

# The Benefits of Human–Companion Animal Interaction: A Review

Sandra B. Barker ■ Aaron R. Wolen

## ABSTRACT

This article provides a review of research published since 1980 on the benefits of human–companion animal interaction. Studies focusing on the benefits of pet ownership are presented first, followed by research on the benefits of interacting with companion animals that are not owned by the subject (animal-assisted activities). While most of the published studies are descriptive and have been conducted with convenience samples, a promising number of controlled studies support the health benefits of interacting with companion animals. Future research employing more rigorous designs and systematically building upon a clearly defined line of inquiry is needed to advance our knowledge of the benefits of human–companion animal interaction.

**Key words:** research review, human–companion animal interaction, animal-assisted activities, controlled trials, animal-assisted intervention, human–animal bonding

## INTRODUCTION

Many articles have been published on the benefits of human–companion animal interaction and this review, while comprehensive, is by no means exhaustive. The review is the result of a comprehensive search of published research since 1980 (through June 2007) using the Medline, PsycINFO, and CINAHL bibliographic databases. The following key words were used to retrieve articles assessing the benefits of human–animal interaction: *animal bond; animal companions; animal-assisted therapy; canine visitation; companion animal; companion cat; dogs and health; human–animal; human–pet; pets and health; pet companionship; pet owners; pet ownership; pet therapy*. Dissertations and book chapters were omitted, as were articles published in journals that were not verified to be peer-reviewed in Ulrich’s Periodicals Directory. Articles published in a language other than English and those focusing on service/assistance animals, police dogs, horses, non-companion animals (e.g., dolphins), or the death of a pet were also omitted.

Abstracts were then reviewed to select articles that involved some type of empirical design, thereby excluding literature reviews and anecdotal reports. The articles were reviewed and sorted into content categories by primary outcome and/or target subject (e.g., nursing-home residents, children, psychiatric patients). The authors then selected the categories that represented the most frequently investigated areas. These categories serve as the framework for this review. Studies focusing on pet ownership are presented first, followed by those focusing on animal-assisted activities (AAA), defined as interventions involving interactions with animals that are not owned by the subjects in the study.

## PET OWNERSHIP

Most studies of pet ownership are descriptive, with data collected primarily from interviews and surveys of

convenience samples, thus making them difficult to compare beyond noting whether the results appear to support a commonly assessed outcome. This section will separately review studies of the physiological and psychosocial benefits of pet ownership.

### Physiological Benefits of Pet Ownership

A landmark study by Friedmann et al of decreased mortality in pet owners one year after discharge from a coronary care unit<sup>1</sup> inspired further research into the potential cardiovascular (CV) and general health benefits of pet ownership. The results were mixed. A longitudinal study on 369 patients participating in the Cardiac Arrhythmia Suppression Trial (CAST) confirmed the results of the original Friedmann trial, finding that pet ownership and social support predicted survival one year after a myocardial infarction.<sup>2</sup> Extending these studies, Friedmann et al analyzed heart rate (HR) variability in a sample of CAST participants with healed myocardial infarcts, with the results suggesting that altered cardiac autonomic modulation may be a possible mechanism of action of reduced mortality in pet owners compared with non-owners.<sup>3</sup>

Several large Australian studies have also researched pet ownership and CV health. One study used health screenings of 5,741 volunteers to compare the CV health of those who owned a pet versus those who did not. Pet owners were found to have lower levels of CV risk factors than those without pets.<sup>4</sup> However, a follow-up survey of over 2,500 community-based adults failed to show any CV benefit from pet ownership.<sup>5</sup> These surveys differed substantially in their methodologies, which may explain the conflicting results: the former study involved self-selected participants and underrepresented pet owners compared to the Australian population,<sup>5</sup> while the latter survey involved a representative sample randomly selected for inclusion in a longitudinal health study.

Another large (n = 1,011) Australian survey concluded that dog and cat owners were in better health than non-owners, based on either physician visits or medication use (but not both), translating into savings of \$988 million AU\$ in health care costs.<sup>6</sup> Those with a close bond to their pets had the additional benefits of less loneliness and a greater social support network. The German Socio-Economic Panel Survey of a nationally representative sample of approximately 10,000 participants supports these findings.<sup>7</sup> Two surveys, conducted five years apart, showed the least physician visits among those who continuously owned a pet during the five year period, followed by those who acquired a pet during the period. Looking at adherence to treatment as a health outcome, researchers have reported that pet ownership predicts adherence to CV rehabilitation, while numerous personality and psychosocial variables do not.<sup>8</sup> Pet owners in this sample of 81 patients were far more likely to complete cardiac rehabilitation than those who did not own a pet.

Interviews with elderly Medicare enrollees in a large, longitudinal study found that pet owners reported fewer visits to physicians over a one-year period and dogs appeared to serve as a buffer from the impact of stressful life events.<sup>9</sup> In another elderly sample, pet attitudes and pet ownership were significant but weak predictors of maintaining improved levels of health and morale in a longitudinal four-year study.<sup>10</sup> In contrast, other descriptive studies have reported no significant difference between pet owners and those without pets in the use of health services;<sup>11,12</sup> morale, locus of control, social interaction, mental status, psychological symptoms, and physical abilities;<sup>13</sup> use of daily medication or presence of medical problems;<sup>14</sup> or multiple health variables, mortality, or healthy behaviors.<sup>15</sup> One large-scale survey of Australian seniors reported an association between caring for a pet and negative health outcomes.<sup>16</sup> Pachana et al attempted to identify factors contributing to such inconsistent results by analyzing a large, longitudinal health data set of 6,404 older Australian women, and found that age, mental and physical health, living arrangements, and housing were all strongly related to pet ownership.<sup>17</sup> Confounding of outcomes by such demographic variables may have contributed to the inconsistencies in reported results. In addition, studies that rely on self-report of pet owners yield subjective results.

Headey has provided another possible explanation for these conflicting findings by differentiating between the social science and medical research methodologies used.<sup>18</sup> He asserts that the survey-based methods used in social science research provide evidence of health benefits associated with pet ownership, whereas controlled clinical trials in medical research seek causal links between pet ownership and specific medical conditions.

A number of experimental studies have focused on the effect of human-pet interaction on CV indicators, with mixed results. In a randomized, repeated-measures crossover design, Moody et al found no significant differences in systolic (SBP), diastolic blood pressure (DBP), or HR between hypertensive pet owners (with and without their pets present during testing) and those who did not own pets.<sup>19</sup> Similarly, a study examining the effects of petting one's own dog versus an unfamiliar dog found that HR and BP were unaffected by the participant's relationship with

the animal, and HR only decreased during the control condition of quietly reading a book.<sup>20</sup> In contrast, several studies that have included a cognitive stressor consistently found that pets reduce indicators of CV stress. Early work on the subject by Allen et al demonstrated this effect by randomly assigning female dog lovers to complete a mental task accompanied by either their pet dog, which produced little stress reactivity in skin conductance, BP, and HR, or by a close friend, which increased overall stress reactivity.<sup>21</sup> In a more recent randomized controlled trial, Allen et al randomly assigned hypertensive adults starting lisinopril (an angiotensin-converting enzyme [ACE] inhibitor) to a group acquiring a dog or cat or to a wait-list control group for six months.<sup>22</sup> The physiological response to stress (SBP, HR, and plasma renin activity) at home was found to be lower in those assigned to pet ownership compared with the control group without pet ownership. In addition, pet owners performed higher in mental tasks. Lisinopril reduced only resting BP. Other studies that have included a mental stress task have also reported positive findings. A related study comparing married couples with and without pets found that pet owners had decreased resting BP and HR, and a lower reactivity in SBP and HR during a mental stress task, with faster return to baseline.<sup>23</sup> A smaller study reported reduced BP, but not HR, when petting a dog while reading aloud.<sup>24</sup> These experimental studies collectively support a beneficial effect of pet ownership on CV stress reactivity that warrants further investigation.

The possibility of an association between pet ownership and CV health has prompted other researchers to investigate whether owning a pet increases physical activity. One observational study found that dog owners walked more frequently, but not for longer, than non-owners,<sup>25</sup> while a survey-based study found the opposite: dog owners walked for longer, but not more frequently, than non-owners, and dog owners were less likely to meet recommended levels of physical activity.<sup>26</sup> A comparison of 3,075 Medicare recipients in the Health ABC Study found no difference in the frequency of walking for exercise or of any physical activity in those with and without pets; although older dog owners engaged in more physical activity overall.<sup>27</sup> In contrast, a large-scale, one-year longitudinal study of 995 community-based seniors in Canada found pet owners to be younger and more physically active than those without pets.<sup>28</sup> In this age- and sex-stratified random sample, pet ownership significantly modified the relationship between social support and change in psychological well-being over the study period. While age may account for the increased physical activity, those without pets were noted to engage in comparatively fewer activities of daily living.

Conflicting findings on physical activity may be explained by confounding variables that have not been controlled for in these studies. For example, one survey found that dog size mediated the frequency of physical activity, with owners of medium- and large-sized dogs walking more often.<sup>29</sup> A sense of responsibility for the health and well-being of one's dog was also found to mediate the relationship between physical activity and dog ownership.<sup>30</sup> These studies emphasize the importance of investigating mediating variables that may play a role in the physiological benefits of pet ownership.

### **Psychosocial Benefits of Pet Ownership**

Several descriptive studies have documented the closeness between people and their pets, including dog owners who were found to be as emotionally close to their dogs as to their closest family member,<sup>31</sup> pet owners with HIV or AIDS who likened their relationship with their pets to that with their family members,<sup>32</sup> and owners whose cats provided a source of emotional support.<sup>33</sup> Similarly, a retrospective study reported that survivors of sexual abuse rated their pets as more supportive during childhood than humans.<sup>34</sup>

A number of surveys have assessed the association between pet ownership and depression. A large Internet survey found that unmarried female pet owners reported the fewest depressive symptoms, while unmarried male pet owners report the most.<sup>35</sup> An equally large survey ( $n=2,551$ ) of Australian seniors reported higher levels of depression in pet owners,<sup>16</sup> while a smaller group of elderly patients sampled in a physician's office revealed no significant differences in depression, happiness, life satisfaction, hobbies, and interests between those with and without pets.<sup>14</sup> Furthermore, no association was found between pet ownership and depression in a large survey of gay and bisexual men ( $n=1,872$ ) participating in the Multicenter AIDS Cohort Study.<sup>36</sup>

Several descriptive studies have examined the relationship between pet ownership and mood in people living alone. In women living alone, pets have been associated with increased morale<sup>37</sup> and decreased loneliness.<sup>38</sup> A more recent study found that cats alleviated negative moods equally as well as a human partner, but that only a human partner strengthened positive moods.<sup>39</sup> Similarly, an observational study has concluded that cats seem to help compensate for the depressive moods of single adults.<sup>40</sup> These descriptive studies suggest that pet ownership may be associated with some benefits to mood in select samples.

The psychological effect of pets on children has received some attention in the literature, with mostly positive outcomes reported. Descriptive studies have reported that pets increase autonomy, self-concept, and self-esteem in some elementary school children.<sup>41</sup> Positive relationships have also been found between parents' perceived competence of their children and pet attachment in kindergarten children, self-reported empathy and pet attachment in kindergarten boys, and attachment and parents' perceived empathy in fifth-grade children.<sup>42</sup> Other survey research with school-age children has reported that children who prefer both dogs and cats have higher levels of empathy than those who prefer one or the other, and children who are highly attached to their pets are more empathic than those who are less attached.<sup>43</sup> Croatian researchers have also found a positive relationship between pet attachment and empathy, increased social orientation, and a positive family climate in school-age children.<sup>44</sup>

These descriptive studies of convenience samples call attention to the need for more rigorous experimental studies of the psychosocial effects of pet ownership on children and adults. The validity of most of the current studies is threatened by the reliance on convenience samples and the presence of uncontrolled extraneous variables.

### **ANIMAL-ASSISTED ACTIVITIES/THERAPY**

The authors recognize the differences between animal-assisted therapy (AAT)—the purposeful incorporation of therapy animals into an individual's treatment plan—and the more general AAA, such as pet visitation. However, published studies do not consistently differentiate between AAT and AAA. Therefore, to minimize confusion and for ease of reading, the more general term AAA will be used to encompass all activities involving a companion animal that is not owned by the recipient of services. This section presents research focusing on CV outcomes, followed by outcomes in clinical samples, with a final section on AAA and children.

#### **Cardiovascular Benefits**

A number of studies have investigated the effect of AAA on CV response and, like the pet ownership studies already presented, report mixed results. One reason may be that the studies vary greatly in terms of samples, AAA interventions, and study conditions. While several studies have incorporated mental stressors into their experimental designs, the large variety of mental stressors employed may also contribute to the inconsistent results. A few studies have reported no difference in BP and HR associated with dog presence,<sup>45,46</sup> while most have reported reductions in BP associated with dog presence,<sup>47,48</sup> tactile interaction with a dog,<sup>49</sup> and, in one study, the presence of a pet goat as well.<sup>50</sup> Studies comparing AAA with quiet reading have found greater BP reductions in the quiet reading condition.<sup>48,51</sup> However, petting one's own dog, as opposed to petting an unfamiliar dog, produced similar declines in BP.<sup>52</sup> Using HR variability as a surrogate index of autonomic activity, Japanese researchers have used a repeated-measures crossover design to assess seniors walking in a park either alone or with a research dog. Their results demonstrated that the dog's presence in the park, as well as at home, increased parasympathetic neural activity, which is generally associated with stress reduction.<sup>53</sup>

Similar to the results of studies on pet ownership studies on CV stress reactivity, the inclusion of a mental stressor in studies of AAA appears to contribute to positive findings, lending further support to the potential benefits of interacting with companion animals on stress reactivity and the importance of conducting research grounded in theoretical models, namely stress models.

#### **Benefits for Individuals with Psychiatric Disorders**

Several experimental studies have reported positive effects of AAA with therapy dogs on hospitalized psychiatric patients, including reductions in fear and anxiety,<sup>54,55</sup> increased attendance at occupational therapy,<sup>56</sup> and more pro-social behaviors.<sup>57</sup> Comparing recently discharged psychiatric patients in two matched adult homes, researchers found improvements in social interaction, psychosocial function, life satisfaction, mental function, depression, social competence, and psychological well-being in those residing in the home receiving six weekly puppy visits.<sup>58</sup> While no differences were detected in functioning and treatment response in geriatric psychiatry patients who were randomly assigned to AAA with therapy dogs or to an exercise group, decreased irritability was noted in women with dementia in both groups.<sup>59</sup> In one study of depressed college students, no significant differences were found in

depression levels after seven weeks of group psychotherapy with and without AAA.<sup>60</sup> Unlike previous studies with dogs, an investigation on the effect of aquarium presence on psychiatric patients' depression, fear, and frustration revealed no benefit, although a trend toward reduced anxiety was observed.<sup>61</sup>

Other studies have focused specifically on AAA in patients diagnosed with schizophrenia. Although sample sizes were small, studies have reported improvements in increased hedonic tone and use of leisure time,<sup>62</sup> involvement in domestic and health activities,<sup>63</sup> nonverbal communication,<sup>64</sup> and social functioning<sup>65</sup> with AAA.

Collectively, these studies provide some evidence of improved mood and increased social behavior associated with AAA in those with psychiatric disorders. Such preliminary results warrant further investigation.

A few studies have targeted samples of health care professionals. Researchers in one descriptive study found that therapists who incorporate therapy dogs into their psychotherapy practices perceive this approach as an effective technique that can benefit clients with a wide range of clinical problems and in various age groups and practice settings.<sup>66</sup> In another study, therapists who had a dog present were rated more favorably by college students than those without a dog.<sup>67</sup> Other researchers have looked at the effect of AAA on measures of psychoneuroimmunology in health care professionals in a repeated-measures crossover study.<sup>68</sup> They found a significant decline in both serum and salivary cortisol levels that was detectable after 45 minutes following as little as five minutes with a therapy dog. No significant effects were found on immune function.

#### **Benefits of AAA for Nursing-Home Residents and Seniors with Dementia**

Studies addressing the benefits of AAA for nursing-home residents have primarily assessed outcomes of mood, daily functioning, and social interactions using various measures and designs. An anthropological study concluded that residents perceive visitors with pets as facilitating a sense of domesticity.<sup>69</sup> A randomized, pre-/post-intervention, control group study comparing the effects of AAA and human visits reported no differences on depression, but AAA improved mood as measured by the profile of mood states (POMS).<sup>70</sup> A longitudinal Australian study comparing a resident dog, visiting dog, and visiting researcher reported improved POMS scores in the resident-dog group over the other groups for tension, confusion, and depression, with both dog groups showing reduced fatigue.<sup>71</sup> Others have found reduced depression in nursing-home residents provided with a companion bird for 10 days.<sup>72</sup> While no association was noted between the presence of an aviary and reduced depression for elderly males in a health care day program, reduced depression was found in those who utilized the aviary.<sup>73</sup>

Using a wide range of measures to compare the effects of AAA with usual nursing-home activities in Torino, Italy, researchers found AAA to be associated with BP reductions, but not with measures of illness, depression, or daily activities, or with mental or nutritional status.<sup>74</sup> Other studies with nursing-home residents have reported positive outcomes associated with AAA. In one study, nursing-home residents who were randomly assigned to one or three

weekly individual AAA sessions over six weeks were found to have decreased loneliness with one AAA session a week.<sup>75</sup> In a follow-up study over the same time frame, the same investigators compared AAA in an individual versus group format, and found reduced loneliness following individual AAA with no benefit in the group format.<sup>76</sup> AAA has been found to enhance social behavior in several studies of loneliness among nursing-home residents.<sup>77-79</sup> Increases in interactive behavior were also found six weeks following the introduction of a resident dog in another study; however, residents' behavior returned to baseline after 22 weeks.<sup>80</sup> A within-subjects observational study of nursing-home residents visited by people alone, pets alone, and people and pets, found that all conditions were associated with increased smiling and alertness, but the greatest number of positive behaviors was associated with close proximity to the person alone.<sup>81</sup>

Focusing on geriatric patients with cognitive impairments, including dementia and Alzheimer's disease, researchers have reported several benefits associated with AAA with dogs, including reduced HR and unit noise,<sup>82</sup> reduced agitation and increased social interaction,<sup>83</sup> increased social behaviors,<sup>84,85</sup> reduced use of physical restraints, increased orientation to time, and facilitated goal achievement.<sup>86</sup> AAA with dogs and cats has also been reported to decrease aggressiveness, anxiety, and phobias in elderly patients with Alzheimer's disease, and to reduce caregiver burden.<sup>87</sup> Patients with Alzheimer's disease who ate in front of an aquarium daily for eight weeks were found to have increased nutritional intake and weight gain,<sup>88</sup> while another study found the presence of a companion canary compared with having a plant improved a range of psychiatric symptoms and perceived quality of life after three months.<sup>89</sup>

Not all studies have reported benefits of AAA for those with cognitive impairments. A single AAA experience had no effect on agitation, socialization, or dementia in one study of 28 residents in extended-care facilities,<sup>90</sup> and no effect on mental status, depression, self maintenance, or irritability was found after four days of AAA in eight patients with dementia.<sup>91</sup> Collectively, however, these studies support the association of beneficial effects with AAA for patients with Alzheimer's disease or dementia, and call for more rigorous research with this population. While not affecting cognitive status, AAA may provide some benefits to mood, loneliness, socialization, and problem behaviors.

#### **Benefits of AAA for Children**

Most studies of AAA with children have focused on clinical populations. However, one crossover study of Native American preschool children who were randomly assigned to brief, bi-weekly AAA sessions with various pets showed no social-skills benefit from AAA, but decreased absences during the first six weeks of the program.<sup>92</sup> Other researchers have reported that the presence of a friendly dog reduced BP in children who were reading aloud or at rest.<sup>93</sup>

A number of studies have evaluated the benefits of AAA for children in health care settings, with mixed results. Descriptive studies report satisfied parents and staff.<sup>94</sup> However, a dog's presence during a dental procedure did not reduce school-age children's behavioral distress or

physiological arousal.<sup>95</sup> One study of young children undergoing a physical examination in a pediatric clinic found no difference on physiological measures of arousal in children who were randomly assigned to the presence of a dog, although less behavioral distress was reported.<sup>96</sup> In contrast, positive outcomes were reported in a within-subjects study of a dog's presence during the routine physical examination of preschool children.<sup>97</sup> The presence of a dog was associated with reduced SBP, mean arterial pressure, HR, and distress. Focusing on pain perception in post-operative children, another study reported that AAA was associated with less perceived physical and emotional pain.<sup>98</sup>

Several small studies have explored the effects of AAA on children with developmental disorders. One observational study of 12 autistic children noted fewer autistic and more socially appropriate behaviors during therapy with a dog; however, these gains declined after one month of follow-up.<sup>99</sup> Using llamas, dogs, and rabbits in occupational therapy with 22 autistic children, researchers reported an increased use of language and social interaction with AAA compared to with traditional occupational therapy.<sup>100</sup> Another study measuring social outcomes was conducted with 10 children with pervasive developmental disorders. These children were rated as being more aware of their social environment, more focused, and more playful during AAA with a dog.<sup>101</sup> Other studies involving very small samples of patients with a variety of developmental and emotional disorders have reported various benefits of AAA, including more sustained focus;<sup>102</sup> emotional stability, improved attitudes toward school, and improved learning in responsibility, respect, and empathy;<sup>103</sup> progress on individual goals;<sup>104</sup> and sociability, vocal expression, and eye contact.<sup>105</sup>

One explanation for the benefits found in children with special needs is provided by Katcher in his rationale for including AAA in the form of an AAT/education (AAT/E) program for children with attention deficit/hyperactivity disorder (ADHD) and conduct disorder.<sup>106</sup> Katcher contends that the innate tendency to pay attention to nature and animals may increase a child's ability to inhibit responses, a critical deficit for children with ADHD and other disorders. However, as Katcher found in his well-designed evaluation of the AAT/E program at Devereux in West Chester, PA, context is an important variable since positive behavioral outcomes noted in the AAT/E context did not generalize to the regular classroom.

Most of the published AAA studies are descriptive and based on convenience samples. While inconsistencies in results abound, there seems to be some agreement on an association between AAA and improvements in mood for certain populations. Support for a positive impact of AAA on depression comes from a recent meta-analysis of five experimental studies that reported medium and significant aggregate effect sizes indicating that AAA is associated with fewer depressive symptoms.<sup>107</sup> The studies included in this meta-analysis met criteria for methodological rigor, and the results provide important evidence for a benefit of AAA in those with depressive symptoms. In addition, AAA shows potential for improving CV reactivity to stress and for improving mood and social behaviors in nursing-home and

psychiatric patients, including those with Alzheimer's disease and other dementias.

## DISCUSSION

One of the earliest reviews of research on the benefits of human-companion animal interaction was conducted in 1984 by Beck and Katcher.<sup>108</sup> They noted the preponderance of descriptive studies and identified only six experimental studies published at that time, which reported little or no benefit of pets. The current review reflects considerable progress since that time, with the review of 129 studies published in peer-reviewed journals. Like the 1984 review, most of the research continues to be descriptive and, while providing valuable information for generating research hypotheses, lacks the necessary controls to enable us to determine whether benefits actually result from pet ownership or AAA. However, a number of strong studies contributing to the field have been presented, including large surveys of nationally or regionally representative samples. A number of these studies used existing databases (e.g., Medicare) or included pet-related variables in non-pet-focused studies (e.g. CAST, Health ABC Study). The series of studies by Friedmann et al investigating pet ownership and mortality have contributed significantly to the field,<sup>1-3</sup> as have the large Australian surveys on pet ownership and CV risk factors and/or health conducted by Anderson et al,<sup>4</sup> Parslow et al,<sup>5,16</sup> Pachana et al,<sup>17</sup> Schofield et al,<sup>29</sup> and Headey et al.<sup>6,7</sup> In North America, large-scale studies on the health benefits of pet ownership by Thorpe et al,<sup>27</sup> Raina et al,<sup>28</sup> Brown and Rhodes,<sup>30</sup> Siegel et al,<sup>36,109</sup> and Tucker et al<sup>110</sup> have added to our knowledge of the benefits for varied populations.

As evident in this review, considerably more experimental studies have been published since the six identified by Beck and Katcher in 1984.<sup>108</sup> While the majority have been conducted on relatively small numbers of convenience samples, several are noteworthy for their methodologies: Banks and Banks' replication of their earlier pre-/post-intervention, control-group study, again finding decreased loneliness in long-term care residents who were randomly assigned to individual AAA sessions for six weeks, with no benefit for AAA delivered in a group setting;<sup>75,76</sup> Barker et al's partial replication of a pre-/post-intervention, cross-over design of AAA with electroconvulsive therapy patients finding significant reductions in fear after AAA with a therapy dog but not in the presence of an aquarium;<sup>54,61</sup> Allen et al's random assignment of 48 hypertensive stock brokers beginning ACE-inhibitor therapy to pet ownership with a wait-list control group, finding pet ownership was associated with reduced CV reactivity and improved mental task performance;<sup>22</sup> Columbo et al's pre-/post-intervention, control-group study involving the random assignment of 144 cognitively impaired nursing-home residents to three months with a plant, canary, or control, and reporting improved scores on measures of psychopathological status and quality of life for the canary group,<sup>89</sup> and Edwards and Beck's time-series study finding increased caloric intake, increased weight, and less need for nutritional supplements in dementia patients who ate their meals in front of an aquarium.<sup>88</sup>

Finally, a few studies have begun to look at physiological mechanisms that may explain the benefits of interacting with companion animals. Both Allen et al<sup>21-23</sup> and Friedmann et al<sup>3,47</sup> have looked at CV mechanisms, while Barker et al<sup>68</sup> have investigated psychoneuroimmunological mechanisms.

This review has summarized many studies on the benefits of human-companion animal interaction. Both clinical and non-clinical samples attest to the perceived benefits of pet ownership and AAA, and the number of controlled studies supporting such claims is growing. Most have measured short-term outcomes, and studies of the long-term effects of human-animal interactions are needed to determine whether the short-term benefits are maintained over time. The studies published so far vary greatly in subject samples, interventions, outcomes, procedures, and instruments, making it difficult to make comparisons and draw conclusions. Indeed, categorizing the published studies for this review represented a challenge, with few lines of research focusing and building on a common area of inquiry. As already noted, a number of these studies reported conflicting findings, which served to clarify the important distinction between research methodologies that limit their interpretation of results to associations and those that establish causation, designs that limit generalization to specific populations (e.g., males, the elderly) and/or locations (e.g., psychiatric hospitals, nursing homes), and the need to identify and control for factors that might explain the results. It is clear that more rigorous research, grounded in theoretical models, is needed to support descriptive studies claiming benefits of human-animal interactions. Randomization and control conditions are needed, as are clear descriptions of interventions to enable replication studies. More consistent use of standardized instruments that have been shown to be sensitive to the effects of human-animal interactions will also improve our ability to compare study results and draw firmer conclusions. For evidence-based benefits of pet ownership or AAA, exploration of the underlying physiological mechanisms of action is needed.

Despite these factors, a few pockets of evidence do exist and appear to be growing. Pets appear to buffer the impact of stress on some owners, and may be associated with other health attributes such as increased physical activity for some owner groups. Seniors in nursing homes and those with Alzheimer's disease or dementia appear to benefit from both pet ownership and AAA in the areas of mood, loneliness, social behaviors, and caloric intake. Similarly, some psychiatric populations also appear to benefit from AAA in terms of improved mood and social behaviors. Finally, there is emerging evidence of the possible benefits of pet attachment for children, particularly with regards to empathy, and of AAA for children with special needs.

Finally, readers will have noted the great variation in research foci of the investigators whose works are included. Whether this reflects varied research interests, lack of consistent research funding available in the field, institutional constraints, or other variables, this review illuminates the need for a more clearly defined direction in future research to systematically investigate the benefits of interacting with companion animals.

## REFERENCES

- 1 Friedmann E, Katcher AH, Lynch JJ, Thomas SA. Animal companions and one-year survival of patients after discharge from a coronary care unit. *Public Health Rep* 95:307-312, 1980.
- 2 Friedmann E, Thomas SA. Pet ownership, social support, and one-year survival after acute myocardial infarction in the Cardiac Arrhythmia Suppression Trial (CAST). *Am J Cardiol* 76:1213-1217, 1995.
- 3 Friedmann E, Thomas SA, Stein PK, Kleiger RE. Relation between pet ownership and heart rate variability in patients with healed myocardial infarcts. *Am J Cardiol* 91:718-721, 2003.
- 4 Anderson WP, Reid CM, Jennings GL. Pet ownership and risk factors for cardiovascular disease. *Med J Aust* 157:298-301, 1992.
- 5 Parslow RA, Jorm AF. The impact of pet ownership on health and health service use: results from a community sample of Australians aged 40 to 44 years. *Anthrozoös* 16:43-56, 2003.
- 6 Headey B. Health benefits and health cost savings due to pets: preliminary estimates from an Australian national survey. *Soc Indic Res* 47:233-243, 1999.
- 7 Headey B, Grabka M, Kelley J, Reddy P, Tseng Y. Pet ownership is good for your health and saves public expenditure too: Australian and German longitudinal evidence. *Aust Soc Monitor* 5:93-99, 2002.
- 8 Herralld MM, Tomaka J, Medina AY. Pet ownership predicts adherence to cardiovascular rehabilitation. *J Appl Soc Psychol* 32:1107-1123, 2002.
- 9 Siegel JM. Stressful life events and use of physician services among the elderly: the moderating role of pet ownership. *J Pers Soc Psychol* 58:1081-1086, 1990.
- 10 Lago D, Delaney M, Miller M, Grill C. Companion animals, attitudes towards pets, and health outcomes among the elderly: a long-term follow-up. *Anthrozoös* 3:25-34, 1989.
- 11 Jorm AF, Jacomb PA, Christensen H, Henderson S, Korten AE, Rodgers B. Impact of pet ownership on elderly Australians' use of medical services: an analysis using Medicare data. *Med J Aust* 166:376-377, 1997.
- 12 Parslow RA, Jorm AF. Pet ownership and risk factors for cardiovascular disease: another look. *Med J Aust* 179:466-468, 2003.
- 13 Robb SS, Stegman CE. Companion animals and elderly people: a challenge for evaluators of social support. *Gerontologist* 23:277-282, 1983.
- 14 Crowley Robinson P, Blackshaw JK. Pet ownership and health status of elderly in the community. *Anthrozoös* 11:168-171, 1998.
- 15 Tucker JS, Friedman HS, Tsai CM, Martin LR. Playing with pets and longevity among older people. *Psychol Aging* 10:3-7, 1995.
- 16 Parslow RA, Jorm AF, Christensen H, Rodgers B, Jacomb P. Pet ownership and health in older adults: findings from a survey of 2,551 community-based Australians aged 60-64. *Gerontology* 51:40-47, 2005.

- 17 Pachana NA, Ford JH, Andrew B, Dobson AJ. Relations between companion animals and self-reported health in older women: cause, effect or artifact? *Int J Behav Med* 12:103–110, 2005.
- 18 Headey B. Pet ownership: good for health? *Med J Aust* 179:460–461, 2003.
- 19 Moody WJ, Fenwick DC, Blackshaw JK. Pitfalls of studies designed to test the effect pets have on the cardiovascular parameters of their owners in the home situation: a pilot study. *Appl Anim Behav Sci* 47:127–136, 1996.
- 20 Gaydos LS, Farnham R. Human–animal relationships within the context of Rogers’ principle of integrality. *ANS Adv Nurs Sci* 10(4):72–80, 1988.
- 21 Allen KM, Blascovich J, Tomaka J, Kelsey RM. Presence of human friends and pet dogs as moderators of autonomic responses to stress in women. *J Pers Soc Psychol* 61:582–589, 1991.
- 22 Allen K, Shykoff BE, Izzo JL Jr. Pet ownership, but not ACE inhibitor therapy, blunts home blood pressure responses to mental stress. *Hypertension* 38:815–820, 2001.
- 23 Allen K, Blascovich J, Mendes WB. Cardiovascular reactivity and the presence of pets, friends, and spouses: the truth about cats and dogs. *Psychosom Med* 64:727–739, 2002.
- 24 Jenkins JL. Physiological effects of petting a companion animal. *Psychol Rep* 58(1):21–22, 1986.
- 25 Rogers J, Hart LA, Boltz RP. The role of pet dogs in casual conversations of elderly adults. *J Soc Psychol* 133:265–277, 1993.
- 26 Bauman AE, Russel SJ, Furber SE, Dobson AJ. The epidemiology of dog walking: an unmet need for human and canine health. *Med J Aust* 175:632–634, 2001.
- 27 Thorpe RJ, Kreisle RA, Glickman LT, Simonsick EM, Newman AB, Kritchevsky S. Physical activity and pet ownership in year 3 of the Health ABC Study. *J Aging Phys Act* 14:154–168, 2006.
- 28 Raina P, Waltner Toews D, Bonnett B, Woodward C, Abernathy T. Influence of companion animals on the physical and psychological health of older people: an analysis of a one-year longitudinal study. *J Am Geriatr Soc* 47:323–329, 1999.
- 29 Schofield G, Mummery K, Steele R. Dog ownership and human health-related physical activity: an epidemiological study. *Health Promot J Aust* 16(1):15–19, 2005.
- 30 Brown SG, Rhodes RE. Relationships among dog ownership and leisure-time walking in Western Canadian adults. *Am J Prev Med* 30:131–136, 2006.
- 31 Barker SB, Barker RT. The human–canine bond: closer than family ties. *J Ment Health Couns* 10:46–56, 1988.
- 32 Allen JM, Kellegrew DH, Jaffe D. The experience of pet ownership as a meaningful occupation. *Can J Occup Ther* 67:271–278, 2000.
- 33 Stambach KB, Turner DC. Understanding the human–cat relationship: human social support or attachment. *Anthrozoös* 12:162–168, 1999.
- 34 Barker SB, Barker RT, Dawson KS, Knisely JS. The use of the family life space diagram in establishing interconnectedness: a preliminary study of sexual abuse survivors, their significant others, and pets. *Individ Psychol* 53:435–450, 1997.
- 35 Tower RB, Nokota M. Pet companionship and depression: results from a United States Internet sample. *Anthrozoös* 19:50–64, 2006.
- 36 Siegel JM, Angulo FJ, Detels R, Wesch J, Mullen A. AIDS diagnosis and depression in the Multicenter AIDS Cohort Study: the ameliorating impact of pet ownership. *AIDS Care* 11:157–170, 1999.
- 37 Goldmeier J. Pets or people: another research note. *Gerontologist* 26:203–206, 1986.
- 38 Zasloff RL, Kidd AH. Loneliness and pet ownership among single women. *Psychol Rep* 75:747–752, 1994.
- 39 Turner DC, Rieger G, Lorenz G. Spouses and cats and their effects on human mood. *Anthrozoös* 16:213–228, 2003.
- 40 Rieger G, Turner DC. How depressive moods affect the behavior of singly living persons toward their cats. *Anthrozoös* 12:224–233, 1999.
- 41 Van Houtte BA, Jarvis PA. The role of pets in preadolescent psychosocial development. *J Appl Dev Psychol* 16:463–479, 1995.
- 42 Melson GF, Peet S, Sparks C. Children’s attachment to their pets: links to socio-emotional development. *Children’s Environments Quarterly* 8:55–65, 1991.
- 43 Daly B, Morton LL. An investigation of human–animal interactions and empathy as related to pet preference, ownership, attachment, and attitudes in children. *Anthrozoös* 19:113–127, 2006.
- 44 Vidovic VV, Stetic VV, Bratko D. Pet ownership, type of pet and socio-emotional development of school children. *Anthrozoös* 12:211–217, 1999.
- 45 Kingwell B, Lomdahl A, Anderson W. Presence of a pet dog and human cardiovascular responses to mild mental stress. *Clin Auton Res* 11:313–317, 2001.
- 46 Craig FW, Lynch JJ, Quartner JL. The perception of available social support is related to reduced cardiovascular reactivity in phase II cardiac rehabilitation patients. *Integr Physiol Behav Sci* 35:272–283, 2000.
- 47 Friedmann E, Thomas SA, Cook LK, Tsai C, Picot SJ. A friendly dog as potential moderator of cardiovascular response to speech in older hypertensives. *Anthrozoös* 20:51–63, 2007.
- 48 Wilson CC. Physiological responses of college students to a pet. *J Nerv Ment Dis* 175:606–612, 1987.
- 49 Vormbrock JK, Grossberg JM. Cardiovascular effects of human–pet dog interactions. *J Behav Med* 11:509–517, 1988.
- 50 DeMello LR. The effect of the presence of a companion-animal on physiological changes following the termination of cognitive stressors. *Psychol Health* 14:859–868, 1999.
- 51 Gaydos LS, Farnham R. Human–animal relationships within the context of Rogers’ principle of integrality. *ANS Adv Nurs Sci* 10:72–80, 1988.

- 52 Baun MM, Bergstrom N, Langston NF, Thoma L. Physiological effects of human/companion animal bonding. *Nurs Res* 33:126–129, 1984.
- 53 Motooka M, Koike H, Yokoyama T, Kennedy NL. Effect of dog-walking on autonomic nervous activity in senior citizens. *Med J Aust* 184(2):60–63, 2006.
- 54 Barker SB, Pandurangi AK, Best AM. Effects of animal-assisted therapy on patients' anxiety, fear, and depression before ECT. *J ECT* 19(1):38–44, 2003.
- 55 Barker SB, Dawson KS. The effects of animal-assisted therapy on anxiety ratings of hospitalized psychiatric patients. *Psychiatr Serv* 49:797–801, 1998.
- 56 Holcomb R, Meacham M. Effectiveness of an animal-assisted therapy program in an inpatient psychiatric unit. *Anthrozoös* 2:259–264, 1989.
- 57 Marr CA, French L, Thompson D, Drum L, Greening G, Mormon J, Henderson I, Hughes CW. Animal-assisted therapy in psychiatric rehabilitation. *Anthrozoös* 13:43–47, 2000.
- 58 Francis G, Turner JT, Johnson SB. Domestic animal visitation as therapy with adult home residents. *Int J Nurs Stud* 22:201–206, 1985.
- 59 Zisselman MH, Rovner BW, Shmueli Y, Ferrie P. A pet therapy intervention with geriatric psychiatry inpatients. *Am J Occup Ther* 50(1):47–51, 1996.
- 60 Folse EB, Minder CC, Aycock MJ, Santana RT. Animal-assisted therapy and depression in adult college students. *Anthrozoös* 7:188–194, 1991.
- 61 Barker SB, Rasmussen KG, Best AM. Effect of aquariums on electroconvulsive therapy patients. *Anthrozoös* 16:229–240, 2003.
- 62 Nathans-Barel I, Feldman P, Berger B, Modai I, Silver H. Animal-assisted therapy ameliorates anhedonia in schizophrenia patients. A controlled pilot study. *Psychother Psychosom* 74(1):31–35, 2005.
- 63 Kovács Z, Kis R, Rózsa S, Rózsa L. Animal-assisted therapy for middle-aged schizophrenic patients living in a social institution. A pilot study. *Clin Rehabil* 18:483–486, 2004.
- 64 Kovács Z, Bulcuz J, Kis R, Simon L. An exploratory study of the effect of animal-assisted therapy on nonverbal communication in three schizophrenic patients. *Anthrozoös* 19:353–365, 2006.
- 65 Barak Y, Savorai BA, Mavashev BA, Beni A. Animal-assisted therapy for elderly schizophrenic patients: a one-year controlled trial. *Am J Geriatr Psychiatry* 9:439–442, 2001.
- 66 Mason MS, Hagan CB. Pet-assisted psychotherapy. *Psychol Rep* 84:1235–1245, 1999.
- 67 Schneider MS, Harley LP. How dogs influence the evaluation of psychotherapists. *Anthrozoös* 19:128–142, 2006.
- 68 Barker SB, Knisely JS, McCain NL, Best AM. Measuring stress and immune response in healthcare professionals following interaction with a therapy dog: a pilot study. *Psychol Rep* 96:713–729, 2005.
- 69 Savishinsky JS. Intimacy, domesticity and pet therapy with the elderly: expectation and experience among nursing home volunteers. *Soc Sci Med* 34:1325–1334, 1992.
- 70 Lutwack-Bloom P, Wijewickrama R, Smith B. Effects of pets versus people visits with nursing home residents. *J Gerontol Soc Work* 44:137–159, 2005.
- 71 Crowley Robinson P, Fenwick DC, Blackshaw JK. A long-term study of elderly people in nursing homes with visiting and resident dogs. *Appl Anim Behav Sci* 47(1–2):137–148, 1996.
- 72 Jessen J, Cardiello F, Baun MM. Avian companionship in alleviation of depression, loneliness, and low morale of older adults in skilled rehabilitation units. *Psychol Rep* 78:339–348, 1996.
- 73 Holcomb R, Jendro C, Weber B, Ursula N. Use of an aviary to relieve depression in elderly males. *Anthrozoös* 10:32–36, 1997.
- 74 Stasi MF, Amati D, Costa C, Resta D, Senepa G, Scarafioiti C, Aimonino N, Molaschi M. Pet-therapy: a trial for institutionalized frail elderly patients. *Arch Gerontol Geriatr Suppl* 9:407–412, 2004.
- 75 Banks MR, Banks WA. The effects of animal-assisted therapy on loneliness in an elderly population in long-term care facilities. *J Gerontol A Biol Sci Med Sci* 57:M428–432, 2002.
- 76 Banks MR, Banks WA. The effects of group and individual animal-assisted therapy on loneliness in residents of long-term care facilities. *Anthrozoös* 18:396–408, 2005.
- 77 Fick KM. The influence of an animal on social interactions of nursing home residents in a group setting. *Am J Occup Ther* 47:529–534, 1993.
- 78 Perelle IB, Granville DA. Assessment of the effectiveness of a pet facilitated therapy program in a nursing home setting. *Soc Anim* 1(1):91–100, 1993.
- 79 Bernstein P, Friedmann E, Malaspina A. Animal-assisted therapy enhances resident social interaction and initiation in long-term care facilities. *Anthrozoös* 13:213–224, 2000.
- 80 Winkler A, Fairnie H, Gericevich F, Long M. The impact of a resident dog on an institution for the elderly: effects on perceptions and social interactions. *Gerontologist* 29:216–223, 1989.
- 81 Hendy HM. Effects of pet and/or people visits on nursing home residents. *Int J Aging Hum Dev* 25:279–291, 1987.
- 82 Walsh PG, Mertin PG, Verlander DF, Pollard CF. The effects of a “pets as therapy” dog on persons with dementia in a psychiatric ward. *Aust Occup Ther J* 42(4):161–166, 1995.
- 83 Richeson NE. Effects of animal-assisted therapy on agitated behaviors and social interactions of older adults with dementia. *Am J Alzheimers Dis Other Demen* 18:353–358, 2003.
- 84 Kongable LG, Buckwalter KC, Stolley JM. The effects of pet therapy on the social behavior of institutionalized Alzheimer's clients. *Arch Psychiatr Nurs* 3:191–198, 1989.



- 85 Batson K, McCabe B, Baun MM, Wilson C. The effect of a therapy dog on socialization and physiological indicators of stress in persons diagnosed with Alzheimer's disease. In Wilson CC, Turner DC, eds. *Companion Animals in Human Health*. Thousand Oaks, CA: Sage Publications, 1998:203–215.
- 86 Katsinas RP. The use and implications of a canine companion in a therapeutic day program for nursing home residents with dementia. *Activ Adapt Aging* 25(1):13–30, 2000.
- 87 Kanamori M, Suzuki M, Yamamoto K, Kanda M, Matsui Y, Kojima E, Fukawa H, Sugita T, Oshiro H. A day care program and evaluation of animal-assisted therapy (AAT) for the elderly with senile dementia. *Am J Alzheimers Dis Other Demen* 16:234–239, 2001.
- 88 Edwards NE, Beck AM. Animal-assisted therapy and nutrition in Alzheimer's disease. *West J Nurs Res* 24:697–712, 2002.
- 89 Colombo G, Buono MD, Smania K, Raviola R, De Leo D. Pet therapy and institutionalized elderly: a study on 144 cognitively unimpaired subjects. *Arch Gerontol Geriatr* 42:207–216, 2006.
- 90 Churchill M, Safaoui J, McCabe BW, Baun MM. Using a therapy dog to alleviate the agitation and desocialization of people with Alzheimer's disease. *J Psychosoc Nurs Ment Health Serv* 37(4):16–22, 1999.
- 91 Motomura N, Yagi T, Ohyama H. Animal assisted therapy for people with dementia. *Psychogeriatrics* 4(2):40–42, 2004.
- 92 Barker SB, Best AM, Fredrickson M, Hunter G. Constraints in assessing the impact of animals in education. *Anthrozoös* 13:74–79, 2000.
- 93 Friedmann E, Katcher AH, Thomas SA, Lynch JJ, Messent PR. Social interaction and blood pressure. Influence of animal companions. *J Nerv Ment Dis* 171:461–465, 1983.
- 94 Gagnon J, Bouchard F, Landry M, Belles-Isles M, Fortier M, Fillion L. Implementing a hospital-based animal therapy program for children with cancer: a descriptive study. *Can Oncol Nurs J* 14:210–222, 2004.
- 95 Havener L, Gentes L, Thaler B, Megel M, Baun M, Driscoll F, Beiraghi S, Agrawal N. The effects of a companion animal on distress in children undergoing dental procedures. *Issues Compr Pediatr Nurs* 24(2):137–152, 2001.
- 96 Hansen KM, Messinger CJ, Baun MM, Megel M. Companion animals alleviating distress in children. *Anthrozoös* 12:142–148, 1999.
- 97 Nagengast SL, Baun MM, Megel M, Leibowitz JM. The effects of the presence of a companion animal on physiological arousal and behavioral distress in children during a physical examination. *J Pediatr Nurs* 12:323–330, 1997.
- 98 Sobo EJ, Eng B, Kassity-Krich N. Canine visitation (pet) therapy: pilot data on decreases in child pain perception. *J Holist Nurs* 24(1):51–57, 2006.
- 99 Redefer LA, Goodman JF. Brief report: pet-facilitated therapy with autistic children. *J Autism Dev Disord* 19:461–467, 1989.
- 100 Sams MJ, Fortney EV, Willenbring S. Occupational therapy incorporating animals for children with autism: a pilot investigation. *Am J Occup Ther* 60:268–274, 2006.
- 101 Martin F, Farnum J. Animal-assisted therapy for children with pervasive developmental disorders. *West J Nurs Res* 24:657–670, 2002.
- 102 Limond JA, Bradshaw JWS, Cormack KFM. Behavior of children with learning disabilities interacting with a therapy dog. *Anthrozoös* 10:84–89, 1997.
- 103 Anderson KL, Olson MR. The value of a dog in a classroom of children with severe emotional disorders. *Anthrozoös* 19:35–49, 2006.
- 104 Granger BP, Kogan LR, Fitchett JA, Helmer KA. A human–animal intervention team approach to animal-assisted therapy. *Anthrozoös* 11:172–176, 1998.
- 105 Kogan LR, Granger BP, Fitchett JA, Helmer KA, Young KJ. The human–animal team approach for children with emotional disorders: two case studies. *Child Youth Care Forum* 28(2):105–121, 1999.
- 106 Katcher AH, Wilkins GG. The Centaur's Lessons: therapeutic education through care of animals and nature study. In Fine AH, ed. *Handbook on Animal-Assisted Therapy: Theoretical Foundations and Guidelines for Practice*. San Diego: Academic Press, 2000:153–177.
- 107 Souter MA, Miller MD. Do animal-assisted activities effectively treat depression? A meta-analysis. *Anthrozoös* 20:167–180, 2007.
- 108 Beck AM, Katcher AH. A new look at pet-facilitated therapy. *J Am Vet Med Assoc* 184:414–421, 1984.
- 109 Siegel JM. Stressful life events and use of physician services among the elderly: the moderating role of pet ownership. *J Pers Soc Psychol* 58:1081–1086, 1990.
- 110 Tucker JS, Friedman HS, Tsai CM, Martin LR. Playing with pets and longevity among older people. *Psychol Aging* 10(1):3–7, 1995.

## AUTHOR INFORMATION

**Sandra B. Barker, PhD**, is a Professor of Psychiatry and Director of The School of Medicine Center for Human–Animal Interaction, Virginia Commonwealth University, P.O. Box 980710, Richmond, VA 23298 USA. She is also Adjunct Professor of Small Animal Clinical Sciences at Virginia-Maryland Regional College of Veterinary Medicine.  
E-mail: sbarker@mcvh-vcu.edu.

**Aaron R. Wolen** is a graduate of the University of Iowa with a BS in psychology and a minor in biology. He is currently pursuing a PhD in human genetics at Virginia Commonwealth University's School of Medicine, P.O. Box 980710, Richmond, VA 23298 USA, where he completed a research assistantship with the Center for Human–Animal Interaction.