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Evolution of research into the mutual benefits of human–animal interaction

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Implications

- There has been unprecedented development of research into human–animal interaction (**HAI**) in recent years, and this has produced rapid growth in our knowledge and understanding of the benefits that accrue from pet ownership.
- Recent evidence and developments in the field of HAI have improved our understanding of the role that pets play in cardiovascular health, their ability to help us cope with stress, some of the ways they can enable us to retain health and mobility into old age, that their mere presence helps us to engage with new people and strengthens communities, and that they may even enhance our immune function.
- Future research would be enhanced by the inclusion of pet-related questions in national health surveys; the adoption of standardized protocols and measures; incorporation of new technologies; and further exploration of animal-assisted interventions (**AAI**), including the expanding roles for therapy and service animals.

Key words: animal-assisted activities, animal-assisted interventions, animal-assisted therapy, anthrozoology, cats, child development, dogs, health promotion, healthy aging, horses, human–animal interaction, human health, pet ownership, pets, service animals

Introduction

If you walked into the homes of pet owners and asked whether they benefited most from the relationship or their pets, the owners would likely highlight both the care and affection they give to their pets and the affection and sense of well-being they derive from having pets in their lives. This common observation belies the difficulties researchers have had with measuring and capturing the mutual benefits of Human-Animal Interaction (**HAI**). In 1987, the National Institutes of Health (**NIH**) held a technology assessment workshop on The Health Benefits of Pets (NIH, 1987), the purpose of which was to provide the scientific community with a synthesis of current knowledge and a framework for future research, and to provide the public with the information needed to make informed decisions regarding the health benefits of pets. Experts from a variety of disciplines were brought together to review the research in five topical areas and identify concepts needing a stronger scientific base. These topical areas included: the role of pets in cardiovascular health, health correlates of pets in older persons, the role of pets in child development, the role of pets in social and therapeutic effects, and safety and risks in people–pet relationships. The group also developed recommendations for future research.

Despite the call for more research after the 1987 meeting, a workshop held on this subject 20 years later found that limited progress had been made in understanding the role pets play in human health and well-being. We still need to learn more about the physical and psychological health benefits that can accrue from these relationships both in daily life and in therapeutic settings. The 2008 workshop was the first of three convened by a public–private partnership (referred to throughout as simply the "Partnership") formed between the Eunice Kennedy Shriver National Institute of Child Health and Human Development (**NICHD**) of the NIH and the WALTHAM Centre for Pet Nutrition (**WALTHAM**), a division of Mars, Incorporated. With a shared mission to promote optimal health and well-being (for the NICHD, in children and adolescents, and for WALTHAM, in pets), the Partnership was formed with the goal of encouraging rigorous scientific research on HAI, a field known as anthrozoology, especially as it relates to child development, health, and the therapeutic use of animals with children and adolescents. This Partnership fueled greater interest and opportunities by providing, for the first time, millions of dollars in funding for HAI research.

Since 2008, unprecedented progress has been made in addressing many of the issues and questions that were raised by the 1987 workshop. A brief overview of research findings to date on the mutual benefits derived from HAI will be presented, providing a snapshot of a rapidly growing field. This overview will include well-established research findings as well as exciting new results. Finally, new research directions, including both topical areas and methodologies, will be highlighted to provide a glimpse of future areas of HAI that are ripe for exploration.

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The Role of Pets in Cardiovascular Health

Most homes in Western countries have a pet present. In the United States (**US**), for example, recent estimates put the figure as high as 68% of households, which equates to 82.5 million homes (APPA, 2014). A growing body of evidence exists on the health and psychological benefits of pet ownership (reviewed in McCardle et al., 2011b,c; Beetz et al., 2012) although some studies have failed to replicate results (Herzog, 2011). Some of the strongest evidence for the health benefits of pets has come from research on cardiovascular health (Friedmann et al., 2011). In 1980, a groundbreaking study showed that there was a significant positive association between having pets and one-year survival after hospitalization for coronary heart disease (Friedmann et al., 1980). Many psychosocial variables were assessed, but only pet ownership and social support emerged as independent predictors of one-year survival after a heart attack (Friedmann and Thomas, 1995). This work was presented at the 1987 workshop, but the panel agreed that the existing body of research was insufficient to conclusively link pet ownership to cardiovascular health. Progress in this area has since advanced so significantly that, in 2013, the American Heart Association issued a scientific statement concluding that pet ownership, particularly dog ownership, is probably associated with decreased risk of cardiovascular disease, and that it may have some causal role in reducing this risk (Levine et al., 2013).

The landmark study of Friedmann et al. (1980) not only provided clues to the potential cardiovascular benefits of pet ownership, but also to the importance of social support in human well-being. These findings led to the question of whether or not pets could be providers of social support or if that was something that could only be received from relationships with other people. Today, one of the more well-supported theories in HAI research is that some of the health benefits conferred by pets are at least partly derived from their role as providers of social support, and that this support acts as a buffer against the stresses of everyday life (Allen et al., 2001, 2002; Kikusui et al., 2006). For example, people who share their homes with pets have healthier physiological responses to stress, including reduced baseline heart rate and blood pressure, and demonstrate less cardiovascular reactivity to, and faster recovery from, mild stressors (Allen et al., 2001, 2002; Friedmann et al., 2013).

These findings are important because chronic psychosocial stress increases the release of cortisol in the body, which in turn, suppresses immune function (Friedmann et al., 2011). Several studies have found that interacting with pet or therapy dogs is associated with reductions in cortisol (Odendaal and Meintjes, 2003; Barker et al., 2010) and self-reported anxiety (Barker and Dawson, 1998). New work on the hormonal basis of the human–animal bond has also shown that oxytocin, released when people are in close physical contact (e.g., interactions between mother and infant), peaks in both people and their dogs when they positively interact and may explain the reductions in cortisol and the feelings of relaxation that relationships with animals can produce (Uvnas-Moberg et al., 2011).

The social support that animals can provide appears to be important to people during all stages of life. Children often report that their pet is a source of unconditional love (Morrow, 1998), provides comfort (McNicholas and Collis, 2001), and is a refuge when feeling upset (Covert et al., 1985); these relationships have also been linked to improvements in self-esteem (McNicholas and Collis, 2001). It has also been demonstrated that visits from therapy animals can reduce distress in children (Nagengast et al., 1997; Hansen et al., 1999), as well as decrease the perception of post-operative pain (Sobo et al., 2006). The value of social support from pets may be even more relevant for older adults because, as one ages, social networks and the support they provide may become weaker. In older adults with fewer social contacts, one study found that those having a strong attachment to a pet reported reduced rates of recent illness than those who were less attached (Garrity et al., 1989).

Health Correlates of Pets in Older Adults

In 1987, research on the health benefits of pets for older adults was primarily focused on the social support that pets could provide and the effect of pet visitation programs in long-term care facilities. Today, the focus has shifted toward "healthy aging," which is about retaining independence and quality of life by preserving physical, mental, and social well-being.

In the US, an estimated 14% of people over the age of 65 share their lives with pets (APPA, 2010), and studies have found that older adults with dogs tend to be more physically active than those without and retain their physical activity for longer (Thorpe et al., 2011). Those without dogs can benefit by walking with shelter dogs or volunteering for handler/therapy dog teams. Results from such programs have demonstrated improvements in walking speed for older adults (Johnson, 2011).

The Role of Pets in Therapeutic and Social Effects

Animal-assisted interventions: The therapeutic effects of animals

Although historical records document that Sigmund Freud often had one of his pet Chows in his therapy sessions with him, the modern practice of including animals in programs designed to aid in the treatment of physical and psychological disorders finds its roots in the writings of child psychotherapist, Boris Levinson, in the late 1960s and 1970s (Levinson, 1969, 1972). Since then, there has been an explosion of animal-assisted interventions (**AAI**) used in a loosely therapeutic sense. Today, AAI are practiced with people at all stages of life and can be found in every conceivable medical or mental health care setting, as well as in schools, universities, workplaces, community centers, juvenile detention facilities, and prisons (Griffin et al., 2011).

The rationale for the creation of AAI, or the introduction of animals into these contexts, tends to include some of the potential benefits that have already been presented (e.g., reducing stress or distress and providing social support); or goals such as assisting with behavioral change, increasing motivation, facilitating the acquisition of new skills, creating a sense of community, or inspiring social interactions.

Interestingly, the 1987 NIH report only specifically mentions therapeutic [horse] riding in its section on animal therapies, presumably because these programs were the first to begin standardizing their methods. This provides a remarkable example of how the field has changed over the past 25 years. Today, the vast majority of AAI employ dogs although interventions that include horses have remained popular (e.g., Pendry and Roeter, 2012).

The social effects of animals

Early research into the ability of animals to stimulate social interactions looked at the benefits of being accompanied by service dogs for people using wheelchairs. Along with providing opportunities for social interaction and increased community integration, studies have reported that these relationships can also enhance self-esteem and psychological well-being

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(Mader et al., 1989; Allen, 1996). These positive effects have not only been observed for people with disabilities; it is now known that animals are powerful catalysts for positive social interaction across many different contexts and have the ability to create connections that transcend racial, cultural, physical, and socioeconomic differences (reviewed in Wood, 2011).

Research is now being conducted that focuses on the community benefits of pets and the concept of *social capital*. Social capital can be somewhat difficult to define, but it has been referred to as the "glue" that holds society together (Lang and Hornburg, 1998). Social capital is created when people interact with one another, for example by volunteering, helping each other, and getting involved in community issues. Health benefits associated with high levels of social capital include reduced mortality rates and better general and mental health (Wood et al., 2009). Research has also identified relationships between strong social capital and decreases in violent crime, positive child development, and quality community governance (Wood et al., 2009). Social capital is another potential mechanism by which pets exert an influence on human health (Wood et al., 2005).

The Role of Pets in Child Development

Many children grow up with a pet in their home, and even consider the pet a member of the family or a best friend (Melson, 2001). Despite the ubiquity of these relationships, there are many unanswered questions about the influence of pets on child development. In addition to providing social support and reducing stress/distress, two areas that have gained attention and seem promising for future research include the influence of HAI on learning and immune function (for reviews, see McCardle et al., 2011b,c).

There has been little research on the effects that pets may have on learning and language development, but several studies point to potential benefits of animal-assisted programs that support learning in the classroom. Gee and colleagues have studied the effect of the presence of a therapy dog on performance of a variety of tasks in both typically and atypically developing preschool children. Their studies have found that the presence of a dog increased speed on motor tasks without compromising accuracy in comparison to conditions without the dog (Gee et al., 2007); preschool children with and without language impairment adhered to instructions for a motor skills task requiring imitation better with the dog present compared with the presence of a human or a stuffed dog control (Gee et al., 2009); children made fewer errors in an object categorization task (Gee et al., 2010a) and needed fewer instructional prompts with a memory task with the dog present (Gee et al., 2010b). Kotrschal and Ortbauer (2003) also found that children paid more attention to the teacher when a dog was present in the classroom. Findings such as these suggest that animals may enhance learning by increasing focus, attention, or motivation, but future work is needed.

There are a number of programs that claim to enhance reading skills of children through reading out loud to dogs. The efficacy of these programs, however, is still in question, as the interventions do not include reading instruction or feedback to the child. Nevertheless, the presence of a friendly animal might help some children to feel more relaxed when reading aloud. In support of this theory, Friedmann et al. (1983) reported that the blood pressure of children was reduced when reading aloud in front of a dog and, in another study, found that the presence of a dog reduced anxiety of children when reading aloud compared with the presence of an adult or friend (Friedmann et al., 2000).

Researchers are also investigating whether exposure to animals early in life can boost immune function in children. There have been mixed findings reported in the literature, especially with regard to risk for allergy and asthma, but recent studies may be providing new evidence that exposure to dogs could confer a protective benefit. Fujimura et al. (2014) conducted research indicating that exposure to dogs may introduce a specific type of bacteria into the microbiome of an infant that has been linked to protection against allergies. Another study found that in a sample of college students, petting a dog significantly increased increased salivary immunoglobulin A (**IgA**) of participants, which is an indication of immune response (Charnetski et al., 2004).

In 1987, the research on child development was primarily concerned with children's behavior and attitudes toward pets and how relationships with pets could help or hinder relationships with peers. The report called for prospective longitudinal studies in home or neighborhood settings to examine the relationships children have with animals and peers. At the time of this writing, there are no nationally representative US surveys that collect such data, but the Partnership is supporting several studies that explore the association between pet ownership and the health and development of children.

Safety and Risks in People–Pet Relationships

Previous sections have described some of the health and psychological advantages to both children and adults from interacting with pets, but these benefits are not completely without risk. The major concerns of the 1987 panel were the greater potential risk of allergies, infections and injuries. Similarly, today we consider the most notable risks of pet ownership to be animal bites, animal-related falls, and zoonotic diseases (reviewed in Haverkos et al., 2011). Fortunately, applying some simple techniques when interacting with animals is likely to significantly reduce these risks (Haverkos et al., 2011).

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The primary stated concern of the panel for a for animal well-being was potential exposure to chemicals such as insecticides and pesticides, which is less of a concern to most to most HAI researchers today. In most cases, companion animals receive mutual benefit from their associations with people. In developed countries, pets are generally provided with comfortable homes, good nutrition, and veterinary care, as well as affection and play. However, they can also experience significant challenges to their welfare. Sadly, millions of pets worldwide are relinquished to shelters or abandoned to free-roaming homeless communities of dogs and cats due to inappropriate preparation, as well as a lack of knowledge and understanding of the care necessary to keep pets in the home. To ensure the welfare of pets, there are a number of factors that must be considered, including selecting an appropriate pet for the family and its lifestyle and having a realistic understanding of the time and financial demands of providing socialization, training, nutrition, exercise, and veterinary care as needed. For service and therapy animals, it is also critical that protocols be developed to ensure that they are given breaks and adequate time to rest throughout the day. Handlers must be knowledgeable about signs of stress in their animals, and there must be a plan in place to provide relief and respite should these be seen (for a review, see Serpell et al., 2006).

Future Research Directions

We do not have the space to fully explore all of the recommendations for future research that were developed by the 1987 panel, but we will attempt to highlight the areas (not already covered in the preceding sections) where significant progress has been made; new avenues of research that could not have been envisioned in 1987; and areas that still need more research.

Including pet questions in national health surveys

The 1987 panel concluded that *"much clarity would be achieved"* by including animal-related and pet ownership questions in national health surveys. Obtaining data from nationally representative samples is important because most HAI studies have been based on small or convenience samples, which may produce findings that do not generalize to the wider population. A number of large surveys in Europe and Australia have incorporated HAI measures (e.g., the German Socio-Economic Panel, or **SOEP**; the Australian National Social Science Survey, or **ISSS-A**; and the Avon Longitudinal Study of Parents and Children, or **ALSPAC**). This has allowed researchers to examine population-level differences in the effects of HAI and how those effects vary based on measures such as household structure, socioeconomic status, and health and well-being. For example, in Germany and Australia, Headey and Grabka (2007) found that people who continuously owned a pet were the healthiest group, and people who ceased to have a pet or never had one were less healthy. Similar results have been found in China, where pet owners had better health outcomes including engaging in more exercise, sleeping better, greater self-reported fitness and health, fewer days of missed work due to sickness, and visiting their doctors less often (Headey et al., 2008). In the United Kingdom (UK), it was found that pregnant mothers who walked their dogs were more than 50% more likely to meet guidelines for physical activity than non-dog owners (Westgarth et al., 2012).

In the US, several NIH-associated studies are currently under way using data from the few American surveys that include HAI-relevant questions to explore the association between pet ownership and owner health and well-being. One such study utilized data from the Health and Retirement Study, which surveys a representative sample of Americans over the age of 50 every two years, to demonstrate the positive relationship between pet ownership and self-reported health in this age group (Bures et al., 2014). The Partnership is working with other large surveys in the US, including the Panel Study of Income Dynamics (**PSID**) Child Development Supplement, to encourage the inclusion of HAI questions. Looking ahead, it is hoped that multiple longitudinal, population-representative surveys will consider the inclusion of standardized questions on core HAI topics, including pet ownership (and reasons for owning/not owning), pet attachment, and physical activity, to facilitate cross-cultural comparisons.

Increasing methodological rigor

Many of the concerns raised by the 1987 panel had to do with a general lack of methodological rigor in existing studies of HAI. While this is still of substantial concern to the field (Griffin et al., 2011), today we are seeing more studies utilizing control groups, adequate sample sizes, and appropriate statistical methods. This will only increase as more surveys include pet ownership and attachment questions. Of particular significance is that, since the formation of the Partnership, more than 20 HAI studies have passed NIH peer-review and received funding (Esposito et al., 2011).

As the field of anthrozoology grows and studies proliferate, it will be increasingly important to compare results across studies. Only through the demonstration of convergent data will we be able to come to more definitive conclusions about the unanswered questions that have plagued the field for decades. Many researchers still resort to creating their own

measures, or significantly modifying existing measures, making it difficult (if not impossible) to replicate studies or to determine whether similar studies measured the same outcome variables. The use of common, valid measures is a first and essential step in the progress of the field.

Expansion of roles for service animals

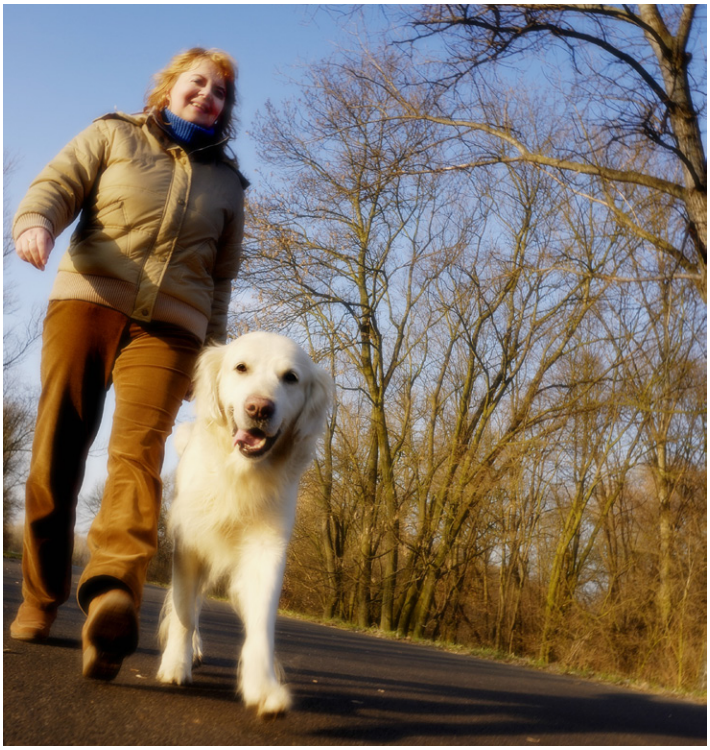
In 1987, the use of service dogs was limited primarily to guide dogs for the visually impaired, with the panel noting that *"more recently, similar animals have proven equally effective for the hearing impaired."* Today, service animals help people with a wide variety of conditions and disabilities, both physical and psychological, to lead fuller, more independent lives. For example, social circumstances and advances in science and medicine have heightened public understanding and awareness of disorders such as the autism spectrum disorders and post-traumatic stress disorder in war veterans. The prevalence of these disorders, combined with their ability to significantly impair functioning, and a shortage of effective, scientifically validated treatments has resulted in an increasing role for service animals to assist people with these conditions. Another recently developed health care role for dogs is that of "detection dog." This role includes dogs with the ability to predict when seizures will occur (reviewed by Brown and Goldstein, 2011), identify drops in blood sugar for people with diabetes (Wells et al., 2008), and detect certain cancers such as melanomas or bladder cancers. Further study and refinement of methodologies is needed in this area (Buszewski et al., 2012; Walczak et al., 2012; Wells, 2012).

Promotion of physical activity

Obesity and the health risks associated with a sedentary lifestyle had not yet entered the public consciousness as serious global epidemics when the panel met in 1987, so the members could not have envisioned the full scope of the involvement of animals in mitigating some of the risks of these conditions. Today, the many health benefits of regular physical activity are well documented and include reduced rates of cardiovascular disease, Type 2 diabetes, depression, and certain types of cancer. There has been a recent surge of studies exploring the role of dog walking as a potential means of increasing motivation for and practice of physical activity (reviewed in Johnson et al., 2011a and Christian et al., 2013). Studies have recently reported that dog owners who walk their pet are more likely to meet national guidelines for physical activity (Schofield et al., 2005). From a public health perspective, promoting dog walking as a means of reaching physical activity guidelines is appealing due to the high proportion of people who share their lives with dogs, the ease and low cost of participating in dog walking, and the type of moderate-intensity physical activity involved (for a review, see Johnson et al., 2011a, b; Bauman et al., 2011). Even modest increases in dog walking (90 min per week) may produce substantial reductions in new cases of many conditions linked to sedentary lifestyles (e.g., coronary artery disease, diabetes, and colon cancer) and may amount to many billions in health care savings. Some studies have also reported reduced rates of obesity among those who walk with their dogs (Coleman et al., 2008).

New technologies

The technology used over the last decade in psychological, biomedical, and social science research has helped facilitate important discoveries, most of which would have been inconceivable in 1987. Much of this technology is becoming more commonly used, less costly, more user-friendly,



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and shows great promise for use in HAI research. For example, functional magnetic resonance imaging (**fMRI**) is being used to answer questions about brain function underlying HAI. Human brain activity measured via fMRI has been assessed in response to positive and negatively valenced vocalizations generated by cats (familiar animal), rhesus monkeys (less familiar animal), and humans and compared with non-biological sounds (Belin et al., 2008). Human participants showed similar patterns of brain activation for emotional vocalizations (e.g., crying, whining, barking, and laughing) from both animals and humans when compared with non-biological control sounds. Study participants also differentiated between negative and positive vocalizations for both species, indicating a common human brain response to mammalian emotional expression regardless of species. Recently, a Hungarian team trained 11 dogs to lie motionless in MRI machines while listening to vocal (including vocal emotional cues) and non-vocal sounds. The fMRI results for the dogs and for humans listening to the same sounds indicate that the brains of dogs and humans show striking similarities in the way both species process emotionally loaded sounds (Andics et al., 2014).

The cost of genetic sequencing has decreased tremendously over the last decade, enabling more and larger efforts in genetic research. The entire genome of the domesticated dog has been sequenced as a single nucleotide polymorphism (**SNP**) map of the canine genome (Lindblad-Toh et al., 2005). Genetic research in HAI has focused predominantly on gene-behavior links in companion animals (primarily dogs), and association of SNP with behavioral traits has been the most common approach. For example, the dopamine D4 receptor gene (**DRD4**) and the tyrosine hydroxylase gene (**TH**) have been associated with activity, impulsivity, and inattention in Siberian Huskies (Wan et al., 2013), and TH has been associated with activity and impulsivity in German Shepherds dogs (Kubinyi et al., 2012). These types of behavioral genetics approaches in ca-

nines not only add to our overall understanding of genes and behavior, but could also aid in the selection process for guide or therapy dogs.

New technologies developed to explore biosocial relationships in humans and animals have resulted in methods that are non-invasive, easy to use, and economical. One such technique is the collection of oral fluids (saliva) for generating salivary amalytes as measures of activity in the hypothalamic–pituitary–adrenal (**HPA**) axis, hypothalamic–pituitary–gonadal (**HPG**) axis, autonomic nervous system (**ANS**), and immune function (IgA). Activity of HPA, using salivary measures of cortisol or IgA, and ANS activity can reveal reactivity to environmental or psychological stressors and degree of resiliency to stressors. Salivary collection techniques similar to those for humans have been developed for different types of domesticated animals, including dogs, cats, and horses (Siegford et al., 2003; Dreschel and Granger, 2005, 2009; Peeters et al., 2011; Bohak et al., 2013). Several HAI studies have used these salivary measures to show reduction of stress and physiological arousal in humans interacting with companion animals, primarily cats or dogs (Allen et al., 2002; Kikusui et al., 2006; Polheber and Matachock, 2013), and to assess the degree of stress in shelter animals (Hennessy et al., 1998), those serving in therapeutic roles (Haubenhofer and Kirchengast, 2006), as well as service and working dogs (Batt et al., 2009).

Traditional plasma measures of physiological and endocrine correlates of positive close contact between people (e.g., between mother and child) have been well described (reviewed in Uvnäs-Moberg, 2003). More recently, these methods have been applied to HAI. Not only does oxytocin increase in people during positive interactions with dogs (Odendaal, 2000; Odendaal and Meintjes, 2003; Miller et al., 2009), but preliminary studies suggest it also increases in dogs during these events (Uvnas-Moberg et al., 2011).

The technologies described above are just a few of the techniques that can be used to elucidate the mechanisms underlying HAI effects. Other techniques include eye-tracking software for understanding the control of attention, degree of social orienting, or how a human or animal scans a face of a conspecific or the other species (e.g., Teglas et al., 2012). There are other techniques for evaluating brain activity including functional near infrared optical brain imaging (**fNIR**; see Hillman, 2007) or electroencephalography (**EEG**) that do not rely on a stationary MRI machine. Researchers of HAI will continue to incorporate new technologies into their studies to provide a bio-behavioral evidence base to our understanding of both the human and animal mechanisms driving HAI.

Strengthening of the HAI academic research infrastructure

The late-1970s through the early-1990s was a time of tremendous growth in the field of anthrozoology; indeed, the term anthrozoology was coined during this period. The foundation for the work being conducted today was developed during this time, and the field saw the creation of new academic research centers (e.g., the Center for the Interaction of Animals and Society at the University of Pennsylvania in 1977), scholarly conferences (e.g., first International Conference on the Human/Companion Animal Bond at the University of Pennsylvania in 1981), peer-reviewed journals (e.g., *Anthrozoös* in 1987), and scientific organizations focused exclusively on HAI research (e.g., International Society for Anthrozoology, or **ISAZ**, in 1991and International Association of Human-Animal Interaction Organizations, or **IAHAIO**, in 1992). Despite this substantial early surge in the development of anthrozoology, until very recently, there were few viable career opportunities for researchers wanting to join the field. This was due primarily to a lack of adequate and consistent sources of research funding, an issue that has only been partly resolved by grants made available through the NIH/Mars-WALTHAM Partnership and governmental funding programs in other countries (e.g., the Austrian Science Fund and the UK Medical Research Council).

The broad, multi-disciplinary nature of the field also has presented a challenge in that HAI research requires well-rounded, diverse teams of scientists and practitioners (individuals with expertise in areas such as psychology, public health, animal behavior, and medicine) working together. Although research centers devoted to the study of HAI have existed since the 1970s, it is still common to be a lone researcher studying anthrozoology within an institution (or even within a particular state or country). Today, new meetings and conferences focused on topics and issues in HAI are being created all over the world, and HAI is being added as a topic on the agendas of large scientific conferences in an array of fields (e.g., the Society for Research in Child Development, or **SRCD**; the American Psychological Association, or **APA**; and the American Occupational Therapy Association, or **AOTA**). These events provide researchers with opportunities to share results, learn about new technologies and methodologies, and form collaborative relationships with other scientists across disciplines; all necessary activities for the advancement of the field.

More recently, the field has benefitted from the formation of new multidisciplinary HAI research groups and centers internationally (e.g., the Anthrozoology Research Group in Australia); the creation of centralized resources for HAI research (e.g., Human-Animal Bond Research Initiative, or **HABRI**); the emergence of new courses and degree programs for both undergraduate and graduate study (e.g., Canisius College, US; University of Windsor, Canada; University of Vienna, Austria); and the launch of the *Human-Animal Interaction Bulletin* (**HAIB**), an online, peer-reviewed journal from APA that is dedicated to publishing HAI studies. In step with the growth in these areas, there also is an increasing demand for scholars with a strong background in anthrozoology. For example, within the last

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several years, new faculty positions in HAI have been created at Purdue University (US) and the University of Denver (US), among others.

Summary and Conclusions

It is clear that remarkable strides have been made in our knowledge and understanding of the benefits that accrue from pet ownership. We now better understand the role of pets in cardiovascular health, their ability to help us cope with stress, some of the ways they can enable us to retain health and mobility into old age, that their mere presence helps us to engage with new people and to strengthen communities, and that they may even enhance our immune function.

We have also seen a tremendous proliferation of AAI with a diverse array of aims and declared benefits. Service animals (primarily dogs) are also being employed to assist with a broad range of physical, neurological, and psychological disabilities in ways that would have been inconceivable 25 years ago. While we certainly know more than we did in 1987, the incredible growth in the number and type of animal programs and services being offered has meant that research has not been able to keep pace with practice. Application of HAI research findings to therapeutic programs is still at an early stage, but it is encouraging to see a recent trend toward integration of animal-assisted practitioners and HAI researchers. Dissemination of research findings to those working in AAI, and a better understanding of the efficacy of different therapeutic practices, is needed to move these interventions from a fringe practice to evidence-based approaches with scientifically validated benefits (and potential risks) to individuals, families, and their pets. While we have seen some studies in these areas, more evidence of long-term benefits to participants is needed as well as evidence that the work being performed does not compromise animal or human well-being.

A solid foundational research base is still needed for HAI in general, not just in the area of AAI. Pet ownership is such a common phenomenon around the world that it is important to understand the mutual benefits and challenges these relationships present within the home. The 1987 call for further studies to deepen our understanding of HAI has only been partially fulfilled. Progress has accelerated in recent years, partly as a result of the Partnership (and the funding it created), but also due in part to the creation of new multi-disciplinary HAI research centers attracting scholars to the field from an array of academic backgrounds. This culture of collaboration has already led to the development of exciting, new approaches and will continue to enrich the field (Esposito et al., 2011).

The benefits of multi-disciplinary research collaborations can be tremendous, but there are significant challenges when a field spans many disciplines without standardization of terminology or measurement. Standardization of terminology and search terms would greatly aid scholars in their ability to find published work, much of which is currently spread thinly across a vast array of journals outside the field of anthrozoology (e.g., psychology, medicine, nursing, and social work). Standardization of measurement, where possible, would also help researchers to draw definitive conclusions from across studies. Increased diversity within samples and nationally representative longitudinal studies are greatly needed.

For HAI research to continue to develop as a credible scientific field, there are still some very basic questions that must be answered: For example, for whom is animal interaction most beneficial? How much contact with an animal is required to achieve benefits? Are benefits maintained after contact with an animal ends? How suitable are different species of pet partners for different populations? Increases in multi-disciplinary collaboration, advances in technology, and the inclusion of pet-related questions in national health surveys are all developments that will help scientists to answer some of these questions. However, these advancements will remain underutilized unless the continued development and improvement of a solid academic infrastructure for HAI researchers can be secured. For this to occur, funding needs to increase and come from a wider number of international funders. It is encouraging to see that since the funding program of the Partnership was launched in 2009, other government bodies have begun to fund HAI studies. Particularly outside the US, greater funding is needed to develop longer-term HAI research programs.

Although many of the research questions of today remain similar to those posed in 1987, recent advances in the field and in methodologies mean that they can now be asked in different ways and with more robust approaches. A more detailed agenda for future research can be found in Griffin et al. (2011) and McCardle et al. (2011a).

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