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Human-Animal Interactions, Relationships and Bonds: A Review and Analysis of the Literature

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The study of human-animal interactions (HAI), and the resulting human-animal relationships (HARs) and bonds (HABs) which are set up as a consequence, is currently a topical issue in comparative psychology. Here we review the HAI/HAR/HAB literature to detect the main publication trends, and to identify the predominant research themes in this area. Research in HAI/HAR/HAB only really started in the 1980s, but since then there has been a growth in studies which is still continuing. Most of these studies have been in the contexts of companion animal or agricultural animal research, but there is now a growing literature on laboratory, zoo and wild animals too. In the companion animal HAI/HAB literature the greatest emphasis has been on Animal-assisted Interventions (AAI), and the benefits to people of pet ownership and interaction with pets. Agricultural HAI/HAR research, on the contrary, has been more concerned with the welfare consequences of HAI/HARs to the animals. This disjunction is reflected in the preference of companion animal researchers to use the term 'bond', but agricultural researchers to use 'relationship'. Other themes prominent in the literature include methodological issues, the characteristics of caretakers, the role of veterinarians, sociological approaches, and theoretical aspects. It is concluded that currently HAI/HAR/HAB research does not constitute a unified field, and there is a need to: (a) agree and define a standard terminology, (b) undertake more research on the effects of HAI on companion animals, (c) undertake more research on the form and frequency of interactions, and (d) increase research on HAI/HAR/HABs in laboratory, zoo and wild-living animals. This research is important to understand whether HAI has positive, neutral or negative consequences, both for humans and for animals.

We share the world with a lot of other animals, and many of us come into contact with some of these animals on a daily basis. Some people share their homes with animals: an estimated 342 million dogs in 93 countries and 281 million cats in 81 countries surveyed by the World Society for the Protection of Animals (Batson, 2008). Many people work with animals: in 2010 there were more than 1.5 billion cattle and buffaloes, 2 billion sheep and goats, and 20 billion poultry birds managed worldwide (FAO, 2013); in the UK in 2012 more than 3.6 million animals were used in laboratories in non-toxicology tests (Home Office, 2012). And people visit animals: over 700 million visits are made to accredited zoos every year (Gusset & Dick, 2011), and even 20 years ago there were an estimated 106-211 million wildlife-related tourists worldwide (International Ecotourism Society, 2000). There are, consequently, many opportunities for people to interact with animals. Nevertheless, although people have speculated on the nature of relationships between people and animals for many centuries (Beierl, 2008; Serpell, 1996), the empirical study of these interactions is a relatively recent development.

Our relationship with other animals goes a long way back into prehistory, more than 50,000 years ago (Braje, 2011). Bulliet (2005) distinguishes three stages in the history of human-animal relationships: a predomestic era, in which human societies were hunter-gatherers who did not perceive a difference between themselves and other animals; a domestic era characterized by the development of beliefs in the difference and superiority of humans; and a postdomestic era, where most of the population have little direct experience of animals, particularly the animals we eat. This poses certain ambiguities in our relationships with animals, which means that we perceive animals in a number of different ways (de Mello, 2012; Dolins, 1999), and these ways, which range from a loved one or object of wonder through to a victim or threat, are very evident in our popular culture (Herzog & Galvin, 1992). Perhaps as a consequence, the ways in which we relate to animals

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can be quite paradoxical. Just taking the example of our favorite companion animals, pet owners in the United States spend more than 11 billion dollars per year on veterinary care, but animal shelters euthanize between 3 and 4 million unwanted cats and dogs annually (Case, 2008).

Nevertheless, it is widely believed that people have an emotional need to connect with animals, which manifests itself in, for example, caring for the environment (Vining, 2003) and visiting zoos (Myers, Saunders, & Birjulin, 2004). Perhaps the most explicit formulation of this idea is the "biophilia" hypothesis of Edward Wilson (Wilson, 1984, 1993), where biophilia summarizes our "innate tendency to focus on life and life-like processes". In this hypothesis, human dependence on nature goes beyond a physical dependence, and also includes aesthetic, intellectual, cognitive and spiritual satisfaction (Kellert, 1993). This hypothesis has been widely applied, for example in interpreting the health benefits that come from connecting with nature (Maller, Townsend, Pryor, Brown, & St Leger, 2006), children's responses to pets and the natural world (Fawcett & Gullone, 2001; Kahn, 1997), and the enjoyment people gain from visits to the zoo (Fraser, Gruber, & Condon, 2007).

This whole area concerning our relationships with and attitudes towards animals constitutes a field of study usually referred to as Human-Animal Studies, which "explores the spaces that animals occupy in human social and cultural worlds and the interactions humans have with them" (de Mello, 2012). Within this field de Mello (2012) distinguishes 'anthrozoology' as the "scientific study of human-animal interaction, and the human-animal bond".

Scientific research on human-animal interactions (HAIs) only started in the 1970s, and is generally regarded as having grown from the views about human-animal bonds (HABs) given originally by Konrad Lorenz (Hines, 2003). Early development of this area of study was primarily due to the veterinary profession, sometimes apparently in the face of some opposition from other professionals (Hines, 2003). Perhaps as a result of it being initially veterinarian-driven, human-animal relationship (HAR) studies were for a long time dominated by consideration of companion animals, with research on agricultural and other contexts starting somewhat later. Inevitably this research is multidisciplinary, not only because of the scope that human-animal studies have for being of interest to a wide range of academic areas, including biology, psychology, sociology, anthropology, economics and medicine; but also because of the disparity between the different contexts in which HAIs take place, including the home, agriculture, laboratories, zoos and the wild. Researchers working within these different contexts have their own priorities, theories, methodologies and sometimes terminologies, and even now it is rare to find publications which stray beyond their own contexts. Nevertheless common, as well as individual, themes are discernable across the literature.

Here we survey the whole field of HAIs, HARs and HABs through a literature review, to identify publication trends over the last 20 years, both in terms of the development of the field in general, and also to detect the themes which have attracted the most attention in this area. We also look to see what commonalities there are, and whether this can be regarded as a unitary field of study.

Method

Literature searches were undertaken through the two search engines Proquest and Google Scholar. The search through Proquest used the following databases: Aquatic Sciences and Fisheries Abstracts, Biological Sciences, Proquest Biology Journals, Proquest Nursing and Allied Health Source, Proquest Psychology Journals, Proquest Science Journals, PsycINFO and Sociological Abstracts. Basic searches with these databases used the keywords "human-animal" and "interaction*," "relationship*" or "bond*;" subsequent searches used these keyword combinations plus one of: "zoo," "agricultur*," "laborator*," "companion animal*," "wild" or "touris*." A further search was then carried out with Google Scholar, using the search term "human-animal interaction." The two searches together yielded 335 papers. Six of these papers were published in 2013, and these were excluded from the quantitative analyses reported below, as they represented only part of a year, but have been used in the review of themes.

The titles, together with authors and journal reference, of all 335 papers were entered into an Excel spreadsheet, which was used to generate the quantitative results, Table 1 and Figure 1. The two authors then independently attempted to identify themes running through the papers, finally arriving at an agreed list, which was added to the spreadsheet and used to generate Tables 3-5 and Figure 2.

One of the problems in undertaking literature searches within this area is the lack of consistent terminology across all of the different disciplines which contribute to HAI/HAR/HAB research (Griffin, McCune, Maholmes, & Hurley, 2012). Because these disciplines use their own nomenclature and there are few agreed-upon index terms, modern search engines struggle to access all of the relevant literature (Griffin et al., 2012). For this reason the papers that we survey here are best regarded as a good representative sample rather than a definitive listing.

Results

The literature searches, after duplicates and 2013 papers were removed, yielded 329 papers. In principle these are all about either HAIs, HARs or HABs, but, in keeping with the wide, multidisciplinary nature of this area, they revealed a variety of approaches, background disciplines, and subject animals. It was possible to distinguish six broad categories of paper on the basis of the contexts in which humans and animals came into contact with each other, and the kinds of animal, and hence presumably kinds of interaction, that they studied (for the rest of this paper these will be referred to as "contexts"): (a) *companion animals* (n = 161 papers): these are animals which are kept by people for pleasure, often in their own homes, and where owners usually expect a close relationship with the animal (Eddy, 2003). The majority of these papers were about companion animals in general or about dogs, with a much smaller number of studies on cats. Papers on HAIs with horses were allocated to this context on the grounds that, although horses are not companion animals in the sense that a house dog or cat is (i.e. the horse does not live in the human home, nor is it usually in such sustained contact with its owner), the HAR between a horse and its caretaker (Hausberger, Roche, Henry, & Visser, 2008) appears to us to qualitatively resemble that between a person and their dog or cat (particularly in respect of an expected close relationship) more than HARs between caretakers and animals in any of the other contexts; (b) *agricultural animals* (n = 76 papers): these are animals which are kept by people because they produce something of value to us (meat, milk, eggs, etc), or because they perform work for us. Most of these papers were about agricultural animals in general or about cattle, but with pigs, lambs and poultry also being the subjects of a large literature. A smaller number of papers considered goats, reindeer, elephants and silver foxes; (c) *laboratory animals* (n = 18 papers): these are animals which are maintained in captivity for experimental purposes, so interactions with animals must be concordant with experimental procedures (Coleman, 2011). Most of these papers dealt with the laboratory environment in general, with primates being the taxon most commonly studied in those papers which were not general; (d) *zoo animals* (n = 22 papers): these are animals which are kept in a facility which is open to the public for extended periods of time, such that the animals experience large numbers of people, most of whom are unfamiliar to them. The majority of these papers were general papers covering a number of species. Where specific taxa were studied, they were usually primates, felids or ungulates; (e) *animals in the wild* (n = 21 papers): these are animals which are not being maintained and managed in captivity, and are therefore probably not normally in either sustained or regular contact with people. These papers, as might be expected, were very variable in their scope and subject matter, with studies on cetaceans or primates being the commonest among those that were not general in scope; (f) *general papers* (n = 31 papers): these are papers which did not restrict themselves to one of the previous five contexts.

What Are the Peer-Reviewed Journals That Accept Articles in This Field of Study?

The papers in our survey were published across 84 different journals, ranging from *Activities, Adaptation & Ageing* through *Journal of Applied Gerontology* to *Zoo Biology*. Most of these journals had only published one paper on HAI/HAR/HAB, but several journals published these papers on a more regular basis. Journals that have each published more than five papers on HAI/HAR/HAB in the past 20 years are: *Applied*

Animal Behaviour Science (*n* = 55), *Anthrozoös* (*n* = 42), *Animal Welfare* (*n* = 12), *Journal of the American Veterinary Medical Association* (*n* = 9), *Society & Animals* (*n* = 9), *Journal of Veterinary Medical Education* (*n* = 9), *ILAR Journal* (*n* = 7), *Journal of Applied Animal Welfare Science* (*n* = 7), *American Behavioural Scientist* (*n* = 6), and *Zoo Biology* (*n* = 5).

How Many Articles Have Been Published in Those Journals on the Topic in the Last 20 Years?

The 10 journals which have each published more than five papers on HAI/HAR/HAB since 1993 are shown in Table 1, broken down in terms of the six animal contexts identified above. By far the largest number of papers is found in the two journals *Applied Animal Behaviour Science* and *Anthrozoös*. Both of these journals publish papers across the different animal contexts, although there appear to be indications of a preference among authors for *Applied Animal Behaviour Science* for agricultural papers and *Anthrozoös* for companion animal papers. Of these ten journals, the highest impact factors (September 2013 figures) are for *ILAR Journal* (2.33), *Journal of the American Veterinary Medical Association* (1.79) and *Applied Animal Behaviour Science* (1.497), and the lowest two are *Society & Animals* (0.55) and *Journal of Veterinary Medical Education* (0.57). These do not compare too favorably with the impact factor of the major behavioral journal *Animal Behaviour* (3.068), or a major Psychology journal such as *Journal of Personality and Social Psychology* (4.877), which perhaps reflects the applied nature of this subject, rather than that HAI/HAR/HAB research is an area of lower academic respectability.

Have the Number of Papers Published Within the Field Changed in the Last 20 Years?

Changes in the number of papers published in this field are shown in Figure 1. Those published prior to 1993 are shown for comparison, and those published between 1993 and 2012 are shown in 5-year blocks. The data are again broken down in terms of the six contexts identified previously. There has been a clear growth in numbers of papers in all contexts except general papers and papers on laboratory animals. It also appears from this figure that, although studies of companion and agricultural animal HAIs have a history before 1993, the application of this area to laboratory, zoo, and wild-living animals is a relatively recent phenomenon.

Table 1
Number of papers in each context of HAI/HAR/HAB research which have been published since 1993

Journal	General	Companion	Agricultural	Lab	Zoo	Wild
AABS	5	10	33	2	5	0
Anthrozoös	2	27	3	1	5	4
J Am Vet Med Ass	1	8	0	0	0	0
Soc & Anim	3	5	0	0	0	1
J Vet Med Ed	4	5	0	0	0	0
Anim Welf	0	0	8	2	2	0
ILAR J	0	1	0	6	0	0
JAAWS	0	2	0	1	4	0
Am Behav Sci	1	5	0	0	0	0
Zoo Biol	0	0	0	0	5	0

Note. Only the 10 journals which have each published more than 5 papers on this subject are included in this table.

Themes: What are the More Specific Subcategories or Areas of Study That Have Been Focused on in the Last 20 Years?

Even a casual browse through the papers in our sample suggests that researchers in the different contexts (i.e., companion, agricultural, etc) approach the field of HAI/HAR/HAB in different ways and with different preoccupations, and identifying the main themes of these papers (Table 2) confirms this to be the case. Despite this, there are also several common themes that occur across several contexts, so it is possible to

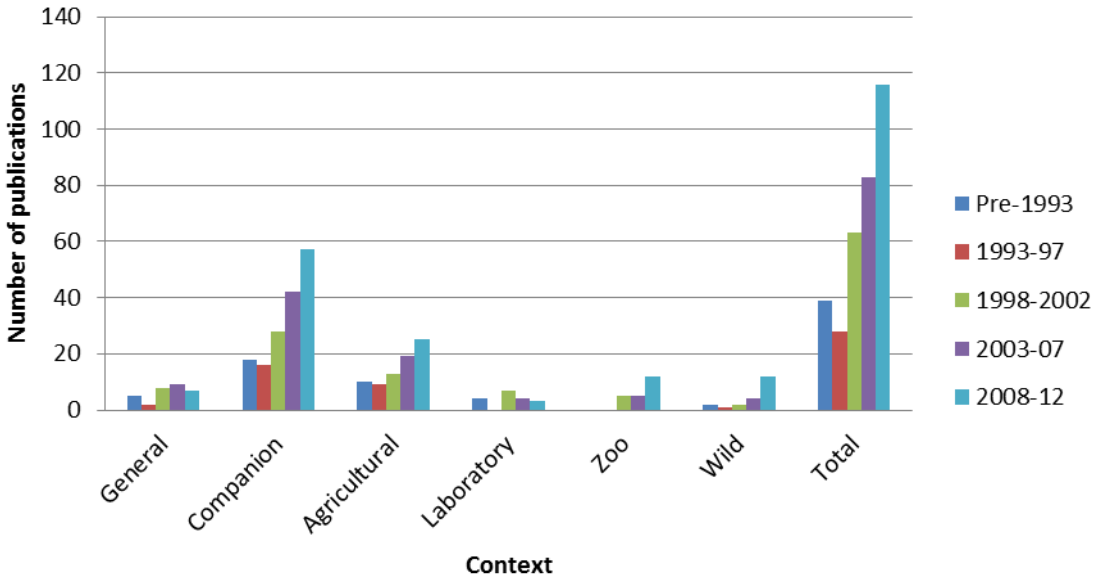

Figure 1. Changes in the number of papers published in HAI/HAR/HAB within each context, shown in 5-year blocks between 1993 and 2012, and with pre-1993 papers shown for comparison.

Table 2
Main themes of the papers included in the review

Theme	General	Companion	Agricultural	Laboratory	Zoo	Wild	Total
Animal-assisted intervention	0	49	0	0	0	2	**51**
Animal welfare	2	18	18	2	6	0	**46**
Methodological issues	3	5	25	4	5	0	**42**
Benefits to humans	0	23	0	0	1	0	**24**
Characteristics of caretakers	1	21	0	1	2	0	**25**
Role of veterinarians	6	11	0	0	0	0	**17**
Sociological aspects	5	12	0	0	0	0	**17**
Theoretical aspects	2	11	1	0	1	0	**15**
HAR in general	0	3	0	0	8	3	**14**
Attitudes to animals	2	3	9	0	0	0	**14**
Facilitate husbandry	0	0	10	0	0	0	**10**
Animal Health	0	0	8	0	1	0	**9**
Effects of tourism	0	0	0	0	0	8	**8**
Creating a bond	0	0	0	6	1	0	**7**
Pet bereavement	0	7	0	0	0	0	**7**
Productivity	0	0	4	0	0	0	**4**
Human-animal conflict	0	0	0	0	0	4	**4**
Domestication	3	1	0	0	0	0	**4**
Open-water encounter	0	0	0	0	0	4	**4**
History of subject	0	2	1	0	0	0	**3**
Other	0	0	2	1	1	1	**5**

Table 3
Common themes and the number of papers concerned with those common themes since 1993

Theme	Contexts Where Found	Number of Papers
Animal Welfare	Gen/Comp/Ag/Lab/Zoo	46
Methodological Issues	Gen/Comp/Ag/Lab/Zoo	42
Characteristics of caretakers	Gen/Comp/Lab/Zoo	25
Theoretical aspects	Gen/Comp/Ag/Zoo	15
HAR in general	Comp/Zoo/Wild	14
Attitudes to animals	Gen/Comp/Ag	14

Note. Common was defined a them that occurred in papers in three or more contexts.

identify both context-specific and common themes. We have regarded themes as being common if they occur as main themes in papers in three or more different contexts (Table 3); of these the most prominent, in terms of numbers of publications, are Methodological Issues, Animal Welfare and Caretaker Characteristics. In contrast we have identified themes as being context-specific if they only occur in publications in one or two of the contexts. In Table 4 are listed the two most prominent (in terms of number of papers) themes in each context; it can be seen that the Companion and Wild literature contains some context-specific themes that generate most of the HAI/HAR/HAB research within those contexts, whereas in the Agricultural, Laboratory and Zoo contexts the most prominent themes are common ones.

Table 4
The two most prominent themes within each of the contexts in papers published since 1993.

Context	Most Prominent Themes	Number of Papers
General	**Role of vets**	**6**
	Sociological aspects	**5**
Companion	**Animal-assisted intervention**	**49**
	Benefits to humans	**23**
Agricultural	Methodological issues	25
	Animal welfare	18
Laboratory	Creating a bond	6
	Methodological issues	4
Zoo	HAR in general	8
	Animal welfare	6
Wild	**Effects of tourism**	**8**
	Human-animal conflict	**4**
	Open-water encounter	**4**

Note. Prominent was determined by numbers of papers. Context-specific themes (i.e. those that occur in just one or two contexts) are shown in bold.

What Percentage of Articles Fall Into Those Different Subcategories (Themes) Throughout the Last 20 Years?

We have identified 20 different themes in Table 2 which each account for more than two papers during the last 20 years, and several others which have just been collectively listed as 'other'. If we take just the themes which each individually account for more than 5% of the post-1993 papers in our sample (n = 290 papers), then we reduce this to eight themes, of which four are common themes and four are context-specific themes. The common themes are: Animal welfare (15.9%), Methodological issues (14.5%), Characteristics of caretakers (8.6%), and Theoretical aspects (5.2%). The context-specific themes are Animal-assisted intervention (17.6%), Benefits to humans (8.3%), Role of veterinarians (5.9%), and Sociological aspects (5.9%). Together these eight themes account for 81.9% of the papers in our post-1993 sample.

Has the Number of Papers Published Within Those Subcategories (Themes) Changed in the Last 20 Years?

Changes in the number of papers in each of the eight major themes identified above are shown in Figure 2. For this, data have been combined for all of the different contexts (Companion, Agricultural etc). The most obvious rise in publications since 1993 can be seen in the themes Animal-assisted intervention and Benefits to humans, both of which are due almost entirely to a substantial companion animal literature, and in the Animal Welfare implications of HAI/HAR/HAB, most of which derives from research on agricultural animals. The remaining themes either show a less obvious rise (Methodological Issues, Characteristics of caretakers) or no obvious pattern (Role of veterinarians, Sociological aspects, Theoretical aspects). One conclusion from this is that the growth that can be detected in the HAI/HAR/HAB field as a whole (Figure 1) is due primarily to the research priorities of the companion animal and agricultural fields, while the growth of this kind of research in other areas (laboratory, zoo, wild) is not yet generating sufficient papers to change this overall pattern.

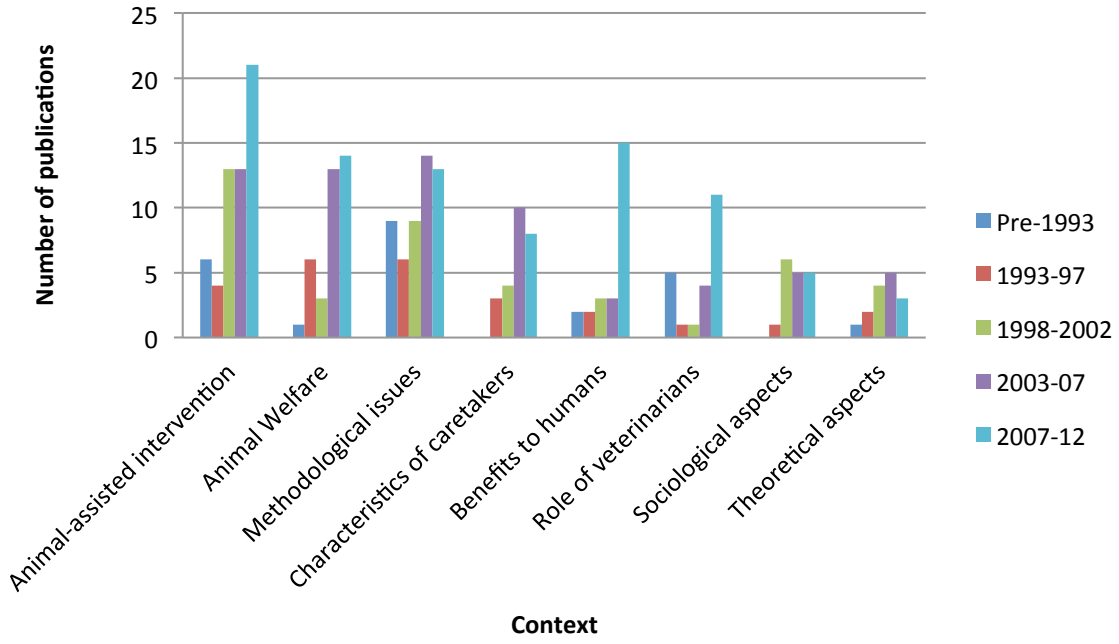

Figure 2. Changes in the number of papers published in the eight main HAI/HAR/HAB themes for all contexts combined, shown in 5-year blocks between 1993 and 2012, and with pre-1993 papers shown for comparison.

Discussion

One inference to be gained by examination of the papers included in this review is that the study of HAI/HAR/HABs is a relatively recent development, and that it appears to have developed relatively independently in researchers depending on whether their subjects are companion, agricultural, laboratory, zoo or wild animals. Since very few studies stray beyond these boundaries, it is pertinent to question whether researchers in these different areas are actually studying the same phenomenon, but from different research perspectives, or whether the HAI/HAR/HABs that, for example agricultural animals show are qualitatively different from those seen in, say, companion animals. It is instructive to consider the terminology these different researchers use, and also to identify the main themes which have driven research both within and across the animal contexts.

Terminology

A noticeable feature of the papers surveyed here is a difference in terminology used by researchers in the different animal contexts (Table 5). In general the preferred term for researchers on companion and laboratory animals is "bond", whereas those who work with agricultural animals rarely refer to a bond, but usually (if they use a term at all) refer to a "human-animal relationship". It is important to understand the sense in which these terms are being used, partly to identify whether they are actually referring to different things. But our usage of terms can also influence our perceptions of the animals as partners in the relationship, and the motivations of their behaviors (Boivin, Lensink, Tallet, & Veissier, 2003), as well as our ethical stance towards them (Anthony, 2003).

HAIs and HARs. Very few papers say what they mean by the term "human-animal relationship" or equivalent (other equivalent terms may be used, such as "human-companion animal interaction" or "zookeeper-animal relationship"), and even fewer say what they mean by "human-animal interaction." The lack of consistency of usage of terms in HAI research has been identified by others as a hindrance to progress in this field (Griffin et al., 2012). These authors define HAI as referring to "the mutual and dynamic interactions between people and animals and how these interactions may affect physical and psychological health and well-being" (Griffin et al., 2012, p. 6-7). However, this definition, developed in the context of companion animal studies, is of limited use in other contexts because of its implied emphasis on the human side of the interaction. In addition, it does not explain what is meant by "interaction." Another conceptualization of HAI and HAR is that given by Estep and Hetts (1992) in the context of laboratory animals; they see HAIs as mutual behaviors arising from mutual perceptions, and these form the foundation of a relationship which has a feedback effect on the nature and perception of future interactions. The concept in this form is also used by a number of authors (e.g., Boivin et al., 2003; Waiblinger et al., 2006) in the agricultural context. More explicit is the framework developed by Hinde (1976, 1987) to understand human-human interactions and relationships. In his framework an interaction is "a sequence in which individual *A* shows behaviour *X* to individual *B*, or *A* shows *X* to *B* and *B* responds with *Y*" (Hinde, 1976, p. 3). A relationship, then, involves "a series of interactions over time between two individuals known to each other" (Hinde 1987, p. 24). Hinde's definition of an interaction is operational as well as conceptual, and allows us to determine through the observation of behavior that an interaction has indeed taken place. The relationship can then be seen, as with Estep and Hetts' description, as the consequence of a history of interactions between two individuals such that they acquire a familiarity with each other's behavior which allows them to make predictions about what the other will do next. This framework has been used, for example, to describe HAI/HARs in zoo animals (Hosey, 2008, 2013).

Table 5
Numbers and percentages of papers which use the terms "human-animal relationship" or "bond" in their titles or abstracts

	"Human-animal relationship"		"Bond"		Total papers examined
	Number	Percent	Number	Percent	
General	8	25.8	12	38.7	31
Companion	22	13.7	86	53.4	161
Agricultural	37	48.7	4	5.3	76
Laboratory	2	11.1	11	61.1	18
Zoo	3	13.6	1	4.5	22
Wild	0	0	0	0	21

In Hinde's formulation an interaction is a dyadic event, so it follows that a relationship is also a phenomenon that occurs between two members of a dyad who are recognizable to and familiar with each other. It has, however, been suggested that relationships can be generalized in situations where individual recognition is not achieved, so that the relationship is between an individual and a group of individuals. Researchers on agricultural animals have used it in this way to describe a generalized HAR between a

stockperson and the animals in their care (e.g., Hemsworth & Coleman, 1998; Waiblinger et al., 2006), and this may also be a way of envisaging the HAR between a zoo animal and the crowds of zoo visitors (Hosey, 2008, 2013). A further elaboration is the realization that HARs can be negative, neutral or positive, depending upon the net quality of the interactions which make up the history of that HAR. From this starting point, models have been constructed to give insights into HARs in both agricultural (Hemsworth, 2003; Waiblinger et al., 2006) and zoo (Hosey, 2008, 2013) animals.

Bonds: Are HARs and HABs different things? The companion animal literature, and to some extent the laboratory literature too, tends to refer to bonds or HABs rather than HARs. A commonly used definition is that of the American Veterinary Medical Association (AVMA, 1998):

> The human-animal bond is a mutually beneficial and dynamic relationship between people and animals that is influenced by behaviors that are essential to the health and well-being of both. This includes, but is not limited to, emotional, psychological, and physical interactions of people, animals, and the environment. The veterinarian's role in the human-animal bond is to maximize the potentials of this relationship between people and animals.

This definition goes beyond the conceptualization of HAR given above, which is based on behaviors, by adding emotional and psychological components and asserting that the HAB is mutually beneficial. Indeed, many papers on human-companion animal interactions concentrate on the emotional, psychological and health benefits of the HAB to people (e.g., Barker & Wolen, 2008; Carmack, 1998; Cole & Gawlinski, 2000; Esposito, McCune, Griffin, & Maholmes, 2011; Friedmann & Son, 2009; Grandgeorge & Hausberger, 2011; Horowitz, 2008; Manor, 1991; Peacock, Chur-Hansen, & Winefield, 2012; Netting, Wilson, & New, 1987; O'Haire, 2010; Timmins, 2008; Virués-Ortega & Buela-Casal, 2006). In this respect the AVMA definition of a HAB is not very different from Griffin et al's (2012) definition of a HAR. However, it is implicit in the concept of HAR outlined above that HARs can be the product of a history of net positive (and thus presumably beneficial) interactions. This then prompts the question of whether a HAB is distinct from, or just the same as, a positive HAR?

Russow (2002), while pointing out that there is no universally accepted definition of HAB, discusses the criteria which should distinguish a HAB from any other kind of HAR. There are three of these, all of which are necessary for a fully developed HAB: (a) it involves a relationship between a human and an individual animal; (b) it is reciprocal and persistent; and iii) it tends to promote an increase in well-being for both parties. Using these criteria, the generalized HARs described above could clearly not be seen as HABs: a stockperson could not have a bond with an entire herd of cows, or a zoo animal with visitors in general. In this respect it is useful to maintain a distinction between the HAB and a positive HAR if only to keep the notion of a generalized HAR. In terms of reciprocity and promoting well-being the evidence is more ambiguous, primarily because the data are somewhat patchy. There is a great deal of evidence for well-being enhancement in companion animal owners, but far fewer studies have looked at effects on the companion animals (e.g., Bergamasco et al., 2010; McGreevy, Righetti, & Thomson, 2005; Odendaal & Meintjes, 2003; see below). In contrast there is evidence for reduction of fear and stress in agricultural animals (e.g., Bertenshaw & Rowlinson, 2008; Bertenshaw, Rowlinson, Edge, Douglas, & Shiel, 2008; Coulon et al., 2013), but it is not clear that any of it relates to HABs rather than general positive HAR effects, and very little work has been undertaken on the resulting well-being of stockpersons. There is even less evidence for HABs in laboratory (Asquith, 2011; Bayne, 2002; Chang & Hart, 2002; Davis & Balfour, 1992; Vitale, 2011) and zoo (Carlstead, 2009; Hosey & Melfi, 2012; Mellen, 1992) animals and caregivers. What little evidence we have suggests that people appear to experience an increase in well-being from HABs, but whether the animals experience anything similar it is not currently possible to say. Furthermore, few studies have described the course of interactions between people and animals, so it is difficult to apply the reciprocity criterion. For now it is

probably pragmatic to continue to see the HAB as something a bit more than just a positive HAR, but clearly more research is needed, particularly from the animal's point of view.

The animal's point of view. Clearly HARs will have an effect on both interactants, and although definitions such as that of Hinde (1976) emphasize behavioral change, there is also the possibility of looking at the physiological changes that occur in tandem, and there is now also the expectation that there will be some emotional change as well (Makowska & Weary, 2013). If, however, we wish to demonstrate that a given HAR is in fact a HAB, then it would seem that there is the additional requirement to show reciprocity and an increase in well-being in both interactants. This is considerably more feasible to do with human interactants than with animals, which presumably accounts for the paucity of studies on this. It is probably true to say that both an increase in well-being and reciprocity in companion animals is usually assumed rather than demonstrated; indeed the preference of workers in this field for the term 'companion' rather than 'pet' reflects their belief that it signifies the presence of a psychological bond and a mutual relationship (Walsh, 2009a). Explanations of the consequences of HAI/HAR in agricultural animals have been interpreted in terms of the animals perceiving humans as either predators or conspecifics (Boivin et al., 2003), a hypothesis which actually dates back to the views of Hediger (1965, 1970) with respect to zoo animals. However, re-assessing this hypothesis for zoo animals using data that are now available (Hosey, 2013) gives the idea only partial support, as the evidence implies that animals see us in more different ways than we previously thought. In any case, looking at HAI/HAR/HAB from the animal's point of view is clearly an area which needs much more research, and perhaps the development of new research strategies.

The Themes

Research in HAI/HAR/HAB can clearly be undertaken from a number of different perspectives, and using the traditions and priorities of a number of different disciplines. Since this appears to generate some disparity in the field, it is instructive to briefly consider what these different themes consist of, and whether or not the whole area of HAI/HAR/HAB research can be regarded as a unitary field of study. Here we briefly describe these eight main themes in size order (according to the number of papers contributing to them), without distinguishing those that are common from those that are context-specific.

Animal-assisted intervention and benefits to humans. It is convenient to consider these two themes together, since they are effectively two aspects of the same topic, one providing basic knowledge about how interaction with animals affects us, the other providing the practical applications of that knowledge. Papers describing the health benefits to humans of interacting with companion animals were among the earliest to be published within the whole area of HAI/HAR/HAB research (Friedmann, Katcher, Lynch, & Thomas, 1980; Friedmann, Katcher, Thomas, Lynch, & Messent, 1983). Research since then has demonstrated wide ranging beneficial effects on people of companion animal ownership and companion animal interaction, involving both physiological and psychological benefits. These include benefits such as reduction in stress as evidenced by reduction in cortisol, heart rate and blood pressure; general improved physical health, particularly with respect to cardiovascular disease; social attention, social behaviour, interpersonal interactions, mood, and self-reported fear and anxiety (Alonso, 1999; Barker & Wolen, 2008; Barker, Krisely, McCain, Schubert, & Pandurangi, 2010; Beetz, Uvnäs-Moberg, Julius, & Kotrschal, 2012; Friedmann & Son, 2009; Virués-Ortega & Buela-Casal, 2006; Walsh, 2009a). Furthermore, it is possible to detect changes in brain activity in human subjects just in the mere presence of a companion animal, without interaction, and these changes are interpreted as representing a state of lower stress and greater relaxation among the subjects (Sugawara et al., 2012). Outside of the companion animal context the potential effects of HAI/HAR/HAB on human well-being have scarcely been looked at. A study in zoos found that a visit to the zoo resulted in decreased blood pressure, a high level of physical exercise (as inferred from the number of steps recorded on a pedometer), and increased quality of life scores on a questionnaire (Sakagami & Ohta, 2010). But this is clearly an area ready for much more research across the whole spectrum of HAI/HAR/HAB research.

Why HAI with companion animals should have such effects is not clear. Possibilities are that there is a direct causal effect (e.g., through the relationship itself or through physiological effects), that there is an indirect effect facilitating human-human interpersonal relations, or because some other factor independently influences the relationship between companion animal ownership and health (Berget & Braastad, 2008; Collis & McNicholas, 1998). Some of the effects could be due to a stress-buffering effect of interacting with an animal who gives non-critical social support, or else through classical conditioning of relaxation (Garrity & Stallone, 1998; Virués-Ortega & Buela-Casal, 2006). It has also been suggested that many of the observed effects could be explained in terms of activation of the oxytocin system, which occurs during sensory stimulation within positive relationships, and mediates a host of effects such as stimulating social interaction, reducing stress and increasing pain thresholds (Beetz et al., 2012). In other cases the likely causes of health gains are a bit more clear; for example, being responsible for someone else's dog yields physical benefits because the subjects feel obliged to take the dog for walks (Johnson & Meadows, 2010).

Clearly an understanding of the beneficial effects of HAI/HAR/HAB with companion animals is of importance to social work (Evans & Gray, 2012; Sable, 2013), child health and development (Esposito et al., 2011; McCardle, McCune, Griffin, & Maholmes, 2012), psychology (Davis & Juhasz, 1985; Horowitz, 2008; Peacock et al., 2012; Walsh, 2009a) and nursing (Barba, 1995; Cole & Gawlinski, 2000; Jorgensen, 1997). As a consequence there has been a great increase in the use of animals to improve the effects identified above in people who are most likely to benefit from them. These uses are referred to by the general term 'animal-assisted intervention' or AAI (Griffin et al., 2012); within this broad category can be distinguished 'animal-assisted therapy' (AAT), which is "the intentional inclusion of an animal in a treatment plan to facilitate healing and recovery of patients with acute or chronic conditions", and 'animal-assisted activity' (AAA), the "use of animals in a recreational or educational manner without specific treatment goals" (Griffin et al., 2012, p. 6-7).

There is an extensive literature on AAT using companion animals; indeed it constitutes the largest theme in our sample of publications. The therapeutic use of animals has a long history which dates back to the 18th century (Netting et al., 1987), and it is now used to facilitate healing or well-being in the elderly (Banks & Banks, 2002, 2005; Bernstein, Friedmann, & Malaspina, 2000; Berry et al., 2012; Carlisle, 2012; Fraser, 1989; Kaiser, Spence, McGavin, Struble, & Keilman, 2002; Kogan, 2000; Lapp, 1991; Wilson & Netting, 1983,1987), with vulnerable children and families (Cirulli et al., 2011; Granger, Kogan, Fitchett, & Helmer, 1998; Fawcett & Gullone, 2001; Walsh, 2009b; Yorke, 2010,), with long-term physical and mental health patients (Barker & Pandurangi, 2003; Carmack, 1998; Filan & Llewellyn-Jones, 2006; Glass, 2000; Howell-Newman & Goldman, 1993; Johnson, Meadows, Haubner & Sevedge, 2003, 2008; Manor, 1991; Souter & Miller, 2007), and with prisoners (Fournier, Geller, & Fortney, 2007; Jasperson, 2010; Strimple, 2003). Despite all of this, AAT is still regarded as not part of mainstream clinical psychology (Raupp, 2002), and its use is driven more by advocates than by medical practitioners (Palley, O'Rourke, & Niemi, 2010). There are also possible risks from infection or from bites (Brodie, Biley, & Shewring, 2002).

The use of AAT is mostly undertaken with dogs (Johnson, Odentaal, & Meadows, 2002), but there are also reports of the therapeutic effects of interaction with horses (Kaiser, Heleski, Siegford, & Smith, 2006a; Kaiser, Smith, Heleski, & Spence, 2006b; Yorke, Adams, & Coady, 2008). Outside of the companion animal context AAI has scarcely been looked at. AAT with cetaceans is now more widely practiced, both with wild and with captive dolphins, and evaluations of the therapeutic effects are now being published (Breitenbach, Stumpf, von Fersen, & Ebert, 2009; Brensing & Linke 2003), which show increased self-confidence and social skills in children after these encounters. In principle, many of the interactive programs taking place in zoos, such as interactive shows with keepers or animal encounters for visitors, fall within the general definition of AAA, but there appear to be no systematic studies of the effects of these on the people taking part.

Animal welfare. Generally it has been postulated that HAI may have consequences for the welfare of animals, whether they are companion (Ladewig, 2005; Odendaal, 2005), agricultural (Boivin et al., 2003; Curtis, 1987), laboratory (Rennie & Buchanan-Smith, 2006) or zoo (Fernandez, Tamborski, Pickens, & Timberlake, 2009; Kreger & Mensch, 1995) animals. Whether those consequences are positive, neutral or negative appears to depend on the quantity and quality of the interactions that the animal has with people, and the quality of the HARs and HABs that are consequently set up, although this has only really been explored in any depth in agricultural animals (Boivin, Garel, Mante, & Le Neindre, 1998; Hemsworth, 2003; Hemsworth, Barnett, & Coleman, 1993; Rennie, Bowell, Dearing, Haskell, & Lawrence, 2003; Waiblinger et al., 2003). Measuring HAR/HAB quality is not easy, so many investigators have looked at HAI quality instead.

Much of the research on the quality of HAIs has focused on grooming or more general handling. The animals in our different contexts probably experience very different extents of routine handling, ranging from quite a lot in dogs and cats to fairly minimal handling in zoo animals, but there appear to be no studies which have assessed the extent of physical contact, whether handling, grooming, or any other kind of contact, across these different contexts. Grooming appears to be positive for dogs, as evidenced by reductions in heart rate (McGreevy et al., 2005), increases in oxytocin (Odendaal & Meintjes, 2003), and reduced cortisol in aversive situations such as a visit to the vet (Hennessy, Williams, Miller, Douglas, & Voith, 1998). Behavioural measures indicate that grooming or gentle handling reduces fear of humans, or in other ways improves the HAR of cows and calves (Bertenshaw & Rowlinson, 2008; Bertenshaw et al., 2008; Boivin, Nowak, & Garcia, 2001; de Passillé, Rushen, Ladewig, & Petherick, 1996; Lensink, Boivin, Pradel, Le Neindre, & Veissier, 2000; Schmied, Boivin, & Waiblinger, 2008; Stewart et al., 2013), lambs (Caroprese et al., 2012; Markowitz, Dally, Gursky, & Price, 1998), pigs (Gonyou, Hemsworth, & Barnett, 1986; Hemsworth & Barnett,1992; Pedersen, Barnett, Hemsworth, Newman, & Schirmer, 1998; Poletto, Meisel, Richert, Cheng, & Marchant-Forde, 2010; Tanida, Miura, Tanaka, & Yashimoto, 1995), rabbits (Podberscek, Blackshaw, & Beattie, 1991), and chicks (Jones, 1993). The corollary of this is that rough handling should increase fear of humans, reduce the quality of the HAR, and thus negatively affect welfare, and studies on agricultural animals support this interpretation (Gonyou, Hemsworth, & Barnett, 1986; Hemsworth, Barnett, & Hansen, 1986; Rushen, Taylor, & de Passillé, 1999; Stewart et al., 2013). The effects of rough handling have scarcely been looked at outside of the agricultural context, although there are indications that farm animals in petting zoos avoid contact with visitors (Anderson, Benne, Bloomsmith, & Maple, 2002). The general conclusion of all of this, admittedly with respect mostly to agricultural animals, is that grooming and gentle handling, particularly when done by a familiar person, are beneficial to welfare, whereas rough handling lowers welfare.

The evidence with respect to other kinds of interaction is more difficult to interpret. The mere presence of a caregiver at feeding can increase affinity in lambs (Tallet, Voissier, & Boivin, 2008), and keepers spending more time with zoo and laboratory animals, sometimes with interactions such as playing or even just talking to them, appears to promote behaviors indicative of raised welfare (Baker, 2004; Baker & Springer, 2006; Carrasco et al., 2009; Manciocco, Chiarotti, & Vitale, 2009; Mellen, 1991). But mere presence of a human can also be aversive in laboratory primates (Thomsen, 1974), and while interactions between zoo animals and zoo visitors may sometimes be aggressive (Anderson, Maple, & Bloomsmith, 2004; Mitchell et al., 1992a; Mitchell, Herring, & Obradovich, 1992b; Osvath, 2009) and sometimes more benign (Cook & Hosey, 1995; Fa, 1989), it is not always clear whether these interactions have welfare consequences, and what these consequences are (Hosey, 2000). It is likely that a better understanding of the quality of HARs and HABs that are set up between animals and different people will help with this, as it is clear from agricultural research that there are differences in these among different stockpersons (Hemsworth, 2003; Hemsworth et al., 1993; Rennie et al., 2003; Waiblinger et al., 2003), and there is increasing evidence that the same may be true in zoos (Carlstead, 2009; Ward & Melfi, 2013).

Methodological issues. For an emerging field of research, it should not be too surprising that a number of papers have been concerned with defining and refining methods of investigation. The companion

animal HAI literature has been dominated by studies of the human side of the HAR/HAB, and this is reflected in the number of papers which report questionnaire-based studies. A variety of questionnaires is available for this research (Wilson & Netting, 2012), designed to measure variables such as bonding (Poresky, Hendrix, Hosier, & Samuelson, 1987; Poresky, 1997), attachment (Zasloff, 1996), attitudes (Poresky, 1989; Wilson et al., 1987), and ratings of animal quality of life (Schneider, Lyons, Tetrick, & Accortt, 2010). At the same time companion animal HAI research has been criticized for relying on descriptive and correlational evidence, with an identified need for more rigorous empirical studies (Barker & Wolen, 2008; Lord, Wittum, & Scarlett, 2007; Wilson & Barker, 2003).

Although questionnaires have been used in HAI research in agricultural (Bertenshaw & Rowlinson, 2009; Porcher, Cousson-Gélie, & Dantzer, 2004,) and zoo (Carlstead, 2009; Hosey & Melfi, 2012) contexts, most HAI/HAR/HAB research outside of the companion animal context has involved observational and experimental techniques, collecting behavioral or physiological data. Within the agricultural literature particularly, there have been attempts to define and evaluate commonly used behavioral measures of HAI/HAR/HAB such as approach/avoidance (Battini, Andreoli, Barbieri, & Mattiello, 2011; Marchant-Forde, Bradshaw, Marchant-Forde, & Broom, 2003; Mazurek, McGee, Minchin, Crowe, & Earley, 2011a; Rousing & Waiblinger, 2004; Waiblinger et al., 2003) and other responses to human presence or sudden appearance (Courbouley & Foubert, 2007; Mazurek et al., 2011b; Temple, Manteca, Velarde, & Dalmau, 2011).

Characteristics of caretakers. A great deal of research on agricultural animals has shown that there are differences between stockpersons in the way they interact with and handle their animals, and that these differences lead to HARs which might be negative, neutral or positive (see '*Animal Welfare*' above). Outside the agricultural context there have been few attempts to look empirically at caretaker differences in terms of the quality of the interactions they are involved in, but several studies have been concerned with the characteristics of human caretakers who are presumed to have HARs or HABs with animals. These form a rather diverse and disparate set of papers. Some look for levels of attachment or empathy, or other characteristics, of caretakers of particular types of animals, such as free-ranging cats (Centonze & Levy, 2002; Finkler & Terkel, 2011), dogs with behavioral problems (Jagoe & Serpell, 1996), normal compared to overweight cats (Keinzle & Bergler, 2006) or dogs (Keinzle, Bergler, & Mandernach, 1998), or house dogs versus yard dogs (Shore, Riley, & Douglas, 2006). Others look at particular categories of owners, such as teachers (Staats, Sears, & Pierfelice, 2006), homeless people (Singer, Hart, & Zasloff, 1995), students (Shore, Douglas, & Riley, 2005), Latino (Johnson & Meadows, 2002), Norwegian (Ellingsen, Zanella, Bjerkås, & Indrebø, 2010) or Hispanic (Schoenfeld-Tacher, Kogan, & Wright, 2011) pet owners, families (Westgarth et al., 2007), children (Daly & Morton, 2003, 2006), or males compared to females (Herzog, 2007). Few, if any, such studies have been undertaken outside of the companion animal context. In laboratory and zoo studies which have focused on caretakers rather than animals the main concerns have been the impact of HARs/HABs on emotional well-being (Chang & Hart, 2002, Hosey & Melfi, 2012) and the ethical dilemmas that this can raise (Herzog, 2002a), caretaker personality (Philips & Peck, 2007), and preferences for different species (Comber & Griffin, 2007).

Role of veterinarians. Much of the early impetus for increasing our understanding of the HAR/HAB, at least within the context of companion animals, came from the veterinary profession (Hines, 2003), and this is reflected in early papers advocating that veterinarians be more aware of the importance of the HAB, together with the ethical concerns that this entails (Bustad & Hines, 1984, Tannenbaum, 1985). There is general agreement amongst commentators that veterinarians should understand the HAB with companion animals because of its impact on the lives, health and well-being of people (Fraser, 1989; Ormerod, 2008; Timmins, 2008), because of the distress caused to owners through euthanasia of an animal and their feelings of bereavement (Clements, Benasutti, & Carmone, 2003; Gerwolls & Labbott, 1994; Morris, 2012; Smith, 2012; Weisman, 1991), and also because of possible welfare consequences for animals (Marder & Duxbury, 2008; Wensley, 2008). Despite this, practising veterinarians underestimate the value of the bond (Catanzaro, 1988),

believe that knowledge of the bond is best gained through experience rather than through structured learning (Martin & Taunton, 2005), and provide few HAB-related resources to other staff at the practice (Martin & Taunton, 2006).

There is also recognition amongst commentators that veterinary courses should incorporate awareness of HABs (McCulloch, 1985), including training in animal behavior (Sherman & Serpell, 2008), awareness of AAT/AAA concepts and techniques (Schaffer, 2008), and human relations skills (Adams, Conlon, & Long, 2004), although surveys appear to indicate that there is not enough attention paid to HABs in veterinary schools (Beck & Martin, 2008). Perhaps as a consequence, veterinary student consideration of the importance of HABs is variable, may change through their course, and appears to be weakest in those students who specialize in agricultural animals (Blackshaw & Blackshaw, 1993; Martin, Ruby, & Farnum, 2003; Williams, Butler, & Sontag, 1999). There appears to have been very little, if any, consideration of the role of veterinarians in HAI/HAR/HAB management or research outside of the companion animal context.

Sociological aspects. A more sociological/ethnographic approach considers HAI/HAR/HAB to be part of a wider concept of human-animal relations (Bulliet, 2005; De Mello, 2012; Knight & Herzog, 2009; Melson, 2002; Mullin, 1999). This approach includes consideration of how we perceive animals (Birke & Brandt, 2009; Brown, 2007; Lawrence, 2003; Shir-Vertesh, 2012), and the perspectives of particular groups or traditions (Birke, Bryld, & Lykke, 2004; Freeman, 2005; Myers, 1996). Once again, this approach has scarcely been taken outside of the companion animal context.

Theoretical aspects. As a field of study, HAI/HAR/HAB research appears to have grown without any particular theoretical foundation, and some effort has been made to supply those underlying theoretical bases. It may seem intuitively obvious that people will derive well-being from their interactions with their pets, or that cows treated roughly will become more fearful of humans, but demonstrations that these things happen need to be explained in terms of known theory. There appears to be no over-arching theory of HAI, and given the diverse and multi-disciplinary nature of the subject it may well be that such a theory is not possible, although concepts such as biophilia come close (Beck & Katcher, 2003; Herzog, 2002b). It should by now, however, be no surprise that attempts to derive theories reflect the preoccupations and perspectives of the contexts in which their authors work. Thus researchers on companion animal HAI/HAR/HAB have been concerned with a theoretical explanation of why we bond with our pets, and why this has beneficial effects for people; in other words, why AAT works (Berget & Braastad, 2008; Collis & McNicholas, 1998; Giaquinto & Valentini, 2009; Kidd & Kidd, 1987). Conversely, HAI/HAR/HAB researchers within the agricultural (Hemsworth, 2003; Waiblinger et al., 2006) and zoo (Hosey, 2008, 2013) contexts have been more concerned with explanations of why different qualities of interaction have the effects that they have on the animals.
Another theoretical trend which has emerged in the companion animal literature is a consideration of whether or not concepts such as "attachment" (Crawford, Worsham, & Swinehart, 2006; Sable, 2013) and "play" (Rooney, Bradshaw, & Robinson, 2000) are equivalent whether between human-human or human-animal dyads (the suggestion from these papers is that they are not). All of these theoretical approaches are of great value, and the HAI/HAR/HAB field would certainly benefit from applying them more widely across the different contexts.

Is HAI/HAR/HAB Research a Unitary Field?

It is fairly clear that HAI/HAR/HAB research cannot, at the moment, be regarded as a single, unified field of study. Workers within the different animal contexts have different theories, methodologies, and research perspectives. It is also possible that they are using terminology in a different way. All of these different approaches are valuable, and it would be profitable to apply them in the other animal contexts. The largest contributions to the HAI/HAR/HAB literature so far have been in the companion and agricultural contexts, but there are indications that some of the perspectives from those are being adopted in the more

emergent fields of laboratory and zoo HAI/HAR/HAB; for example, the recognition of the impact of HARs on laboratory technicians (Arluke, 1999; Birke, Arluke, & Michael, 2007) parallels some of the companion animal literature, and models of HARs in zoo animals (Hosey, 2008, 2013) are built upon previously published models for agricultural animals (Hemsworth, 2003).

For HAI/HAR/HAB research to become a more coherent and unified field, some of the following should happen: (a) some agreement over a standardised terminology, at least with respect to the terms 'human-animal interaction', 'human-animal relationship' and 'human-animal bond', and greater clarity from authors as to what they mean when they use these terms; (b) more empirical (observational and experimental) research on companion animals, particularly with respect to identifying and quantifying the form and frequency of their interactions with humans, the consequences of these for their behavioral, physiological and other indicators of well-being, and whether the bonds they are assumed to have with humans really are bonds according to definitions such as that of Russow (2002); this research should be undertaken without the assumption that interaction will necessarily be positive for both interactants, and that even if an animal benefits, this may not improve its welfare; (c) more research on the form and frequency of agricultural animals' interactions with humans, beyond an emphasis on their fear responses and subsequent effects on their productivity; and more consideration of the affective dimensions of the stockperson end of the HAR; (d) it probably goes without saying that more of all of these things need doing for laboratory and zoo animal HAI/HAR/HABs. Finally, little has been said in this review about HAIs with wild-living animals; little work has been done on this, but with increasing human encroachment on wild habitats, and the inevitable human-animal conflict that ensues from this, here is an area where more work is urgently needed.

Priorities for Future Research

The research needs identified in the previous sections emerge from our analysis of the literature in this review, but are also highlighted as research priorities in some of the papers we have reviewed. Thus, various authors have identified the need for a more consistent use of terminology (Griffin et al., 2012), more rigorous research, particularly with companion animals and their use in AAT (Barker & Wolen, 2008; Griffin et al., 2012; Palley et al., 2010), better understanding of the mechanism behind the bond (Cirulli et al., 2011), possibilities of using HAI as enrichment for laboratory animals (Roberts, 1989), companion animals (Wells, 2004) and zoo animals (Claxton, 2011; Szokalski, Litchfield, & Foster, 2012), and more research on animal fear, keeper attitudes, and positive measures of welfare for zoo animals (Carlstead, 2009). To these we can add a need for studies on a greater range of species, and more consideration of the effects of HAI/HAR/HAB both for humans and for animals, and whether they are negative, positive or neutral. Whatever else we can say, we can certainly be confident that this is a field of study with plenty of possibilities and priorities for future research. This knowledge is of great importance to both humans and animals, and more importantly should yield great benefits in understanding the relationship between them.

References

Adams, C. L., Conlon, P. D., & Long, K. C. (2004). Professional and veterinary competencies: addressing human relations and the human-animal bond in veterinary medicine. *Journal of Veterinary Medical Education, 31*, 66-71.

Alonso, Y. (1999). Der Einfluss von Haustieren auf die menschliche Gesundheit: Gibt es einen Zusammenhang? *Gesundheitswesen, 61,* 45-49.

Anderson, U. S., Benne, M., Bloomsmith, M. A., & Maple, T. L. (2002). Retreat space and human visitor density moderate undesirable behaviour in petting zoo animals. *Journal of Applied Animal Welfare Science, 5,* 125-137.

Anderson, U. S., Maple, T. L., & Bloomsmith, M. A. (2004). A close keeper-nonhuman animal distance does not reduce undesirable behaviour in contact yard goats and sheep. *Journal of Applied Animal Welfare Science,7,* 59-69.

Anthony, R. (2003). The ethical implications of the human-animal bond on the farm. *Animal Welfare, 12,* 505-512.

Arluke, A. (1999). Uneasiness among laboratory technicians. *Occupational Medicine, 14,* 305-316.

Asquith, P. J. (2011). Of bonds and boundaries: what is the modern role of anthropomorphism in primatological studies? *American Journal of Primatology*, *73,* 238-244. doi: 10.1002/ajp.20832

AVMA. (1998). Statement from the Committee on the Human-Animal Bond. *Journal of the American Veterinary Medical Association, 212,* 1675.

Baker, K. C. (2004). Benefits of positive human interaction for socially housed chimpanzees. *Animal Welfare, 13,* 239-245.

Baker, K. C. & Springer, D. A. (2006). Frequency of feeding enrichment and response of laboratory nonhuman primates to unfamiliar people. *Journal of the American Association for Laboratory Animal Science, 45,* 69-73.

Banks, M. R., & Banks, W. A. (2002). The effects of animal-assisted therapy on loneliness in an elderly population in long-term care facilities. *Journal of Gerontology A Biological Science and Medical Science, 57,* M428-M432.

Banks, M. R. & Banks, W. A. (2005). The effects of group and individual animal-assisted therapy on loneliness in residents of long-term care facilities. *Anthrozoös, 18,* 396-408.

Barba, B. (1995). The positive influence of animals: animal-assisted therapy in acute care. *Clinical Nurse Specialist, 9,* 91-95.

Barker, S. B., & Pandurangi, K. A. (2003). Effects of animal-assisted therapy on patients' anxiety, fear, and depression before ECT. *Journal of ECT, 19,* 38-44.

Barker, S. B., & Wolen, A. R. (2008). The benefits of human-companion animal interaction: a review. *Journal of Veterinary Medical Education, 35,* 487-495.

Barker, S. B., Knisely, J. S., McCain, N. L., Schubert, C. M., & Pandurangi, K. A. (2010). Exploratory study of stress-buffering response patterns from interaction with a therapy dog. *Anthrozoös, 23,* 79-91.

Batson, A. (2008). *Global Companion Animal Ownership and Trade: Project Summary*. WSPA. Retrieved from http://www.wspa-international.org.

Battini, M., Andreoli, E., Barbieri, S., & Mattiello, S. (2011). Long-term stability of avoidance distance tests for on-farm assessment of dairy cow relationship to humans in alpine traditional husbandry systems. *Applied Animal Behaviour Science, 135,* 267-270. doi: 10.1016/j.applanim.2011.10.013

Bayne, K. (2002). Development of the human-research animal bond and its impact on animal well-being. *ILAR Journal*, *43,* 4-9.

Beck, A. M., & Katcher, A. H. (2003). Future directions in human-animal bond research. *American Behavioral Scientist, 47,* 79-93.

Beck, A. M., & Martin, F. (2008). Current human-animal bond course offerings in veterinary schools. *Journal of Veterinary Medical Education, 35,* 483-486.

Beetz, A., Uvnäs-Moberg, K., Julius, H., & Kotrschal, K. (2012). Psychosocial and psychophysiological effects of human-animal interactions: the possible role of oxytocin. *Frontiers in Psychology, 3, article 234,* 1-15. doi:10.3389/fpsyg.2012.00234

Beierl, B. H. (2008). The sympathetic imagination and the human-animal bond: fostering empathy through reading imaginative literature. *Anthrozoös, 21,* 213-220.

Bergamasco, l., Osella, M. C., Savarino, P., Larosa, G., Ozella, L., Manassero, M., . . . Re, G. (2010). Heart rate variability and saliva cortisol assessment in shelter dog: human-animal interaction effects. *Applied Animal Behaviour Science*, *125,* 56-68. doi:10.1016/j.applanim.2010.03.002

Berget, B. & Braastad, B. O. (2008). Theoretical framework for animal-assisted interventions – implications for practice. *Therapeutic Communities, 29,* 323-337.

Bernstein, P. L., Friedmann, E., & Malaspina, A. (2000). Animal-assisted therapy enhances resident social interaction and initiation in long-term care facilities. *Anthrozoös, 13,*213-224.

Berry, A., Borgi, M., Terranova, L., Chiarotti, F. Alleva, E., et al. (2012). Developing effective animal-assisted intervention programs involving visiting dogs for institutionalized geriatric patients: a pilot study. *Psychogeriatrics, 12,* 143-150.

Bertenshaw, C., & Rowlinson, P. (2008). Exploring heifers' perception of 'positive' treatment through their motivation to pursue a retreated human. *Animal Welfare, 17,* 313-319.

Bertenshaw, C., & Rowlinson, P. (2009). Exploring stock managers' perceptions of the human-animal relationship on dairy farms and an association with milk production. *Anthrozoös, 22,* 59-69.

Bertenshaw, C., Rowlinson, P., Edge, H., Douglas, S., & Shiel, R. (2008). The effect of different degrees of 'positive' human-animal interaction during rearing on the subsequent production of commercial dairy heifers. *Applied Animal Behaviour Science, 114,* 65-75. doi: 10.1016/j.applanim.2007.12.002

Birke, L., & Brandt, K. (2009). Mutual corporeality: gender and human/horse relationships. *Women's Studies International Forum, 32,* 189-197.

Birke, L., Arluke, A., & Michael, M. (2007). *The Sacrifice: How scientific experiments transform animals and people*. Purdue University Press.

Birke, L., Bryld, M., & Lykke, N. (2004). Animal performances: an exploration of intersections between feminist science studies and studies of human/animal relationships. *Feminist Theory, 5,* 167-183.

Blackshaw, J. K., & Blackshaw, A. W. (1993). Student perceptions of attitudes to the human-animal bond. *Anthrozoös, 6,* 190-198.

Boivin, X., Garel, J. P., Mante, A., & Le Neindre, P. (1998). Beef calves react differently to different handlers according to the test situation and their previous interactions with their caretaker. *Applied Animal Behaviour Science*, *55,* 245-257.

Boivin, X., Nowak, R., & Garcia, A. T. (2001). The presence of the dam affects the efficiency of gentling and feeding on the early establishment of the stockperson-lamb relationship. *Applied Animal Behaviour Science, 72,* 89-103.

Boivin, X., Lensink, J., Tallet, C., & Veissier, I. (2003). Stockmanship and farm animal welfare. *Animal Welfare, 12,* 479-492.

Braje, T. J. (2011). The human-animal experience in deep historical perspective. In T. J. Braje (Ed.), *The Psychology of the human-animal bond; a resource for clinicians and researchers* (pp. 62-80). New York, NY: Springer Science.

Breitenbach, E., Stumpf, E., von Fersen, L., & Ebert, H. (2009). Dolphin-assisted therapy: changes in interaction and communication between children with severe disabilities and their caregivers. *Anthrozoös, 22,* 277-289.

Brensing, K., & Linke, K. (2003). Behavior of dolphins towards adults and children during swim-with-dolphin programs and towards children with disabilities during therapy sessions. *Anthrozoös, 16,* 315-331.

Brodie, S. J., Biley, F. C., & Shewring, M. (2002). An exploration of the potential risks associated with using pet therapy in healthcare settings. *Journal of Clinical Nursing, 11,* 444-456.

Brown, S. E. (2007). Companion animals as self-objects. *Anthrozoös, 20,* 329-343.

Bulliet, R. W. (2005). *Hunters, herders and hamburgers: the past and future of human-animal relations*. New York, NY: Columbia University Press.

Bustad, L. K. & Hines, L. (1984). Our professional responsibilities relative to human-animal interactions. *Canadian Veterinary Journal, 25,* 369-376.

Carlisle, G. K. M. (2012). Human-animal interaction and older adults. *Journal of Gerontological Nursing, 38,* 54-56.

Carlstead, K. (2009). A comparative approach to the study of keeper-animal relationships in the zoo. *Zoo Biology, 28,* 589-608.

Carmack, B. J. (1998). Companion animals: social support for orthopaedic clients. *The Nursing Clinics of North America, 33,* 701-711.

Caroprese, M., Napolitano, F., Boivin, X., Albenzio, M., et al. (2012). Development of affinity to the stockperson in lambs from two breeds. *Physiology & Behavior, 105,* 251-256.

Carrasco, L., Colell, M., Calvo, M., Abelló, M. T., Velasco, M., & Posada, S. (2009). Benefits of training/playing therapy in a group of captive lowland gorillas (*Gorilla gorilla gorilla*). *Animal Welfare, 18,* 9-19.

Case, L. (2008). Perspectives on domestication: the history of our relationship with man's best friend. *Journal of Animal Science, 86,* 3245-3251.

Catanzaro, T. E. (1988). A survey on the question of how well veterinarians are prepared to predict their client's human-animal bond. *Journal of the American Veterinary Medical Association, 192,* 1707-1711.

Centonze, L. A., & Levy, J. K. (2002). Characteristics of free-roaming cats and their caretakers. *Journal of the American Veterinary Medical Association, 220,* 1627-1633.

Chang, F. T., & Hart, L. A. (2002). Human-animal bonds in the laboratory: how the animal behaviour affects the perspectives of caregivers. *ILAR Journal ,43,* 10-18.

Cirulli, F., Borgi, M., Berry, A., Francia, N., Alleva, E., et al. (2011). Animal-assisted interventions as innovative tools for mental health. *Annali dell'istituto superior di sanità, 47,* 341-348.

Claxton, A. M. (2011). The potential of the human-animal relationship as an environmental enrichment for the welfare of zoo-housed animals. *Applied Animal Behaviour Science, 133,* 1-10. doi: 10.1016/j.applanim.2011.03.002

Clements, P. T., Benasutti, K. M., & Carmone, A. (2003). Support for bereaved owners of pets. *Perspectives in Psychiatric Care, 39,* 49-54.

Cole, K. M. & Gawlinski, A. (2000). Animal-assisted therapy: the human-animal bond. *AACN Clinical Issues, 11,* 139-149.

Coleman, K. (2011). Caring for nonhuman primates in biomedical research facilities: scientific, moral and emotional considerations. *American Journal of Primatology, 73*, 220-225. doi: 10.1002/ajp.20855

Collis, G. M., & McNicholas, J. (1998). A theoretical basis for health benefits of pet ownership: attachment versus psychological support. In C. C. Wilson & D. C. Turner (Eds.), *Companion animals in human health* (pp. 105-122). Thousand Oaks, CA: Sage Publications.

Comber, J., & Griffin, G. (2007). Genetic engineering and other factors that might affect human-animal interactions in the research setting. *Journal of Applied Animal Welfare Science, 10,* 267-277.

Cook, S., & Hosey, G. R. (1995). Interaction sequences between chimpanzees and human visitors at the zoo. *Zoo Biology*, *14,* 431-440.

Coulon, M., Nowak, R., Andanson, S., Ravel, C., Marnet, P.G., et al. (2013). Human-lamb bonding: oxytocin, cortisol and behavioral responses of lambs to human contact and social separation. *Psychoneuroendocrinology, 38,* 499-508.

Courboulay, V., & Foubert, C. (2007). Testing different methods to evaluate pig welfare on farm. *Animal Welfare, 16,* 193-196.

Crawford, E. K., Worsham, N. L., & Swinehart, E. R. (2006). Benefits derived from companion animals, and the use of the term "attachment". *Anthrozoös, 19,* 98-112.

Curtis, S. E. (1987). Animal well-being and animal care. *The Veterinary Clinics of North America. Food Animal Practice, 3,* 339-356.

Daly, B., & Morton, L. L. (2003). Children with pets do not show higher empathy: a challenge to current views. *Anthrozoös, 16,* 298-314.

Daly, B., & Morton, L. L. (2006). An investigation of human-animal interactions and empathy as related to pet preference, ownership, attachment, and attitudes in children. *Anthrozoös, 19,* 113-127.

Davis, H., & Balfour, A. D. (Eds.). (1992). *The inevitable bond: examining scientist-animal interactions*. Cambridge, UK: CAB International.

Davis, J. H., & Juhasz, A. M. (1985). The preadolescent/pet bond and psychosocial development. *Marriage & Family Review, 8,* 79-XX.

De Mello, M. (2012). *Animals and society: An introduction to human-animal studies*. New York, NY: Columbia University Press.

De Passillé, A. M., Rushen, J., Ladewig, J., & Petherick, C. (1996). Dairy calves' discrimination of people based on previous handling. *Journal of Animal Science, 74,* 969-974.

Dolins, F. L. (1999). A look back in the mirror: perspectives on animals and ethics. In F. Dolins (Ed.), *Attitudes to animals: views in animal welfare* (pp. 3-11). Cambridge, UK: Cambridge University Press.

Eddy, T. J. (2003). What is a pet? *Anthrozoös, 16*, 98-105.

Ellingsen, K., Zanella, A. J., Bjerkås, A., & Indrebø, A. (2010). The relationship between empathy, perception of pain and attitudes towards pets among Norwegian dog owners. *Anthrozoös, 23,* 231-243.

Esposito, L., McCune, S., Griffin, J. A., & Maholmes, V. (2011). Directions in human-animal interaction research: child development, health, and therapeutic interventions. *Child Development Perspectives, 5,* 205-211.

Estep, D. Q., & Hetts, S. (1992). Interactions, relationships and bonds: the conceptual basis for scientist-animal relations. In H. Davis & A. D. Balfour (Eds.), *The inevitable bond: examining scientist-animal interactions* (pp. 6-26). Cambridge, UK : CAB International.

Evans, N., & Gray, C. (2012). The practice and ethics of animal-assisted therapy with children and young people: is it enough that we don't eat our co-workers? *British Journal of Social Work, 42,* 600 (abstract).

Fa, J. E. (1989). Influence of people on the behaviour of display primates. In E. F. Segal (Ed.), *Housing, care and psychological well-being of captive and laboratory primates* (pp. 270-290). Park Ridge, USA: Noyes Publications.

Fawcett, N. R. & Gullone, E. (2001). Cute and cuddly and a whole lot more? A call for empirical investigation into the therapeutic benefits of human-animal interaction for children. *Behavior Change, 18,* 124-133.

FAO. (2013). *FAO Statistical Yearbook 2013: World Food and Agriculture*. Rome: Food and Agriculture Organization of the United Nations.

Fernandez, E. J., Tamborski, M. A., Pickens, S. R., & Timberlake, W. (2009). Animal-visitor interactions in the modern zoo: conflicts and interventions. *Applied Animal Behaviour Science, 120,* 1-8. doi: 10.1016/j.applanim.2009.06.002

Filan, S. L., & Llewellyn-Jones, R. H. (2006). Animal-assisted therapy for dementia: a review of the literature. *International Psychogeriatrics, 18,* 597-611.

Finkler, H., & Terkel, J. (2011). Dichotomy in the emotional approaches of caretakers of free-roaming cats in urban feeding groups: findings from in-depth interviews. *Anthrozoös, 24,* 203-217.

Fournier, A. K., Geller, E. S., & Fortney, E. E. (2007). Human-animal interaction in a prison setting: impact on criminal behaviour, treatment progress, and social skills. *Behavior and Social Issues, 16,* 89-105.

Fraser, A. F. (1989). Role of veterinarians in the senior citizen-animal bond. *Canadian Veterinary Journal, 30,* 562-565.

Fraser, J., Gruber, S., & Condon, K. (2007). Exposing the tourist value proposition of zoos and aquaria. *Tourism Review International, 11,* 279-293.

Freeman, D. M. A. (2005). Cross-cultural perspectives on the bond between man and animals. In D. M. A. Freeman, *Cultural zoo: Animals in the human mind and its sublimations* (pp. 3-43). Madison, CT, USA: International Universities Press.

Friedmann, E., Katcher, A. H., Lynch, J. J., & Thomas, S. A. (1980). Animal companions and one – year survival of patients after discharge from a coronary care unit. *Public Health Reports, 95,* 307-312.

Friedmann, E., Katcher, A. H., Thomas, S. A., Lynch, J. J., & Messent, P. R. (1983). Social interaction and blood pressure: influence of animal companions. *Journal of Nervous and Mental Disease, 171,* 461-465.

Friedmann, E., & Son, H. (2009). The human-companion animal bond: how humans benefit. *The Veterinary Clinics of North America: Small Animal Practice, 39,* 293-326.

Garrity, T. F., & Stallone, L. (1998). Effects of pet contact on human well-being. In C. C. Wilson & D. C. Turner (Eds.), *Companion animals in human health* (pp. 3-22). Thousand Oaks, CA: Sage Publications.

Gerwolls, M. K., & Labott, S. M. (1994). Adjustment to the death of a companion animal. *Anthrozoös, 7,* 172-187.

Giaquinto, S. & Valentini, F. (2009). Is there a scientific basis for pet therapy? *Disability & Rehabilitation, 31,* 595-598.

Glass, R. T. (2000). The human/animal interaction in myalgic encephalomyelitis/chronic fatigue syndrome: a look at 127 patients. *Journal of Chronic Fatigue Syndrome, 6,* 65-72.

Gonyou, H. W., Hemsworth, P. H., & Barnett, J. L. (1986). Effects of frequent interactions with humans on growing pigs. *Applied Animal Behaviour Science, 62,* 137-151.

Grandgeorge, M., & Hausberger, M. (2011). Human-animal relationships: from daily life to animal-assisted therapies. *Annali dell'Istituto Superiore di Sanità, 47,* 397-408.

Granger, B. P., Kogan, L., Fitchett, J., & Helmer, K. (1998). A human-animal intervention team approach to animal-assisted therapy. *Anthrozoös, 11,* 172-176.

Griffin, J. A., McCune, S., Maholmes, V., & Hurley, K. (2012). Human-animal interaction research: an introduction to issues and topics. In P. D. McCardle, S. McCune, J. A. Griffin, & V. E. Maholmes (Eds.), *How animals affect us: examining the influences of human-animal interaction on child development and human health.* Washington DC: American Psychological Association.

Gusset, M., & Dick, G. (2011). The global reach of zoos and aquariums in visitor numbers and conservation expenditures. *Zoo Biology, 30,* 566-569.

Hausberger, M., Roche, H., Henry, S., & Visser, E.K. (2008). A review of the human-horse relationship. *Applied Animal Behaviour Science, 109,* 1-24. doi: 10.1016/j.applanim.2007.04.015

Hediger, H. (1965). Man as a social partner of animals, and vice versa. *Symposia of the Zoological Society of London, 14,* 291-300.

Hediger, H. (1970). *Man and animal in the zoo: zoo biology*. London: Routledge & Kegan Paul.

Hemsworth, P. H. (2003). Human-animal interactions in livestock production. *Applied Animal Behaviour Science, 81,* 185-198.

Hemsworth, P. H., & Barnett, J. L. (1992). The effects of early contact with humans on the subsequent level of fear of humans in pigs. *Applied Animal Behaviour Science, 35,* 83-90.

Hemsworth, P. H., & Coleman, G. J. (1998). *Human-livestock interactions: the stockperson and the productivity of intensively farmed animals*. Wallingford, UK: CAB International.

Hemsworth, P. H., Barnett, J. L., & Hansen, C. (1986). The influence of handling by humans on the behaviour, reproduction and corticosteroids of male and female pigs. *Applied Animal Behaviour Science, 15,* 303-314.

Hemsworth, P. H., Barnett, J. L., & Coleman, G. J. (1993). The human-animal relationship in agriculture and its consequences for the animal. *Animal Welfare, 2,* 33-51.

Hennessy, M. B., Williams, M. T., Miller, D. D., Douglas, C. W., & Voith, V. L. (1998). Influence of male and female petters on plasma cortisol and behaviour: can human interaction reduce the stress of dogs in a public animal shelter? *Applied Animal Behaviour Science, 61,* 63-77.

Herzog, H. A. (2002a). Ethical aspects of relationships between humans and research animals. *ILAR Journal, 43,* 27-32.

Herzog, H. (2002b). Darwinism and the study of human-animal interactions. *Society & Animals, 10,* 361-367.

Herzog, H.A. (2007). Gender differences in human-animal interactions: a review. *Anthrozoös, 20,* 7-21.

Herzog, H. A., & Galvin, S. L. (1992). Animals, archetypes, and popular culture: tales from the tabloid press. *Anthrozoös, 5*, 77-92.

Hinde, R. A. (1976). On describing relationships. *Journal of Child Psychology and Psychiatry, 17,* 1-19.

Hinde, R. A. (1987). *Individuals, Relationships and Culture.* Cambridge, UK: Cambridge University Press.

Hines, L. M. (2003). Historical perspectives on the human-animal bond. *American Behavioral Scientist, 47*, 7-15.

Home Office. (2012). *Annual Statistics of Scientific Procedures on Living Animals, Great Britain 2012*. London: Stationary Office.

Horowitz, S. (2008). The human-animal bond: health implications across the lifespan. *Alternative and Complementary Therapies, 14,* 251-256.

Hosey, G. R. (2000). Zoo animals and their human audiences: what is the visitor effect? *Animal Welfare, 9,* 343-357.

Hosey, G. R. (2008). A preliminary model of human animal relationships in the zoo. *Applied Animal Behaviour Science, 109,* 105-127. doi: 10.1016/j.applanim.2007.04.013

Hosey, G. (2013). Hediger revisited: how do zoo animals see us? *Journal of Applied Animal Welfare Science, 16,* 338-359. doi: 10.1080/10888705.2013.827916

Hosey, G. & Melfi, V. (2012). Human-animal bonds between zoo professionals and the animals in their care. *Zoo Biology, 31,* 13-26. doi:10.1002/zoo.20359

Howell-Newman, K., & Goldman, R. L. (1993). Marketing animal facilitated therapy. *Health Marketing Quarterly, 11,* 77-98.

International Ecotourism Society. (2000). *Ecotourism Statistical Fact Sheet*. Retrieved from http://www.active-tourism.com/factsEcotourism1.pdf

Jagoe, A., & Serpell, J. (1996). Owner characteristics and interactions and the prevalence of canine behaviour problems. *Applied Animal Behaviour Science, 47,* 31-42.

Jasperson, R. A. (2010). Animal-assisted therapy with female inmates with mental illness: a case example from a pilot program. *Journal of Offender Rehabilitation, 49,* 417-433.

Johnson, R. A., & Meadows, R. L. (2002). Older Latinos, pets and health. *Western Journal of Nursing Research, 24,* 609-620.

Johnson, R. A., & Meadows, R. L. (2010). Dog-walking: motivation for adherence to a walking program. *Clinical Nursing Research, 19,* 387-402.

Johnson, R. A., Odentaal, J. S. J., & Meadows, R. L. (2002). Animal-assisted interventions research: issues and answers. *Western Journal of Nursing Research, 24,* 422-440.

Johnson, R. A., Meadows, R. L., Haubner, J. S., & Sevedge, K. (2003). Human-animal interaction: a complementary/alternative medical (CAM) intervention for cancer patients. *American Behavioral Scientist ,47,* 55-69.

Johnson, R. A., Meadows, R. L., Haubner, J. S., & Sevedge, K. (2008). Animal-assisted activity among patients with cancer: effects on mood, fatigue, self-perceived health, and sense of coherence. *Oncology Nursing Forum, 35,* 225-232.

Jones, R. B. (1993). Reduction of the domestic chick's fear of human beings by regular handling and related treatments. *Animal Behaviour, 46,* 991-998.

Jorgensen, J. (1997). Therapeutic use of companion animals in health care. *Image – the Journal of Nursing Scholarship, 29,* 249-254.

Kahn, P. H., Jr. (1997). Developmental psychology and the Biophilia hypothesis: children's affiliation with nature. *Developmental Review, 17,* 1-61.

Kaiser, L., Spence, L. J., McGavin, L., Struble, L., & Keilman, L. (2002). A dog and a "happy person" visit nursing home residents. *Western Journal of Nursing Research, 24,* 671-683.

Kaiser, L., Heleski, C. R., Siegford, J., & Smith, K. A. (2006a). Stress-related behaviours among horses used in a therapeutic riding program. *Journal of the American Veterinary Medical Association, 228,* 39-45.

Kaiser, L., Smith, K. A., Heleski, C. R., & Spence, L. J. (2006b). Effects of a therapeutic riding program on at-risk and special education children. *Journal of the American Veterinary Medical Association, 228,* 46-52.

Kellert, S. R. (1993). Introduction. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 20-27). Washington DC: Island Press.

Kidd, A. H., & Kidd, R. M. (1987). Seeking a theory of the human/companion animal bond. *Anthrozoös, 1,* 140-157.

Kienzle, E., & Bergler, R. (2006). Human-animal relationship of owners of normal and overweight cats 1-3. *Journal of Nutrition*, *136 supplement 7S,* 1947S-1950S.

Kienzle, E., Bergler, R., & Mandernach, A. (1998). A comparison of the feeding behaviour and the human-animal relationship in owners of normal and obese dogs. *Journal of Nutrition, 128, supplement 12S*, 2779S-2782S.

Knight, S., & Herzog, H. (2009). All creatures great and small: new perspectives on psychology and human animal interactions. *Journal of Social Issues, 65,* 451-461.

Kogan, L. R. (2000). Effective animal-intervention for long term care residents. *Activities, Adaptation & Aging, 25,* 31-45.

Kreger, M. D., & Mench, J. A. (1995). Visitor-animal interactions at the zoo. *Anthrozoös, 8,* 143-158.

Ladewig, J. (2005). Of mice and men: improved welfare through clinical ethology. *Applied Animal Behaviour Science, 92,* 183-192.

Lapp, C. A. (1991). Nursing students and the elderly: enhancing intergenerational communication through human-animal interaction. *Holistic Nursing Practice, 5,* 72-79.

Lawrence, E. A. (2003). Some observations on "what is a pet?" *Anthrozoös, 16,* 123-126.

Lensink, B. J., Boivin, X., Pradel, P., Le Neindre, P., & Veissier, I. (2000). Reducing veal calves' reactivity to people by providing additional human contact. *Journal of Animal Science, 78,* 1213-1218.

Lord, L. K., Wittum, T. E., & Scarlett, J. M. (2007). Use of group-randomized trials in pet population research. *Preventive Veterinary Medicine, 82,* 167-175.

Makowska, I. J. & Weary, D. M. (2013). Assessing the emotions of laboratory rats. *Applied Animal Behaviour Science, 148*, 1-12. doi: 10.1016/j.applanim.2013.07.013

Manciocco, A., Chiarotti, F., & Vitale, A. (2009). Effects of positive interaction with caretakers on the behaviour of socially housed marmosets (*Callithrix jacchus*). *Applied Animal Behaviour Science, 120,* 100-107.

Manor, W. (1991). Alzheimer's patients and their caregivers: the role of the human-animal bond. *Holistic Nursing Practice, 5,* 32-37.

Marchant-Forde, J. N., Bradshaw, R.H., Marchant-Forde, R.M., & Broom, D.M. (2003). A note on the effect of gestation housing environment on approach test measures in gilts. *Applied Animal Behaviour Science, 80,* 287-296.

Marder, A., & Duxbury, M. M. (2008). Obtaining a pet: realistic expectations. *The Veterinary Clinics of North America. Small Animal Practice, 38,* 1145-1162.

Markowitz, T. M., Dally, M. R., Gursky, K., & Price, E. O. (1998). Early handling increases lamb affinity for humans. *Animal Behaviour, 55,* 573-587.

Martin, F., & Taunton, A. (2005). Perceptions of the human-animal bond in veterinary education of veterinarians in Washington State: structured versus experiential learning. *Journal of Veterinary Medical Education, 32,* 523-530.

Martin, F., & Taunton, A. (2006). Perceived importance and integration of the human-animal bond in private veterinary practice. *Journal of the American Veterinary Medical Association, 228,* 522-527.

Martin, F., Ruby, K., & Farnum, J. (2003). Importance of the human-animal bond for pre-veterinary, first-year, and fourth-year veterinary students in relation to their career choice. *Journal of Veterinary Medical Education, 30,* 67-72.

Mazurek, M., McGee, M., Minchin, W., Crowe, M. A., & Earley, B. (2011a). Is the avoidance distance test for the assessment of animals' responsiveness to humans influenced by either the dominant or the flightiest animal in the group? *Applied Animal Behaviour Science, 132,* 107-113. doi:10.1016/j.applanim.2011.03.001

Mazurek, M., McGee, M., Crowe, M. A., Prendiville, D. J., Boivin, X., et al. (2011b). Consistency and stability of behavioral fear responses of heifers to different fear-eliciting situations involving humans. *Applied Animal Behaviour Science, 131,* 21-28. doi:10.1016/j.applanim.2011.01.004

McCardle, P. D., McCune, S., Griffin, J. A., & Maholmes, V. E. (Eds.). (2012). *How animals affect us: examining the influences of human-animal interaction on child development and human health.* Washington DC: American Psychological Association.

McCulloch, W. F. (1985). The veterinarian's education about the human-animal bond and animal-facilitated therapy. *The Veterinary Clinics of North America. Small Animal Practice, 15,* 423-429.

McGreevy, P. D., Righetti, J., & Thomson, P. C. (2005). The reinforcing value of physical contact and the effect on canine heart rate of grooming in different anatomical areas. *Anthrozoös, 18,* 236-244.

Mellen, J. D. (1991). Factors influencing reproductive success in small captive exotic felids (*Felis* spp.): a multiple regression analysis. *Zoo Biology, 10,* 95-110.

Melson, G. F. (2002). Psychology and the study of human-animal relationships. *Society & Animals, 10,* 347-352.

Mitchell, G., Herring, F., Tromborg, C., Dowd, B., Steiner, S., & Obradovich, S. (1992a). Targets of aggressive facial displays by golden-bellied mangabeys (*Cercocebus galeritus chrysogaster*) at the Sacramento Zoo. *Applied Animal Behaviour Science, 33,* 249-259.

Mitchell, G., Herring, F., & Obradovich, S. (1992b). Like threaten like in mangabeys and people? *Anthrozoös, 5,* 106-112.

Morris, P. (2012). Managing pet owners' guilt and grief in veterinary euthanasia encounters. *Journal of Contemporary Ethnography, 41,* 337-365.

Mullin, M. H. (1999). Mirrors and windows: sociocultural studies of human-animal relationships. *Annual Review of Anthropology, 28,* 201-224.

Myers, O. E. (1996). Child-animal interaction: nonverbal dimensions. *Society & Animals, 4,* 19-35.

Myers, O. E., Saunders, C. D., & Birjulin, A. A. (2004). Emotional dimensions of watching zoo animals: an experience sampling study building on insights from Psychology. *Curator, 47,* 299-321.

Netting, F. E., Wilson, C. C., & New, J. C. (1987). The human-animal bond: implications for practice. *Social Work, 32,* 60-64.

Odendaal, J. S. J. (2005). Science-based assessment of animal welfare: companion animals. *Revue scientifique et technique (International Office of Epizootics), 24,* 493-502.

Odendaal, J. S. J., & Meintjes, R. A. (2003). Neurophysiological correlates of affiliative behaviour between humans and dogs. *Veterinary Journal, 165,* 296-301.

O'Haire, M. (2010). Companion animals and human health: benefits, challenges and the road ahead. *Journal of Veterinary Behavior: Clinical Applications and Research, 5,* 226-234.

Ormerod, E. J. (2008). Bond-centred veterinary practice: lessons for veterinary faculty and students. *Journal of Veterinary Medical Education, 35,* 545-552.

Osvath, M. (2009). Spontaneous planning for future stone throwing by a male chimpanzee. *Current Biology*, *19 (5),* R190-R191.

Palley, L. S., O'Rourke, P., & Niemi, S. M. (2010). Mainstreaming animal-assisted therapy. *ILAR Journal, 51,* 199-207.

Peacock, J., Chur-Hansen, A., & Winefield, H. (2012). Mental health implications of human attachment to companion animals. *Journal of Clinical Psychology, 68,* 292-303.

Pedersen, V., Barnett, J. L., Hemsworth, P. H., Newman, E. A., & Schirmer, B. (1998). The effects of handling on behavioral and physiological responses to housing in tether-stalls among pregnant pigs. *Animal Welfare, 7,* 137-150.

Phillips, C. & Peck, D. (2007). The effects of personality of keepers and tigers (*Panthera tigris tigris*) on their behaviour in an interactive zoo exhibit. *Applied Animal Behaviour Science, 106,* 244-258.

Podberscek, A. L., Blackshaw, J. K., & Beattie, A. W. (1991). The effects of repeated handling by familiar and unfamiliar people on rabbits in individual cages and group pens. *Applied Animal Behaviour Science, 28,* 365-373.

Poletto, R., Meisel, R. L., Richert, B. T., Cheng, H-W., & Marchant-Forde, J. N. (2010). Aggression in replacement grower and finisher gilts fed a short-term high-tryptophan diet and the effect of long-term human-animal interaction. *Applied Animal Behaviour Science, 122,* 98-110. doi:10.1016/j.applanim.2009.11.015

Porcher, J., Cousson-Gélie, F., & Dantzer, R. (2004). Affective components of the human-animal relationship in animal husbandry: development and validation of a questionnaire. *Psychological Reports, 95,* 275-290.

Poresky, R. H. (1989). Analysing human-animal relationship measures. *Anthrozoös, 2,* 236-244.

Poresky, R. H. (1997). The Companion Animal Bonding Scale: internal consistency and factor structure when administered by telephone. *Psychological Reports, 80,* 937-939.

Poresky, R. H., Hendrix, C., Hosier, J. E., & Samuelson, M. L. (1987). The companion animal bonding scale – internal reliability and construct validity. *Psychological Reports, 60,* 743-746.

Raupp, C. D. (2002). The 'furry ceiling': clinical psychology and human-animal studies. *Society & Animals, 10,* 353-360.

Rennie, A. E., & Buchanan-Smith, H. M. (2006). Refinement of the use of non-human primates in scientific research. Part I: the influence of humans. *Animal Welfare, 15,* 203-213.

Rennie, L. J., Bowell, V. A., Dearing, J. M., Haskell, M. J., & Lawrence, A. B. (2003). A study of three methods to assess stockmanship on commercial dairy forms: can these become effective welfare assessment techniques? *Animal Welfare, 12,* 591-597.

Roberts, J. A. (1989). Environmental enrichment, providing psychological well-being for people and primates. *American Journal of Primatology, 1,*25-30.

Rooney, N. J., Bradshaw, J. W. S., & Robinson, I. H. (2000). A comparison of dog-dog and dog-human play behaviour. *Applied Animal Behaviour Science, 66,* 235-248.

Rousing, T., & Waiblinger, S. (2004). Evaluation of on-farm methods for testing the human-animal relationship in dairy herds with cubicle loose housing systems - - test-retest and inter-observer reliability and consistency to familiarity of test person. *Applied Animal Behaviour Science, 85,* 215-231.

Rushen, J., Taylor, A. A., & de Passillé, A. M. (1999). Domestic animals' fear of humans and its effect on their welfare. *Applied Animal Behaviour Science, 65,* 285-303.

Russow, L. M. (2002). Ethical implications of the human-animal bond in the laboratory. *ILAR Journal, 43,* 33-37.

Sable, P. (2013). The pet connection: an attachment perspective. *Clinical Social Work Journal, 41,* 93-99.

Sakagami, T., & Ohta, M. (2010). The effect of visiting zoos on human health and quality of life. *Animal Science Journal, 81,* 129-134.

Schaffer, C. B. (2008). Enhancing human-animal relationships through veterinary medical instruction in animal-assisted therapy and animal-assisted activities. *Journal of Veterinary Medical Education, 35,* 503-510.

Schmied, C., Boivin, X., & Waiblinger, S. (2008). Stroking different body regions of dairy cows: effects on avoidance and approach behaviour toward humans. *Journal of Dairy Science, 91*, 596-605.

Schneider, T. R., Lyons, J. B., Tetrick, M. A., & Accortt, E. E. (2010). Multidimensional quality of life and human-animal bond measures for companion dogs. *Journal of Veterinary Behavior: Clinical Applications and Research, 5,* 287-301.

Schoenfeld-Tacher, R., Kogan, L. R., & Wright, M. L. (2010). Comparison of strength of the human-animal bond between Hispanic and non-Hispanic owners of pet dogs and cats. *Journal of the American Veterinary Medical Association, 236,* 529-534.

Serpell, J. (1996). *In the company of animals: a study of human-animal relationships* (2nd ed.). Cambridge, UK: Cambridge University Press.

Shir-Vertesh, D. (2012). "Flexible Personhood": loving animals as family members in Israel. *American Anthropologist, 114,* 420-432.

Sherman, B. L., & Serpell, J. A. (2008). Training veterinary students in animal behaviour to preserve the human-animal bond. *Journal of Veterinary Medical Education, 35,* 496-502.

Shore, E. R., Douglas, D. K., & Riley, M. L. (2005). What's in it for the companion animal? Pet attachment and college students' behaviours toward pets. *Journal of Applied Animal Welfare Science, 8,* 1-11.

Shore, E. R., Riley, M. L., & Douglas, D. K. (2006). Pet owner behaviours and attachment to yard versus house dogs. *Anthrozoös, 19,* 325-334.

Singer, R. S., Hart, L. A., & Zasloff, R. L. (1995). Dilemmas associated with rehousing homeless people who have companion animals. *Psychological Reports, 77,* 851-857.

Smith, A. (2012). Pet loss and human emotion: what's new? *Death Studies, 36,* 292-297.

Souter, M. A. & Miller, M. D. (2007). Do animal-assisted activities effectively treat depression? A meta-analysis. *Anthrozoös, 20,* 167-180.

Staats, S., Sears, K., & Pierfelice, L. (2006). Teachers' pets and why they have them: an investigation of the human animal bond. *Journal of Applied Social Psychology, 36*, 1881-1891.

Stewart, M., Shepherd, H. M., Webster, J. R., Waas, J. R., et al. (2013). Effect of previous handling experiences on responses of dairy calves to routine husbandry procedures. *Animal, 7,* 828-833.

Strimple, E. O. (2003). A history of prison inmate-animal interaction programs. *American Behavioral Scientist, 47,* 70-78.

Sugawara, A., Masud, M. M., Yokoyama, A., Mizutani, W., Watanuki, S., et al. (2012). Effects of presence of a familiar pet dog on regional cerebral activity in healthy volunteers: a positron emission tomography study. *Anthrozoös, 25,* 25-34.

Szokalski, M. S., Litchfield, C. A., & Foster, W. K. (2012). Enrichment for captive tigers (*Panthera tigris*): current knowledge and future directions. *Applied Animal Behaviour Science, 139,* 1-9. doi: 10.1016/j.applanim.2012.02.021

Tallet, C., Veissier, I., & Boivin, X. (2008). Temporal association between food distribution and human caregiver presence and the development of affinity to humans in lambs. *Developmental Psychobiology, 50,* 147-159.

Tanida, H., Miura, A., Tanaka, T., & Yoshimoto, T. (1995). Behavioral response to humans in individually handled weanling pigs. *Applied Animal Behaviour Science, 42,* 249-259.

Tannenbaum, J. (1985). Ethics and human-companion animal interaction: a plea for a veterinary ethics of the human-companion animal bond. *The Veterinary Clinics of North America. Small Animal Practice, 15,* 431-447.

Temple, D., Manteca, X., Velarde, A., & Dalmau, A. (2011). Assessment of animal welfare through behavioral parameters in Iberian pigs in intensive and extensive systems. *Applied Animal Behaviour Science, 131,* 29-39. doi: 10.1016/j.applanim.2011.01.013

Thomsen, C. E. (1974). Eye contact by non-human primates toward a human observer. *Animal Behaviour, 22,* 144-149.

Timmins, R. P. (2008). The contribution of animals to human well-being: a veterinary family practice perspective. *Journal of Veterinary Medical Education, 35*, 540-544.

Vining, J. (2003). The connection to other animals and caring for nature. *Human Ecology Review, 10,* 87-99.

Virués-Ortega, J., & Buela-Casal, G. (2006). Psychophysiological effects of human-animal interaction: theoretical issues and long-term interaction effects. *Journal of Nervous and Mental Disease, 194,* 52-57.

Vitale, A. (2011). Primatology between feelings and science: a personal experience perspective. *American Journal of Primatology, 73,* 214-219. doi: 10.1002/ajp.20863

Waiblinger, S., Menke, C., & Foelsch, D. W. (2003). Influences on the avoidance and approach behaviour of dairy cows towards humans on 35 farms. *Applied Animal Behaviour Science, 84,* 23-39.

Waiblinger,S., Boivin, X., Pedersen, V., Tosi, M.-V., Janczak, A.M., Visser, E.K., & Jones, R.B. (2006). Assessing the human-animal relationship in farmed species: a critical review. *Applied Animal Behaviour Science, 101,* 185-242.

Walsh, F. (2009a). Human-animal bonds I: the relational significance of companion animals. *Family Process, 48,* 462-480.

Walsh, F. (2009b). Human-animal bonds II: the role of pets in family systems and family therapy. *Family Process, 48,* 481-499.

Ward, S. J., & Melfi, V. (2013). The implications of husbandry training on zoo animal response rates. *Applied Animal Behaviour Science, 147,* 179-185. doi: 10.1016/j.applanim.2013.05.008

Weisman, A. D. (1991). Bereavement and companion animals. *Omega: Journal of Death and Dying, 22,* 241-248.

Wells, D. L. (2004). A review of environmental enrichment for kennelled dogs, *Canis familiaris*. *Applied Animal Behaviour Science, 85,* 307-317.

Wensley, S. P. (2008). Animal welfare and the human-animal bond: considerations for veterinary faculty, students, and practitioners. *Journal of Veterinary Medical Education, 35,* 532-539.

Westgarth, C., Pinchbeck, G.L., Bradshaw, J.W., Dawson, S., Rosalind, M., et al. (2007). Factors associated with dog ownership and contact with dogs in a UK community. *BMC Veterinary Research, 3*, 5.

Williams, S., Butler, C., & Sontag, M. A. (1999). Perceptions of fourth year veterinary students about the human-animal bond in veterinary practice and in veterinary college curricula. *Journal of the American Veterinary Medical Association, 215,* 1428-1432.

Wilson, C. C., & Barker, S. B. (2003). Challenges in designing human-animal interaction research. *American Behavioral Scientist, 47,* 16-28.

Wilson, C. C., & Netting, F. E. (1983). Companion animals and the elderly: a state-of-the-art summary. *Journal of the American Veterinary Medical Association, 183,* 1425-1429.

Wilson, C. C., & Netting, F. E. (1987). New directions: challenges for human-animal bond research and the elderly. *Journal of Applied Gerontology, 6,* 189-200.

Wilson, C. C., & Netting, F. E. (2012). The status of instrument development in the human-animal interaction field. *Anthrozoös, 25,* S11-S55.

Wilson, C. C., Netting, F. E., & New, J. C. (1987). The Pet Attitude Inventory. *Anthrozoös, 1,* 76-84.

Wilson, E. O. (1984). *Biophilia*. Cambridge, Mass, US: Harvard University Press.

Wilson, E. O. (1993). Biophilia and the conservation ethic. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 31-41). Washington, DC: Island Press.

Yorke, J. (2010). The significance of human-animal relationships as modulators of trauma effects in children: a developmental neurobiological perspective. *Early Child Development & Care, 180,* 559-570.

Yorke, J., Adams, C., & Coady, N. (2008). Therapeutic value of equine-human bonding in recovery from trauma. *Anthrozoös, 21,* 17-30.

Zasloff, R. L. (1996). Measuring attachment to companion animals: a cat is not a dog is not a bird. *Applied Animal Behaviour Science, 47,* 43-48.

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