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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

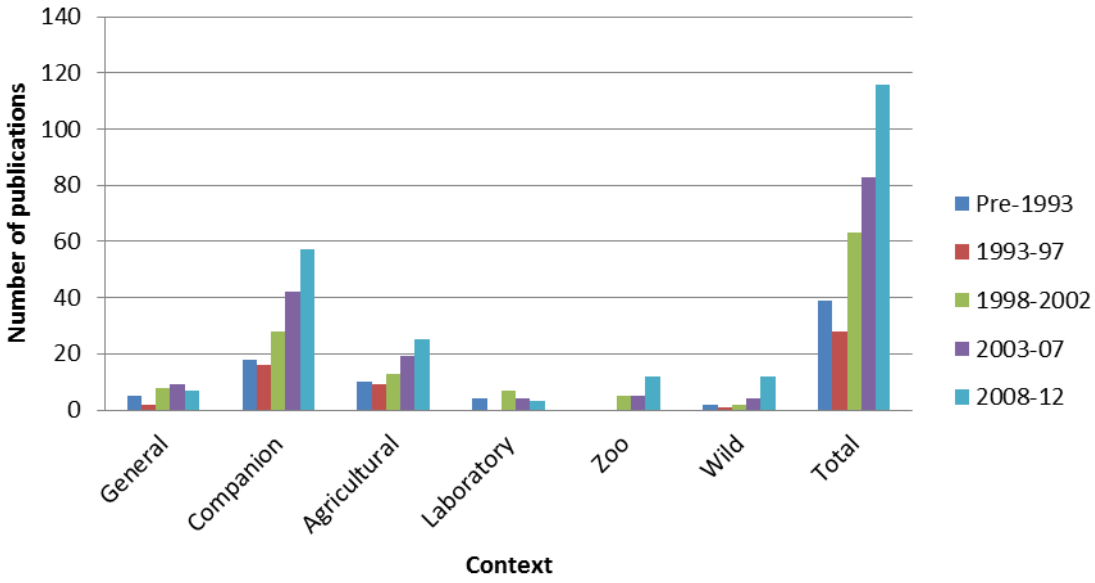

Figure 1. Changes in the number of papers published in HAI/HAR/HAB within each context, shown in 5-year blocks between 1993 and 2012, and with pre-1993 papers shown for comparison.

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.

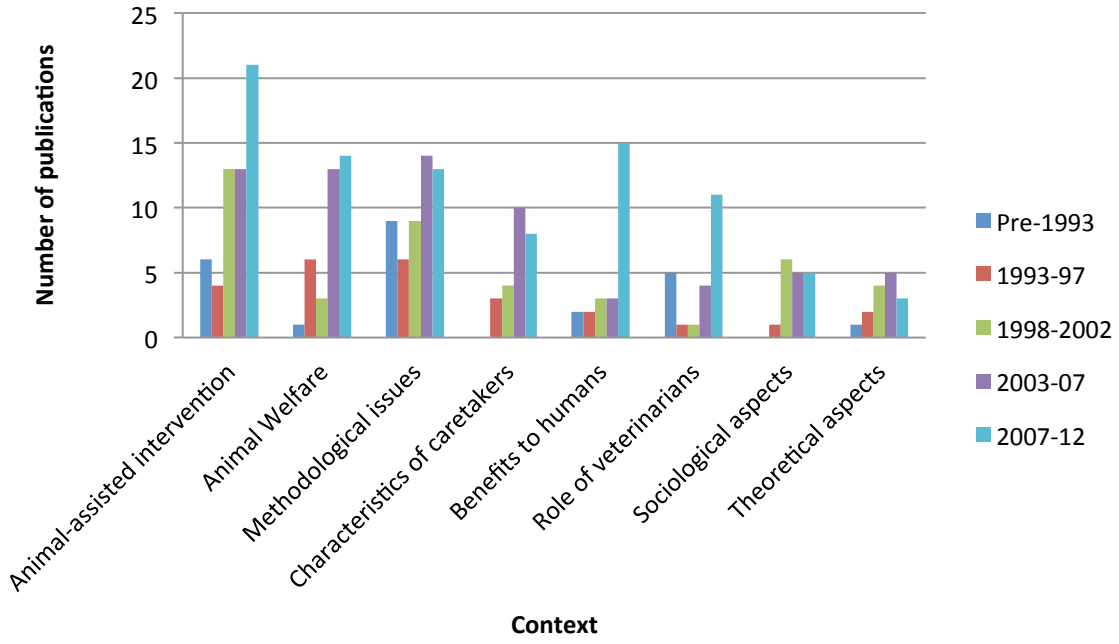

Figure 2. Changes in the number of papers published in the eight main HAI/HAR/HAB themes for all contexts combined, shown in 5-year blocks between 1993 and 2012, and with pre-1993 papers shown for comparison.

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.

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