Further research is necessary to tease apart any causal direction in the relationship.

As facilitators of social support between human beings, companion animals act as "social lubricants" (Gunter, 1999). They facilitate social interactions for their owners because they encourage approaches by others and often stimulate conversation (McNicholas and Collis, 2006). For example, Eddy et al. (1988) conducted a study in which a person in a wheelchair was stationed in a heavily trafficked pedestrian locale, such as a shopping mall or college campus. The person in the wheelchair was either alone or with a service dog. An observer stationed nearby recorded the number and type of social approaches by strangers. Results indicated that participants with a dog received more positive social approaches, including smiles and conversations, than participants without a dog present. The authors conclude that the presence of an animal may help people overcome social isolation because of the socializing effects of animals. Further research will be necessary to evaluate the socializing effects of different types of animals among various populations and settings.

Applications

Taken together, the current published data indicate the potential of human-animal interactions to benefit human mental and physical health and well-being. Initial studies documented the relationship between companion animals and human physical health by noting increased survival rates from coronary artery disease, decreased medication use, and fewer visits to physicians among pet owners. The biophilia hypothesis highlights the capacity of human-animal interactions to reduce cardiovascular, behavioral, and psychological indicators of stress and anxiety. The social support theory emphasizes the capacity of human-animal interactions to reduce loneliness and increase psychological well-being and life satisfaction. Researchers have thus speculated that companion animals may play an important role in human development and well-being, from childhood throughout the lifespan. On the basis of this assumption, volunteers and professionals have begun to incorporate animals into therapeutic work.

The practice of using animals as a part of therapy dates back to the late 18th century, when animals were introduced into mental institutions to help socialize patients with mental disorders (Serpell, 2006). Only recently, however, have scientists and practitioners begun to create standardized terms for these endeavors (Kruger and Serpell, 2006). The umbrella term *animal-assisted intervention* is defined by Kruger and Serpell (2006) as "any intervention that intentionally incorporates animals as part of a therapeutic or ameliorative process or milieu." The term "therapeutic" in this instance refers to the ameliorative nature of the interactions, rather than necessarily indicating a curative medical or psychiatric treatment. The two most commonly cited subcategories include *animal-assisted therapy* and *animal-assisted activities*. The main difference between the two is that animal-assisted therapy revolves around specific, individualized goals, whereas animal-assisted activities have no specified treatment goals and can be used identically with many people (Gammonley et al., 1997; Delta Society, n.d.). Animal-assisted activities, therefore, provide opportunities for therapeutic benefits through spontaneous interactions, but they do not constitute a targeted therapy, which involves the goal-directed treatment of a symptom or impairment (Kruger and Serpell, 2006). Some debate exists over the exact distinction between animal-assisted therapy and animal-assisted activities, and in the past the field has lacked a uniform method of reporting intervention type. At present, these definitions represent the most up-to-date and widely accepted classifications (Kruger and Serpell, 2006; American Veterinary Medical Association, 2007; Delta Society, n.d.).

Numerous benefits have been reported from animal-assisted interventions. Examples include reduced anxiety during and after therapeutic sessions; improved rapport and communication between patients and therapists; enhanced attendance at, compliance with, and retention in therapy; and improved behavior outside the context of therapy

(Barker and Dawson, 1998; Katcher and Wilkins, 1998; Kruger et al., 2004; Fine, 2006). The research on animal-assisted interventions for targeted populations is still in its infancy, but the studies conducted to date have yielded encouraging results (Wilson and Barker, 2003; Kruger and Serpell, 2006).

For example, a few studies have examined the effect of animal-assisted interventions for people with Alzheimer's disease, which is a neurological disorder that significantly impairs a person's general health and well-being (American Psychiatric Association, 2000). It affects 1 in 10 people over the age of 65, and nearly half of people over the age of 85 (Hingley and Ruggeri, 1998). Because there is currently no successful cure or method of prevention, the main goal of most interventions is to improve patients' quality of life (Edwards and Beck, 2002). Research has demonstrated that animal-assisted interventions for persons with Alzheimer's disease can increase socialization, decrease aggression and agitation, and increase nutritional intake and overall health (Baun and McCabe, 2003; Filan and Llewellyn-Jones, 2006). One study, by Batson et al. (1997), examined the effect of the presence of a therapy dog on participants with Alzheimer's dispersed across three long-term care facilities. Order of sessions (with vs. without therapy dog) was counterbalanced across participants. Results indicated that in the presence of the therapy dog, participants demonstrated increased socialization, as assessed by videotaped coding of predetermined social interaction variables, including the frequency and duration of smiles, tactile contact, looks, physical warmth, and praise. Limitations in this study included the use of only one brief session (10 minutes) without examining any lasting effects over time, and the lack of a control condition to examine changes that may have been due to the novelty effect of animal presence. These limitations are a common theme throughout the animal-assisted intervention literature and will need to be addressed in future research.

Another study, by Edwards and Beck (2002), used a time series design with a nonequivalent control group to examine the effect of the introduction of a fish tank to an Alzheimer's disease care unit. Baseline weight and nutritional intake were assessed over a two-week period, followed by either the introduction of a fish aquarium (animal-assisted intervention) or a scenic ocean picture (control intervention for the novelty effect of a change in environment). Results indicated that both weight and nutritional intake significantly increased each week over an eight-week period for the group with the fish aquarium. Participants in this group also demonstrated increased morale and required less nutritional supplements, resulting in reduced health care costs. The authors concluded that the implementation of an animal-assisted intervention with a fish aquarium may be an efficient means of enhancing nutritional intake for individuals with Alzheimer's disease (Edwards and Beck, 2002). One limitation to this study was the use of a convenience sample, whereby participants were assigned to a condition based on their treatment center

rather than random assignment at the individual level. Because of the nature of the intervention, individual random assignment would have compromised the integrity of the treatment groups and therefore was not feasible. The ability of many animal-assisted interventions to affect a group of individuals at the same time is a key strength in practice and often a key limitation for research design. To use more complex statistical analyses such as hierarchical linear modeling to handle group-level assignment, larger sample sizes are required, which can be difficult to recruit and financially maintain (Maas and Hox, 2005). Future animal-assisted intervention research that necessitates group-level assignment will require increased funding to support larger sample sizes for advanced statistical modeling. Attention to the optimal allocation of resources, such as the optimal design model, may be necessary to achieve the most powerful results based on the resources available (Raudenbush, 1997).

Another target population for animal-assisted intervention research has been children with attention deficit hyperactivity disorder (ADHD) and conduct disorder. Attention deficit hyperactivity disorder is a developmental disorder characterized by inattention, impulsiveness, and in some cases, hyperactivity (American Psychiatric Association, 2000). Children and teenagers with ADHD are at higher risk for health-threatening behaviors, such as smoking as well as alcohol and drug abuse (Rowland et al., 2002). Conduct disorder is characterized by a repetitive pattern of behavior linked to aggression, destructiveness, deceitfulness, and serious violations of rules (American Psychiatric Association, 2000). Conduct disorder poses a major public health concern because of the physical harm and property damage it inflicts on the community (Burke et al., 2002; Schaeffer et al., 2003). Katcher and Wilkins (2000) examined the effect of a 6-month animal-assisted intervention program for children with ADHD and conduct disorder. They used a controlled crossover design in which 50 children were randomly assigned to a nature education program focusing on either animals or outdoor activities. The animal program constituted the animal-assisted intervention condition and focused on learning about caring for and interacting with animals. The outdoor program constituted a control condition designed to be similarly helpful and attractive to participants; it focused on recreation activities such as rock climbing, canoeing, and water safety. Behavioral change was measured using standardized teacher-report and child self-report instruments. Results indicated that participants in the animal-assisted intervention condition showed increased attendance, cooperation, and engagement in learning, and decreased antisocial and violent behavior (Katcher and Wilkins, 2000). One limitation in this study was the use of informant reports as the sole means of assessing change. Future research can build upon Katcher and Wilkins's (2000) ground-breaking preliminary results by using multimodal assessments of change, such as blind ratings of participant behavior in addition to teacher, child, and parent informant reports.

A final example of utilizing companion animals for targeted populations can be seen in the study of animal-assisted interventions for children with autism spectrum disorder (ASD). ASD is a prevalent and debilitating disorder with no universal treatment protocol or cure (Lord et al., 2005). The main feature of the disorder is impairment in social interactions (American Psychiatric Association, 2000). Children with ASD tend to be rejected and victimized by their peers, which can lead to social isolation, loneliness, and in many cases, depression (Bauminger and Kasari, 2001; Bauminger et al., 2003). The lack of social support and friendships they experience early on can lead to impaired mental and physical health as they grow older (Hertzman and Wiens, 1996). Theorists and clinical practitioners who work with ASD have proposed that one successful means of helping children with ASD may be the use of animal-assisted interventions, and empirical research is beginning to support this claim (Law and Scott, 1995; Grandin and Johnson, 2005). One study by Martin and Farnum (2002) examined the effect of 15-minute therapy sessions with a live dog, a stuffed dog, or a ball. The animal-assisted therapy condition consisted of sessions with the live dog, whereas the control condition consisted of sessions with either the stuffed dog or the ball. Ten children with ASD experienced each condition once a week (3 sessions per week in total) for 15 weeks. Results from video-coded observations of sessions indicated that in the presence of the dog, children with ASD demonstrated increased playfulness, focus, and social awareness. The study is limited by a relatively small sample size and the simultaneous occurrence of all three conditions each week for each participant, which may have confounded any duration effects of a single condition over time. Future studies can build upon this promising initial research with an increased sample size and a modified study design, in which participants experience only one condition at a time.

Another study, by Bass et al. (2009), examined the effect of a 12-week animal-assisted intervention for children with ASD using therapeutic horseback riding. Participants were randomly assigned either to participate in the animal-assisted intervention or to be a part of a wait-list control group. Participants in the animal-assisted intervention group received one-hour therapeutic horseback riding lessons once a week for 12 weeks. Parent-report questionnaires were administered at pretest and at posttest. Results indicated that participants in the animal-assisted intervention condition demonstrated increased sensory and social motivation, and decreased inattention. Although their study lacked a control condition to evaluate the novelty effect of a new experience, the authors have provided a strong basis for further exploration of the benefits of animal-assisted interventions with horses for children with ASD.

In addition to persons with Alzheimer's disease, ADHD, conduct disorder, and ASD, other populations that have experienced positive outcomes include people suffering from affective disorders, anxiety, aphasia, dementia,

depression (Hoffmann et al., 2009), personality disorders, schizophrenia; and victims of abuse and neglect (Barker and Dawson, 1998; Nathans-Barel et al., 2005; Filan and Llewellyn-Jones, 2006; Macauley, 2006; Souter and Miller, 2007; Berget et al., 2008; Parish-Plass, 2008). The applications seem endless, and research is just beginning to uncover the many possibilities for incorporating animals into interventions to improve human mental and physical health. Because of the limitations of initial research, further critical scientific evaluation will be required to advance the field of human-animal interactions and the science behind the human-animal bond.

Challenges

Despite the benefits that can be gained from human-animal interactions, companion animals and their owners face struggles. In the housing industry, there has been a shift toward renting rather than owning. The majority of rental agreements prohibit companion animal ownership. With home rentals on the rise, pet ownership decreased by 7.3% in Australia and by 1.4% in Germany between 1996 and 2001 (Headey et al., 2002). It is estimated that this decline cost about AU \$495 million in increased Australian health expenditure and €367 million in increased German health expenditure (Headey et al., 2002).

Not only are companion animals being pushed out of people's homes, but they are also restricted from their community spaces. Companion animals are prohibited in many of the places where they may be needed the most, such as hospitals, nursing homes, and educational institutions. For instance, research has demonstrated that companion animals greatly benefit the elderly, yet most elders cannot own pets because of their economic situation or housing constraints (Beck and Katcher, 2003). The elderly population subsequently finds few opportunities to interact with companion animals because of the absence of animals in public and community spaces.

A final challenge lies in the rapidly growing shift toward urban living. Over the past few hundred years, many societies have experienced a hasty transformation from rural life and engagement with nature to complete disengagement and life in a human-manufactured world of artificial products and settings (Beck and Katcher, 1996; Gullone, 2000). For the first time in known history, human beings are spending little to no time in physical contact with plants, animals, and the living environment (Katcher and Beck, 1987). The consequences of this abrupt withdrawal from a defining part of human evolutionary experience are just beginning to unfold (Wilson, 1993). Recent meta-analyses indicate that the modern industrialized lifestyle of many societies has a detrimental effect on psychological health (Gullone, 2000; Maller et al., 2005).

Largely because of these factors, pet ownership and interaction with nature are rapidly on the decline. At the

same time, the rates of stress-related disorders are at an all-time high (Maller et al., 2002). Preliminary research indicates that companion animals can positively influence human mental and physical health and well-being, yet further research is critical. Unfortunately, the prohibition of animals in community spaces such as hospitals, nursing homes, and educational institutions has rendered carefully controlled, empirical studies extremely difficult in most cases, which limits the possibility of obtaining concrete and measurable results. Without results to demonstrate efficacy, funding agencies and facilitators of community spaces are hesitant to take chances on animal-assisted interventions, furthering the decline of human-animal interactions in modern, industrialized societies. The cycle continues to prevent human-animal interaction research from achieving sustainable gains in funding and research publication.

Conclusions and future directions

Knowledge of the benefits of companion animals for human mental and physical health has increased substantially in recent years. Studies have demonstrated that companion animal owners have increased survival rates from coronary artery disease and have better general mental and physical health than non-owners (Friedmann et al., 1980; Headey, 1999). Animal-assisted interventions have been successful at improving the mental health and quality of life for persons with developmental, neurological, social, and psychological impairments (Hart, 2006). Yet although the field of human-animal interactions has grown exponentially in a short time, it is still in its early stages. Although great strides have been made to establish the field and impressive results have come from its study, further investigation is critical.

Human-animal interaction research is in great need of carefully controlled, empirical studies that are able to demonstrate concrete, measurable results. Important topics for future research include the magnitude and type of benefits gained from human-animal interactions, the populations that benefit most from different types of interventions involving different species of animals, the public health implications across communities and cultures, the financial implications for individuals and the general public, and concrete strategies to foster and incorporate a sense of respect and appreciation for all life forms into everyday human life.

To examine these topics, increased funding is crucial. The resources currently devoted to human-animal interaction research will not allow for the breadth and depth of study required. Furthermore, funding for animal-assisted interventions themselves will remain scarce until research provides significant empirical data to support their efficacy. Because of the challenges of incorporating animals into many settings such as hospitals and schools, critical research has in the past been sparse. To move the field of human-animal interaction research forward, it may be

necessary to conduct small-scale studies at the institutions that will make exceptions and allow animals onto their premises. From these preliminary results, future research will be able to build and expand to conduct more rigorous and better-controlled experiments. Another way to break the cycle will be to have scientists and practitioners from a variety of disciplines work together. The study of human-animal interactions bridges many fields, such as psychology, veterinary science, biology, medicine, public policy, sociology, and environmental science. Interdisciplinary collaboration among these and other fields has the potential to exponentially increase the output of human-animal interaction research, and subsequently the financial and political support of its programming on a practical level.

Taken together, the published data have demonstrated impressive and diverse benefits associated with companion animal ownership and animal-assisted interventions. The task at present will be to collaborate to document these effects on a larger scale, to better understand the mechanisms and outcomes associated with them, and to raise awareness so that they can be better utilized to enhance the psychological well-being of communities through interaction with and respect for the living creatures with whom we share our planet.

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